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**The effect of field dependent/field independent cognitive styles
on self efficacy outcomes and math performance**

Nickel, Leslee Ann, Ph.D.

City University of New York, 1990

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THE EFFECT OF FIELD DEPENDENT / FIELD INDEPENDENT
COGNITIVE STYLES ON SELF EFFICACY OUTCOMES
AND MATH PERFORMANCE

by

Leslee Ann Nickel

A dissertation submitted to the Graduate Faculty in
Educational Psychology in partial fulfillment of the
requirements for the degree of Doctor of Philosophy,
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Leslee Ann Nickel

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To my sister Sara, who has
taught me compassion

and

In loving memory of my grandmother Lucy,
who taught me determination

Abstract

THE EFFECT OF FIELD DEPENDENT / FIELD INDEPENDENT COGNITIVE STYLES ON SELF EFFICACY OUTCOMES AND MATH PERFORMANCE

By

Leslee Ann Nickel

Advisor: Professor Marian Fish

This study draws from two bodies of literature in an effort to examine how instruction can best support the child's cognitive style in order to enhance feelings of efficacy and math performance; so that all children, regardless of cognitive style, can function at their optimal level. In addition, this study extends the research of Schunk and his associates, and Witkin and his associates, regarding self efficacy training and teaching to a child's cognitive style respectively.

Subjects consisted of 80 fourth and fifth grade students. This study was run in four separate stages: assessment of cognitive style, self efficacy judgment and division performance pretest, strategy training,

and self efficacy judgment and division performance posttest. All subjects were administered the Group Embedded Figures Test (GEFT) and were randomly assigned to field dependent / field independent conditions based on established norms. All subjects were of at least average intelligence as measured by The Student's Ability Index of the California Achievement Test. All subjects were also administered self efficacy judgment and division performance pretests. During the training phase subjects received, on separate days, three 55 minute training sessions. The training took the form of either cognitive modeling strategy training or didactic strategy training. During the self mastery stage of training subjects received performance feedback by having the number of pages of problems completed correctly recorded by an adult proctor, or no feedback at all. The posttest phase consisted of self efficacy judgment and division performance reassessment.

Contrary to expectations, there were no significant interactions between cognitive style and strategy training condition nor cognitive style and performance feedback, for either self efficacy judgments or division performance. However, self efficacy judgments were significantly positively

effected by performance feedback. The benifit from performance feedback on division performance was significantly effected positively when subjects moved away from a strategy training condition which was matched for their cognitive style. Educational implications and suggestions for future research are discussed.

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CHAPTER I

INTRODUCTION

For the past decade educators and researchers have become increasingly concerned with the roles that cognitive style and self efficacy play in academic achievement. While several cognitive styles have been identified to date, the field dependence - independence dimension continues to be extensively studied and applied to educational problems. Witkin, Moore, Goodenough and Cox (1977) have identified four areas where the field dependence - independence cognitive style can be used in approaching problems in education. These are how students learn, how teachers teach, how students and teachers interact, and how students make educational - vocational choices and perform in the areas that they choose.

Witkin et al. (1977) address both social and cognitive characteristics when studying the role of cognitive style and how students learn. They have outlined four ways in which cognitive style may influence learning, two which focus on social characteristics and two which focus on cognitive

characteristics. First, relatively field dependent persons have been found to selectively attend to social aspects of their learning environment and are better at learning and retaining material presented within a social context. While relatively field dependent and independent persons may not differ in their ability to learn or remember, they do differ in what they regard as relevant, salient, and necessary to attend to. In general, field dependent persons tend to be better at learning and retaining social material than their field independent counterparts (Ruble & Nakamura, 1972; Crutchfield, 1958). Also, field dependent persons are better at learning social material when the material is peripheral to the task on which they are concentrating (Fitzgibbons, Goldberger & Eagle, 1965). These findings suggest that field dependent persons are better at retaining social material. In the classroom environment, field dependent students may be more facile at learning and retaining material that contains social content, for example, placing the concept within a practical context.

A second way in which students' cognitive styles may influence their learning is in the effects of different types of reinforcement. Generally, field

dependent students are more likely to need externally defined goals and reinforcers than field independent students, who have a tendency to respond to self defined goals and reinforcers. Evidence suggests that field independent persons tend to learn more than field dependent persons when intrinsic motivation is required. However, when external reinforcement for learning is provided the differences between field dependent/independents for learning becomes negligible. This holds true regardless of whether the reinforcement is in the form of tangibles or praise (Ferrell, 1971; Pasclisanu, 1970; Steinfeld, 1973).

The third factor which Witkin et.al. (1977) suggest influences how students learn is their differential use of mediators in learning. The differential use of mediators are influenced by a student's cognitive style. Studies of organizational factors in learning (Fleming, 1968) have indicated that field independent people more often make use of mediators in learning. When material to be learned lacks clear inherent structure, field independent learners tend to create a strategy or provide their own organization in an attempt to facilitate learning. Fleming (1968) also indicated that field dependent

persons are more likely to have difficulty in learning unstructured material when compared to field independent persons who tend to provide mediating structural rules to enhance learning. Conversely, when the task to be learned is presented in an already organized, structured mode, and the need to impose inherent structure as a mediator is not required, field dependent and field independent people are less likely to differ in their learning. Evidence for this differential use of mediators has been provided in the areas of acquisition (Koran, Snow & McDonald, 1971) retention of learned information (Renzi, 1974; Schwen, 1970) and concept attainment (Nebelkopf & Dryer, 1973).

The last factor which Witkin et.al. (1977) report influences the way in which students learn, is the differential use of cue salience. Field dependent persons are generally responsive to the dominant arrangement of the field as presented and tend not to divert from that arrangement. Therefore, it is expected that the effects of cue salience are stronger for field dependent than field independent learners (Dickstein, 1968; Goodenough, 1976; Kuschenbaum, 1969; Shapson, 1973).

In the area of how teachers teach evidence suggests that field dependent teachers favor teaching situations that permit interaction with students while field independent teachers prefer situations that tend to be impersonal and directed at more cognitive aspects of learning (Moore, 1973; Wu, 1968).

How teachers and students interact in terms of matched and mismatched cognitive styles has also been given attention in the literature. DiStefano (1970) found that teachers and students matched for cognitive style (field dependence, field independence) perceived each other positively; likewise, teachers and students mismatched in cognitive style perceived each other negatively. James (1973) found that teachers assigned higher grades to their students who were matched in cognitive style.

Finally, with regard to educational and vocational choices, field independent persons, as a group, are likely to demonstrate interests in disciplines where their competence in articulation, analysis, or structuring are necessary, and where relations with other people are not particularly involved. Conversely, field dependent persons are likely to choose disciplines which feature social content and

involve interpersonal relations in daily ongoing activities (Arbuthnot & Gruenfeld, 1969; Chung, 1967; Keen, 1974; Scheibner, 1970; Zytowsky, Mills, & Paepe, 1969).

In addition to the role of cognitive style in academic achievement, much attention has been focused on the role of self efficacy in academic achievement. The term self efficacy was introduced by Bandura in 1977. His exact definition is "the conviction that one can successfully execute the behavior required to produce [certain] outcomes" (Bandura, 1977, p.193). Emphasis is placed on the distinction between expectancy for success and beliefs about environmental contingencies or outcome expectancies. Feedback about self-efficacy expectancies is assumed to derive from four different sources: performance experiences, vicarious experiences, verbal persuasion, and emotional or physical arousal. Performance experiences are the most powerful influences on self efficacy expectancies. Vicarious experiences such as observational learning, modeling and imitation, are next in line, with their effects depending on factors such as perceived similarity between the model and the observer, the number and variety of models, and

perceived power of the models. Verbal persuasion is influenced by factors such as perceived expertness, trustworthiness, and attractiveness of the one providing the feedback. Finally, emotional factors such as anxiety affect self efficacy when people associate those factors with poor performances, incompetence and/or failure.

Researchers have proposed a number of ways perceived self efficacy affects achievement. Based on the assumption that self efficacy has motivational effects, children who do well in a subject area would exhibit greater achievement strivings. Conversely, children who are experiencing difficulty in a subject area would have a tendency to give up easily and avoid engaging in activities associated with that subject area. In light of this theory Schunk (1981) designed several methods to raise perceived self efficacy which would in turn increase persistence and skill performance. He found that cognitive modeling produced greater gains in accuracy but that the method combining modeling with effort attribution yielded the highest efficacy judgment and performance. A treatment of didactic instruction followed by a practice period yielded no significant changes. In a later study,

Schunk (1982) found that youngsters who were poor in subtraction skills gained higher achievement and perceived efficacy through a didactic training treatment combined with attributional feedback for past achievement. Schunk (1984) also found instruction with rewards and proximal goals led to higher self efficacy than either reward alone or proximal goals alone. Later Schunk (1985) found that modeling a strategy which emphasized use of task strategies enhanced motivation and skill development, but that providing the student with a task strategy and achievement beliefs led to highest self efficacy. The differential effects of the treatments of modeling, didactic instruction, modeling strategies, teaching strategies and feedback, raised by researchers are issues which need to be addressed further.

Maddux and Stanley (1986) suggest that there is a need to establish theoretical links between self efficacy theory and other theories. They report that self efficacy expectancies can be seen as closely related to peoples' perception of their environment as unresponsive and the perception of controllability of aversive outcomes.

The research findings of field dependent field

independent cognitive style and its relationship to educational performance generally supports the view that students learn differentially depending upon their cognitive style. While many methods have been devised to increase a student's perceived self efficacy, little is known about the dynamics underlying the relationship between cognitive style and higher self efficacy attainment. The fact that all people do not learn in the same way because of differing cognitive styles may be influencing these results.

Purpose of the Study

The purpose of this study is to examine the relationship between cognitive style (field dependence, field independence) and the way in which it may effect the outcomes of the differing self efficacy enhancing strategies presented in the literature. In addition, a model considering the effects of cognitive style on the different self efficacy strategies will be presented. The model is derived from the findings and suggestions of researchers in the field.

Rationale for the Study

Little is known about the relationship between cognitive style (field dependence field independence) and self efficacy strategy outcomes. Researchers have identified several strategies designed to enhance a student's perceived self efficacy, therefore increasing achievement. However, they have not considered how a person's cognitive style may influence the effect of the particular strategies. In fact, there is no research in which the relationship between these variables has been examined in a systematic manner.

The chapter which follows will provide a review of the field dependent - field independent cognitive

style, and student self efficacy literature. It will focus upon the areas in which field dependence/field independence and self efficacy research has been conducted. The literature review will support the presentation of a model which will form the foundation of the research proposed.

Chapter II

Review of the Literature

This literature review will present the major issues related to the field dependence field independence cognitive style, perceived self efficacy, and their educational implications. Research related to these issues will be discussed and a theoretical model will be presented. Lastly, further research will be proposed and its educational implications discussed.

Major Issues Raised Within the Literature

A number of issues identified in the literature require discussion if the relationship between field dependence field independence and self efficacy strategies is to be seen clearly. These issues are as follows: 1) field dependence and field independence as cognitive styles; 2) the educational implications of field dependence field independence cognitive styles; 3) an understanding of self efficacy theory; 4) self

efficacy strategy training; and 5) the educational implications of self efficacy strategy training.

Field Dependence and Field Independence as
Cognitive Styles

The field dependence/field independence dimension of cognitive style has been extensively studied and applied to education. Field dependence - independence originated in the laboratory setting and was concerned with how people located the upright in space (Witkin, 1949, 1959, 1952; Witkin & Asch, 1948). The ability to perform this task combines information received from our visual environment and sensations from within our bodies. Usually, information from these two sources coincide, and compliment each other to provide us with an accurate sense of location of the true upright. Witkin's (1949, 1950, 1952) early work attempted to eliminate the complex visual world and substitute a more manipulable visual framework. Concurrently, a separation of visual and bodily standards was made. As a result, the rod and frame device was constructed. It consisted of a frame that could be rotated around its center and a rod located within it which could be

tilted clockwise or counter-clockwise, independently of the frame. The subject's task was to adjust the rod to the perceived upright position while the frame remained in its initial position of tilt. It was found that there were individual differences among people in how they performed the task. Some people perceived the rod as upright if it was fully aligned with the surrounding frame, regardless of its position. Others adjusted the rod more or less close to the upright without considering the position of the frame and perceived the rod as a discrete entity from the visual frame of reference. They determined the uprightness of the rod in accordance to the felt position of their body rather than the visual frame immediately surrounding it. Another method used involved adjusting the uprightness of one's body within a frame. Some people perceived their own bodies as upright when they were fully aligned with the tilted surround, others positioned their bodies as upright regardless of surrounding field. The latter, seemed able to experience the body as a discrete entity in relation to the surrounding field, while the others experienced the surround as having an extreme effect on their body position. Another assessment used by Witkin was the embedded

figures task. Here the subject was shown a simple figure. It was then removed and the subject was shown a complex figure, and directed to locate the simple figure within it. For people at one end of the spectrum, the simple figure emerged quickly from the complex design. For people at the other extreme the simple figure seemed impossible to locate.

What is common in 1) locating the upright in space, 2) the rod and frame test, and 3) the embedded figures test, is the extent to which the person perceives part of a field as discrete from the surrounding field; or as a whole rather than embedded within the field. The above is felt to be a factor of individual differences. At one extreme perception is strongly dominated by the prevailing field and these individuals are said to be field dependent. At the other end are those people who experience items as more or less separate from the surrounding field, and they are said to be field independent. These labels reflect a tendency as scores on any measure of field independence/field dependence form a continuous distribution and people are quite stable in their preferred mode of perception (Fatereson & Witkin, 1970; Witkin, Goodenough & Karp, 1967).

Extensive evidence indicates that these styles are also manifested when one deals with symbolic representations, such as thinking and problem solving. The field dependent person tends to have difficulty with types of problems where the solution depends on extracting a critical element out of the context in which it is presented and restructuring the problem material so that the item is now used in a different context. A field independent person is likely to overcome the organization of the field, or restructure it, when presented with a field having a dominant organization. Conversely, the field dependent person tends to adhere to the organization of the field as given (Moore, Glesser, & Warm, 1970; Nebelkopf & Dryer, 1970; Witkin et al., 1974). Stasz (1974) found that field dependent / field independent students and teachers differentially categorized social studies concepts. Field dependent teachers and students clustered concepts into large loosely organized groups, while the field independents clustered concepts into small, tight groups which offered less overlap among them.

Witkin et al. (1977), used an articulated - global continuum when describing field dependence/

independence. They saw analysis and structuring as complimentary aspects of articulation. People who perceive in an articulated way, perceive items as separate from their background when a field is organized. When a field is not organized they impose structure upon it. People who perceive in a global fashion experience things in relation to the overall character of the prevailing field as given. They identified field independent persons as articulated and field dependent persons as more global in their experiences. Field dependent persons in contrast to field independent persons are generally more attentive to, and tend to use prevailing social frames of reference (Witkin & Goodenough, 1977). Field dependent persons are more selectively attuned to the social components of their environment, and attend more to verbal messages with social content even if they are peripheral to the situation being attended to (Fitzgibbons & Goldberger, 1971). Field dependent persons also take greater account of external social referents in defining their attitudes and feelings. They express their social orientation by taking greater account of external referents in defining their social attitudes and feelings, especially in ambiguous

conditions (McFall & Schenhein, 1970).

In addition to being sensitive to social cues and interested in what other people say and do, field dependent people tend to be drawn to others as in a sense of liking to be with them (Holley, 1972; Trego, 1972). Justice (1970) demonstrated that field dependent persons prefer to be physically close to others. Generally, they are better liked, perceived as warm, tactful, considerate, outgoing and affectionate, and known by more people. These characteristics are those associated with good interpersonal skills (Dingman, 1972; Oltman, Goodenough, Witkin, Freedman & Friedman, 1975).

Field independent persons assume a more impersonal personality style, and are sometimes described as cold and distant, unaware of social undercurrents, and individualistic (Crutchfield, 1958; Pemberton, 1952). They also tend to be interested in abstract or theoretical issues (Biggs, Fitzgerald & Atkinson, 1971). Generally, field independent persons are described as being in tune with their own feelings, needs, and attributes. They, in turn, use these as internal referents in dealing with social situations.

In sum, Witkin et al., (1977) posits two cognitive

styles in relation to field dependency/field independency, the articulated field independent, and the global field dependent styles. He describes their characteristics as concerned with the form rather than the context of cognitive activity. They refer to individual differences in how we perceive, think through and solve problems, learn, relate to others, et cetera. Second, cognitive styles are pervasive dimensions. Third, cognitive styles are stable over time. It can be predicted that a person who has a particular style one day will have the same style for a good time to come. Fourth, with regard to value judgments, cognitive styles are bipolar. That is, each pole has an adaptive value under specified circumstances, and therefore, may be judged positively in relation to those circumstances.

The Educational Implications of
Field Dependent / Field Independent Cognitive Style

Several studies have indicated that field independent students in general are higher achieving in traditional educational settings. Geldmeister and Friedman (1980) investigated the reading abilities of sixth grade children in two inner city schools. They found that memory of consonant sequences was significantly better for skilled readers who made, on the average, fewer errors. They also found that skilled readers were significantly more field independent than less skilled readers. This association of high field independence with reading skill supported previous research on the importance of this cognitive style individual difference measure for predicting academic achievement. Roach (1985) also examined the relationship between field dependence/independence and reading achievement. A sample of 418 sixth grade students was selected from 5 elementary schools. All students had slightly above average intelligence, and were assessed for field dependence/independence, and reading achievement. The results indicated a significant positive correlation between field

independence/analytic conceptual style and higher achievement in reading. This emphasizes the importance of analytic ability and attention to detail in relation to reading skills.

Reardon, Jolly, McKinney and Forducy (1982) studied the relationship between field dependence/field independence cognitive styles and a student's learning approach on an active learning task. They based their hypothesis on research indicating that field independent individuals generally perform better on learning and memory tasks than field dependent individuals. Both field dependent and field independent subjects were asked to sort geometric and verbal material into pigeon holes according to category examples. This forced both groups to take an active role in a learning situation. Then they were requested to recall the locations of the categories. Both groups were found to excel on the sorting tasks, but, field dependent subjects were poorer at it. Field dependent subjects were also found to make more correct locations than field independent subjects. Generally, the field independent subjects favored a verbal approach, while field dependent favored a more perceptual approach. These results offer support for the view that

differences in memory between the two groups are not a function of differences in their approach to learning. When both field dependent and independent subjects are equally active in learning, memory differences were found. It was suggested that active learning, which should compensate for performance deficits of field dependent persons, may influence performance by increasing demands for processing. It may be that a passive learning style is a strategy used by field dependent persons to minimize the effects of processing load.

Blaha and Chomin (1982) investigated the relationship between reading attitude and academic aptitude and field independence. Their findings suggest that students who perceive themselves as having difficulty in reading and are willing to acknowledge the existence of a problem tend to be those with less verbal ability. Also, students who became emotionally upset and/or experienced unpleasant physical sensations or feelings when engaged in or thinking about reading activities also tended to have less verbal ability. Finally, students with less verbal ability did not perceive themselves as valuing reading type activities for their intrinsic worth or as a source of

information, learning, and emotional satisfaction. They also found these children to be more field dependent with a relatively global cognitive style and whose experiences were determined by the organization of the field. Conversely, field independent children (those possessing a relatively articulated cognitive style and tending to analyze and structure experiences in a novel way) experienced the least reading difficulty. This coincides with the research that suggests that in the elementary grades field independent students are better readers than field dependent students. Therefore, it could be expected that field independent students report fewer reading difficulties. Results also indicated that the children with expressed reading difficulty also tended to be more dependent and tended not to assume personal responsibility for successful academic achievement.

In another study Blaha (1982) investigated the extent to which reading attitudes and cognitive styles are effective in the prediction of achievement in the areas of reading and mathematics. His results suggested that children with greater reading achievement tended to have a relatively field independent cognitive style and valued reading type

activities for their intrinsic values rather than perceiving external reinforcement as important. They also tended to prefer alternatives other than reading when faced with a learning task. He also found that children with better achievement in arithmetic concepts tended to be more field independent, did not prefer learning modes other than reading, and valued intrinsic rewards available from reading rather than relying on extrinsic reinforcement from others. Also, children who performed better in arithmetic computation tended to be field independent and acknowledged fewer difficulties in reading. In general, field independence was a consistent contributor to both mathematics and reading achievement. Conversely, children who were field dependent tended to achieve lower scores in both reading and arithmetic.

Ishmail and Kong (1985) using 375 primary school children studied the relationship between field dependence/independence and academic achievement while partitioning out general intellectual ability. Field dependence/independence was measured by the Group Embedded Figures Test (GEFT) and reading achievement by the Otis Lennon School Ability Test. Their results indicated that groups who scored high in the GEFT

(field independent) and the Otis Lennon performed significantly better on the National Language Mathematics and Science achievement tests. These results remained consistent after partitioning out the effect of intellectual ability.

Shade (1983) reasoned that in addition to serving as information processing strategies the field dependence/independence cognitive style also served as a coping mechanism by guiding an individual's behavior in various situations. For the most part, schools demand a particular cognitive style, that is, a preference for being analytical rather than global in attention and thinking. She studied 135 ninth grade students dividing them into achievement levels as measured by standardized achievement batteries. They were classified as high, average and low achievers according to stanine rankings. The GEFT was used to determine field dependence/independence. Her results indicated that the middle achieving group's scores on the GEFT clustered around the distribution mean score, but high and low achievement groups were generally clustered at opposite ends of the scale. The high field independent students were: able to impose structure on tasks, self directed, more able to handle

abstract material and took a hypothesis testing approach to learning. In addition, they were: more self motivated, able to handle visual material, very task oriented, and they preferred to work alone.

The lower achievers, on the other hand, tended to be predominately field dependent. These students required cues from the environment in order to solve problems, had difficulty providing their own structure and performed well in cooperative work environments. They also were skilled in remembering material especially when placed in a social context. While they had no difficulty learning they preferred to learn in an auditory or kinesthetic mode and seemed to respond best to teachers who were warm and used positive reinforcement techniques.

Andrews (1981) investigated the relationship between instructional mode and field dependent/independent cognitive style. Students were divided into two groups; one group was taught through instructor centered teaching, while the other group was taught through peer centered teaching. The results indicated that the field independent student who was competitive, independent and impersonal benefited from the teacher centered approach which made use of

textbooks, handouts and lectures. The field dependent, more interpersonally oriented student, preferred and benefited from peer oriented classes, review sessions, study questions and student presentations.

Ruble and Nakamura (1972) found that second and third grade students who were field dependent and personally oriented were more likely to seek cues and reinforcers from role models or teachers.

Teacher - student interaction.

The classroom environment is a setting where differences in cognitive styles of students and teachers as well as their interactive effects can be explored. Wu (1967) reported that field independent students and teachers had a tendency to be more content oriented, whereas, field dependent students and teachers tended to share a more interpersonal orientation. The field dependent teachers also preferred greater interaction with their students, whereas, field independent teachers preferred teaching situations that were impersonal in nature and geared toward more abstract cognitive aspects of instruction. Therefore, the content focus of the field independent student may be less well received by field dependent

teachers, and the interpersonal style of the field dependent student may be less tolerated by field independent teachers. For example, field dependent teachers and students may be more likely to prefer team problem solving (cognitive modeling) situations, whereas field independent teachers and students may prefer situations that require independently generated problem solving (didactic) strategies.

These interactional factors of field dependent/independent cognitive styles of students and teachers have lead to the investigation of how students and teachers matched or mismatched for field dependence/independence perform in educational settings, and the effects of such on the student's academic achievement. Di Stefano (1970) reported an interaction of student and teacher style, such that, each party tended to describe the other more positively when their relative degrees of field dependence/independence were similar and described the other more negatively when their styles were dissimilar.

To determine differential approaches in the design of classroom instruction, and to investigate how these differences compared to those observed under simulated

teaching conditions, Mahlios (1981) observed 12 fifth and sixth grade teachers (6 field dependent, 6 field independent) in their regular elementary classrooms for a 96 hour period of time. The GEFT was administered to 36 fifth and sixth grade teachers in two southwestern metropolitan schools. The six highest and lowest scores were then selected. The teachers were matched for years of experience, age, and level of training (at least a master's degree). A total of 8 hours of observation (using the Teacher Child Dyadic Interaction Scale) was made in each of the 12 classrooms, with each teacher being observed for 24, five minute periods. The results indicated that field independent teachers initiated a significantly greater number of academic interactions with their students as a whole class. Conversely, field dependent teachers interacted significantly more often with their students in small groups and individually. The field independent teachers asked more academic oriented questions while field dependent teachers asked significantly more factual questions. In addition, field independent teachers asked significantly more analysis level questions. These findings support the student's perceptions that field dependent teachers

have a tendency to teach more factual, descriptive information, while field independent teachers are viewed as teaching and encouraging students to apply principles. Lastly, field independent teachers provided significantly more corrective feedback statements to their students following failures, as well as, more conceptual elaboration and thorough feedback statements following student successes. To summarize, field dependent/independent teachers differed most dramatically in 1) their overall frequencies of academic interactions and the context of their interactions with their students, 2) their conceptual level of instructional activity, 3) and the type of feedback they offered their students.

A study conducted by Renninger and Snyder (1983) explored the influence of matched or mismatched cognitive styles of field dependence/independence on the perceived satisfaction and performance of teachers and their students. Their sample consisted of 192 students from 8 secondary school classes (8 teachers). Four teachers who were field independent, taught math and four, who were field dependent taught English. The subjects were members of the classes of the participating teachers. Field dependence/independence

was assessed by the GEFT, and both satisfaction and performance was determined through the use of a Likert type questionnaire. Two questionnaires were designed to measure both student's and teacher's perceived satisfaction with each other, as well as teacher effectiveness and student performance. They were distributed to both teachers and students. Standardized tests were also used to assess students' ability apart from teachers' perceptions. Their results indicated that field independent students scored significantly higher in both reading and math on the Scholastic Aptitude Test. In addition, students whose cognitive style matched that of their teachers expressed greater satisfaction with the class and teacher than did students whose style was mismatched with that of their teacher. The field dependent students rated field independent teachers lower than they rated field dependent teachers, and there was a tendency for students to rate teachers of matched style more favorably than they rated teachers of mismatched cognitive style. Also, the relatively field dependent teachers gave higher grades to all students irrespective of students' cognitive style. Lastly, teachers in both cognitive style groups rated the more

field dependent students as exerting more meaningful effort than did the field independent students. In sum, this study indicates greater overall achievement scholastically among field independent students in comparison to their field dependent counterparts. The field independent students in the sample outperformed the field dependent students in both verbal and mathematic sections of the standardized tests. Secondly, there was a significant interaction effect of student and teacher cognitive style on the student's perception of satisfaction and a similar trend on the perception of teacher effectiveness. The overall pattern was consistent with that found in earlier research (DiStefano, 1970) indicating a match - mismatch effect, favoring matched styles. However, the source of the interaction was located primarily in the differential reactions of the field dependent students to teachers of opposite styles (field independent). Also, students tended to be more satisfied with and rated teachers of matched styles as more effective. Again this pattern was more evident among field dependent students. Teacher effectiveness and student satisfaction, at least from the student's perspective, seemed to go hand in hand and are seemingly influenced

by respective cognitive styles. This suggests that the more interpersonal style and responsiveness of the field dependent teacher may perhaps promote greater feelings of acceptance among field dependent students, whereas, the content orientation of the field independent teacher may be perceived as rejecting by the field dependent students. Thirdly, the study reveals a complex set of relationships between cognitive style and teacher perceptions of satisfaction, student grades, and student effort. It appears that field dependent teachers tend to be more satisfied with their student and enjoy them more. They also tend to assign higher grades and see their students as exerting more meaningful effort regardless of cognitive style.

Another study which focused on the relationship of student - teacher cognitive style and academic achievement was conducted by Paradise and Block (1984). They sampled 100 male and 100 female fourth grade students who had the same teachers for reading and math. All students were administered a standardized achievement test at the beginning of the school year. The pretest mean grade equivalent score in reading was 4.8 and in mathematics was 4.5. Twenty teachers were

used in the sample. The GEFT was administered to all students and teachers. At the completion of the school year all students were again administered the same standardized achievement test. The results yielded a significant positive relationship between matched student teacher cognitive style and higher reading achievement scores. The same trend was also found for mathematics achievement.

Individual Efficiency.

Jolly and Reardon (1985) examined the issue of individual efficiency in the formation and use of automatized sequences from an individual differences (field dependent/independent) perspective. They reasoned that automaticity requires: 1) an ability to isolate essential elements of the behavior to be automatized so that they can be utilized; 2) a certain flexibility in attention deployment so that as the elements of the automatized sequence are verified, attention can be paid to external elements; and 3) a reorientation of attention to the automatized sequence (i.e., a return to controlled processing of the lower level elements) after failures to verify. They suggested that individuals differ in their ability to

isolate essential stimulus elements in addition to the flexibility of their use of attention. Field dependent individuals in the concept attainment situations sampled less fully from available cues in the environment, and tended to be dominated by more salient ones. When these salient cues were the more relevant ones for the solution of a concept attainment problem the field dependent person became highly adaptive. However, when ambiguous cues were more relevant for solution, field independent students held the advantage. Three conditions were examined: 1) development of the automatized sequence, 2) the effect of task relevant material and 3) the effect of task irrelevant material. All subjects participated in each condition. Field independent subjects were more efficient and faster at mastering automatized sequences indicating a differential style in organizing and relating to the elements that made up the automatized task. All subjects experienced either severe, mild, or no interruption of the sequences at various points during the trials. Attention given to task relevant and task irrelevant material during the interruptions was measured through the use of recognition confidence measures. Results indicated that the distinction

between task relevant and task irrelevant items was important to both field dependent and field independent subjects. The field dependent subjects incorporated more task irrelevant material as an attentional focus and monitored both types of material more closely when the sequence was not interrupted. Conversely, field independent subjects did not attend to irrelevant material and dealt primarily with the task at hand. However, during interrupted sequences field independent subjects monitored task relevant information more closely than their field dependent counterparts. In sum, field dependent subjects appeared to have a broader, less efficient focus on task material, whereas, field independents have a narrower, efficient focus.

DeBiasio (1986) studied problem solving efficiency in triads composed of varying numbers of field dependent and field independent subjects. He investigated the interactive effects of situational task demands and interpersonal group environment on small group performance. High structure and low structure tasks were solved by three types of triads: three field dependent subjects, three field independent subjects, and triads with both field

dependent/independent subjects. The subject pool consisted of 231 subjects whose level of field dependence/ independence was assessed by the GEFT. The results indicated that field independent groups completed tasks, regardless of structure, 25% faster than did field dependent triads. Also, a significant task structure by group interaction was realized. Field independent groups completed the low structure task 34% faster than field dependent groups completed the high structure task. Field independent groups completed the high structure task 26% faster than did field dependent groups, and the combined performance of the field independent and mixed groups was 24% faster than the field dependent groups on the high structure task. A significant main effect for group composition regardless of task, was found. The group performance in order from quickest to slowest was as follows: field independent, 1 field dependent 2 field independent, field dependent, 2 field dependent 1 field independent. In sum, this study reveals that the difference in performance between a high structure and low structure task for field independent groups was less than it was for field dependent groups. This points to their ability to handle low structure situations by imposing

structure upon it, their ability to maintain a task orientation, and their need to achieve. Secondly, there was a significant interaction between group composition and task structure, with field dependent groups performing poorly in the high structure task. Based upon the research cited above it appears that cognitive style (field dependence/field independence) may play an important role in academic achievement in traditional educational settings.

Self Efficacy Theory

The concept of self efficacy was first introduced by Bandura in 1977. He defined the concept as "the conviction that one can successfully execute the behavior required to produce [certain] outcomes" (Bandura, 1977, p.193). The theory maintains that all behavioral and psychological change occurs through the changes in a person's sense of personal mastery or efficacy. Bandura states that "people possess, weight and integrate diverse sources of information concerning their capabilities, and they regulate their choice behavior and effort expenditure accordingly" (p 212).

According to the theory an individual maintains two related expectancies concerned with mastery or coping. First, there is an outcome expectancy, which is the belief that a particular behavior will or will not yield a particular outcome. Second, there is a self efficacy expectancy, which is an individual's belief that he or she is or is not capable of performing the task or tasks required. Self efficacy expectancy is thought to have its most powerful influence on both the initiation of a behavior and persistence in the face of frustration or failure.

The concept of self efficacy was a result of developments in the field of behavioral change during the 1970's which focused on replacing symbolic experiences with successful performances as the primary source of change. Bandura (1977) postulated that "cognitive processes can mediate change but that cognitive events are also induced and altered most readily by experience of mastery arising from effective performance." (p. 191).

Several sources effect the way in which behavior is acquired and controlled. Modeling is a way in which much human behavior is developed. The observation of others enables one to form a conception of how new

behavior patterns are performed and may act as a guide at a later date. Feedback, is another way in which behavior can be developed, and modified. Consequences serve as a way of informing people what they must do to attain positive outcomes and avoid negative ones. By observing the outcomes of their actions, people can determine which responses are appropriate in which settings, and adjust their behavior accordingly. Motivation is partially anchored in cognitive activities. The ability to represent future outcomes in one's mind is one cognitively based source of motivation. Through these representations of future outcomes, people can formulate motivators of behavior. Bandura (1977) outlines a second source of cognitively based motivation which operates through the intervening influences of goal setting and self evaluative determinations. Individuals create self reinforcements so that they can persist on a task until their performance has reached the level or standard they outlined for themselves. This is done by making self rewarding reactions contingent on attaining a certain level of behavior. Negative discrepancies motivate corrective changes in behavior and both the anticipation of accomplishment and the negative

appraisals of insufficient performance, provide incentive for action.

The theory of self efficacy is based upon the assumption that psychological procedures can serve as a source of creating and strengthening expectations of personal efficacy. Efficacy expectations are differentiated from response outcome expectancies in the following manner. An efficacy expectation is the conviction that one can successfully execute the behavior necessary to produce the outcome. An individual's expectations of personal mastery can effect both their willingness to attempt a task and their persistence on the task. The strength of an individual's convictions in their own effectiveness can even effect their willingness to cope with given situations. Perceived self efficacy not only has an influence over choice and settings of activities, but also can effect a person's persistence on a task. The stronger a person's perceived self efficacy the more active their efforts and the greater their persistence. However, it should be noted that expectation alone will not produce desired performance if the fundamental capabilities are not present.

Maddux and Stanley (1986) have outlined four

sources upon which self efficacy expectations are based. They are in order of magnitude: 1) performance accomplishments, 2) vicarious experience, 3) verbal persuasion and 4) physiological states. Performance accomplishments are based on personal mastery experiences, with repeated successes producing strong efficacy expectations and repeated failures producing weak efficacy expectations. When strong efficacy expectations are developed, the negative impact of occasional failures is minimal, and when they are overcome by determined effort, they can strengthen self motivated persistence. A positive self efficacy, once established can generalize to other situations which were effected by a preoccupation with personal inadequacies.

Vicarious experience is a less dependable source of information about one's capabilities than personal accomplishments because it relies on influences from social comparison. Therefore, efficacy expectations induced through modeling alone are likely to be weaker and more susceptible to change. Modeling, however, can enhance efficacy by providing the observer with a situation where determined effort has aided in overcoming the difficult situation. Showing the gains

achieved by effortful coping behavior minimizes the negative impact of distress for the observer, but also demonstrates that even the most anxious can eventually succeed through perserverance. Modeled behavior with clear outcomes provides more efficacy information than those with ambiguous outcomes. What appears to be important elements are the model's characteristics, (ie, their adeptness, perserverance, age, and expertness) the similarity between models and observers, the difficulty of performance tasks, the situational arrangements under which the modeled achievements occur, and the diversity of modeled attainments.

Verbal persuasion is widely used in an attempt to influence human behavior, because of its ease and availablilty. Through suggestion, individuals are led into believing they can successfully cope with what has overwhelmed them in the past. Efficacy expectations obtained in this manner are weaker than those obtained through one's own accomplishments, because an authentic experiential base has not been established. Verbal persuasion is dependent upon the perceived credibility of the persuaders, their prestige, trustworthiness, expertise, and assuredness.

Lastly, emotional arousal may have informative value regarding personal competency, and can therefore provide another source of information that can effect perceived self efficacy. According to Hunt, Cole, and Reis (1958), visceral arousal occurring in situations perceived as threatening are interpreted as fear, arousal in thwarting situations is experienced as anger, and that resulting in loss of valued objects as sorrow. People who see their arousal resulting from personal inadequacies are more likely to lower their efficacy expectations than those who attribute their arousal to certain situational factors. Individuals rely partially on physiological arousal feedback in judging their anxiety and vulnerability to stress. People are more likely to expect success when they are not experiencing aversive arousal because high arousal generally debilitates performance. For example, fear reactions generally generate further fear of impending stressful situations through anticipatory self arousal. Through generating fear provoking thoughts about their inabilities individuals can elevate their anxiety to levels that exceed the fear they experience during the threatening situation. Often fears and deficits are interdependent. Avoidance of stressful activities

impedes the development of coping skills, resulting in a lack of competence in dealing with fear, providing a realistic basis for it. Social learning theory dictates that potential threats activate fear through cognitive self arousal (Bandura, 1977). Therefore, perceived self competence can affect one's susceptibility to self arousal. People who believe that they are less vulnerable than they assumed previously are less likely to have frightening thoughts in threatening situations. Those whose fears are weak can reduce self doubt and fear arousal to a level where they are able to perform successfully. These successes, in turn, strengthen self efficacy expectancy.

The information conveyed through performance accomplishments, vicarious experiences, verbal persuasion, and emotional arousal, becomes instructive only through cognitive appraisal. The cognitive processing of efficacy information concerns the types of cues people have learned to use as indicators of personal efficacy and the influence rules they use for integrating efficacy information from varying sources (Bandura, 1981). For example, people can gain competence through real circumstances but because of

faulty appraisals of circumstances under which they improve, will ascribe their achievements to external factors rather than their own capabilities. Successes are more likely to enhance self efficacy if performances are perceived as resulting from skill than from erroneous means. On the other hand, failures would produce more reduction in self efficacy when attributed to ability rather than to situational circumstances.

The impact of performance attainments on self efficacy varies depending on whether outcomes are attributed mainly to ability or effort (Bandura 1977). Success with minimal effort reinforces a strong sense of self efficacy, while successes achieved through high levels of effort infer lesser ability and therefore have a weaker effect on perceived self efficacy. Cognitive appraisals of difficulty levels of tasks further influence the impact of performance accomplishments on perceived self efficacy. Success on an easy task provides one new information for altering an individual's sense of self efficacy, whereas success on challenging tasks provides substantial evidence of competence.

The cognitive processing of efficacy information

is an important factor in Bandura's theory. Bandura, Jeffrey and Gajdos (1975) provided support for the idea that lasting changes in self efficacy are best achieved through participant methods which use powerful induction procedures, at first, to develop abilities, then removing external aids to verify personal efficacy, and finally using self directed mastery to strengthen and generalize expectations of personal efficacy. Independent performance enhanced efficacy expectations in the following ways. First, it created cumulative exposure to former threats, which gave the participant more evidence that they no longer were negatively affected by what they previously feared. The reduced emotional arousal confirmed increased coping capabilities. Second, self directed mastery enabled perfect coping capabilities which in turn lessened one's vulnerability to stress. Lastly, independent performance enabled subjects to experience success first hand, which further reinforced expectations of self competence.

Differences between efficacy expectations and performance are most likely to occur when situational and task factors are ambiguous. When performance requirements are not well defined, individuals who

underestimate the task demands will exhibit positive discrepancies between self efficacy and performance attainment, and those who overestimate task demands will experience negative discrepancies. Therefore, the individual should understand what will be required and the circumstances under which he/she will be required to perform. In addition, performances and the corresponding efficacy expectations should be analyzed into separate activities, and perhaps ordered by level of difficulty (Bandura, 1982).

In order to test the propositions regarding the growth and functions of self efficacy Bandura (1977, 1981, 1982) makes use of a microanalytic methodology. This is accomplished by presenting individuals with efficacy scales which represent tasks varying in difficulty, complexity or threat value. Individuals then designate the tasks they feel they can perform and their degree of certainty. Efficacy judgments appear to vary on several dimensions that possess important performance implications. First they differ in level of difficulty. Therefore, when tasks are placed in hierarchical order by level of difficulty the self judged efficacy of varying people may only be derived from simpler tasks, extend to moderately difficult

ones, or pervade some of the most challenging and demanding performances. Secondly, efficacy judgments also vary in strength. Individuals who have a strong sense of personal mastery or efficacy will persevere in their coping strategies in the face of failure while those who have weak self efficacy percepts will tend to give up and have their weak efficacy percepts strengthened. Thirdly, self efficacy percepts differ in generality, that is, they may pervade a varied scope of activities or be limited to only a select few. Consequently, an accurate efficacy analysis requires a detailed assessment of level, strength, and generality of self efficacy taken with the same precision with which behavioral processes are measured. The relationship between self referent thought and action can most clearly be determined through a microanalysis of the differences between efficacy judgment and performance at the level of individual tasks.

Bandura (1982) posited that people develop intrinsic interest by developing a positive self efficacy. This is accomplished with the use of positive incentives, as well as a wide variety of other factors. They include the level of pre-existing interest and ability, magnitude and salience of reward,

type of activity, degree of award contingency and accompanying social messages. These factors can radically alter or even cancel out the effects of rewards offered for merely undertaking a task. Bandura assigned perceived competence a mediating role in the development of intrinsic motivation. He theorizes that interest develops from satisfactions obtained from fulfilling internal standards and from perceived self efficacy gained from performance accomplishments and other sources of efficacy information. Incentives for task mastery can contribute to the development of interest and self efficacy in several ways. First, positive incentives generate performance accomplishments. Second, acquiring information and skills that permit one to fulfill personal standards of merit tend to peak interest and established a sense of personal efficacy. Success in reaching desired outcomes through challenging performances also verify existing competences. This is due to the fact that people do not usually perform at maximal levels, even though they have the necessary skills. When incentives are provided upper skill limits are tested and people find out what they are capable of. Incentives can aid in substantiating talents, by mobilizing high effort,

even though no new skills are acquired in the process. The level of reinforcement also provides social information about the quality of one's performance. Most often accurate performances are seen as the reason for rewards instead of the rewards being seen as the cause of competent performance (Karniol & Ross, 1977)

Bandura (1982) suggests that contingent rewards are not necessarily the optimal way for establishing the type of sustained involvement in activities that builds interest and self efficacy. The social learning model suggests that an important cognitively based source of motivation operates through processes of goal setting and self evaluation behaviors (Bandura, 1977). This type of self motivation involves an internal comparison process, and requires personal standards against which to judge performance. People establish self-incentives from their efforts by making self-satisfaction conditional on a certain level of performance mastery.

Self motivation is achieved optimally by establishing attainable sub-goals which build up to larger future goals. This is because proximal subgoals provide immediate reinforcers and guidance for further action. Distal goals, on the other hand, are too far

removed in time to effectively generate effort, or to direct what a person does in the present. Proximal goals are also important in the development of self-percepts of efficacy, because people usually have little basis for evaluating performances because they do not have standards against which to measure their performances available. Subgoal achievements provide a good measure of progress in the chain of events leading to distal goals, therefore, establishing a growing sense of self efficacy. There are two ways in which proximal goals can contribute to peaking one's interest in activities. When people aspire to, and master, desired levels of performance they experience a sense of satisfaction (Locke, Cartledge, & Kerr, 1970). The satisfaction obtained from subgoal attainments can develop intrinsic interest. When achievements are compared to greater distal goals, the large negative gaps between standards and attainments are likely to alter the level of self satisfaction along the way. As a result, interest fails to develop, even though skills are being developed and acquired in the process. In sum, a sense of personal efficacy in mastering tasks is more likely to enhance interest in them than is self perceived inefficacy in performing competently.

Bandura and Schunk (1981) conducted a study providing evidence that proximal self motivation can build intrinsic interest in activities that are not valued. They hypothesized that self motivation could be enhanced through proximal goal setting and could act as an effective mechanism for cultivating competencies, self percepts of efficacy, and intrinsic interest. They selected 40 children, ages 7.3 to 10.1, who exhibited gross deficits and disinterest in mathematical tasks. The children took part in a program of self directed learning under conditions involving proximal goals, distal goals, or no goals. Prior to this treatment, however, students self efficacy judgments were obtained for all children. After participation in the treatment program the children's mathematical self efficacy was measured. The results of this study revealed no significant sex differences on any of the measures at either the pretest or posttest assessments. The posttest assessment revealed gains in self efficacy and arithmetic performance on generalization problems and the types of problems used in the treatment phase. Children who made use of proximal sub goals subsequently increased their perceived self efficacy

and exhibited even further gains following the performance posttest. Children who employed distal goals displayed a moderate increase in self efficacy but a small decline after the posttest. Self directed learning without goals produced a modest increase at a borderline level of significance. In separate comparisons between treatments, the proximal group exceeded all others in strength of perceived self efficacy, as measured both before and after the behavioral posttest. The children in the distal goals group also exceeded the controls in self efficacy, however, they did not differ significantly from those who set no goals for themselves.

Self directed enhanced mastery of subtraction operations in all three experimental groups was seen, while the controls continued to exhibit confusion in how to subtract numbers from one another. Those youngsters who made use of proximal subgoals out-performed all the other youngsters who participated in subtraction skills. Those youngsters who used self directed learning either with distal or no goals did not differ significantly from each other, but surpassed the control youngsters. The youngsters who participated in the proximal subgoal condition proved

to be more skilled than those who participated in the distal, no goal or control conditions, and the distal and no goal self directed groups were more skilled than the controls.

The children who used proximal subgoals were markedly more persistent after treatment than before in dealing with difficult problems than the distal or no goals children. Conversely, the controls demonstrated a decrease in persistence in the posttest, and all treatment children were more persistent than the controls.

In regard to the development of intrinsic interest the children who participated in the proximal subgoal treatment surpassed all three comparison groups. However, the distal, no goal and controls did not differ from each other. In addition, the proximal self motivators produced a more rapid mastery of the subject matter than did the distals, or no goal self instructionals. The accuracy with which children judged their mathematical efficacy was also influenced by experimental treatment. Children in the distal, no goals, and control groups exhibited only moderate agreement between their self judged efficacy and their performance. On the other hand, children who

participated in the proximal group were quite accurate in the self appraisals of efficacy.

Finally, correlational analysis of the relevant variables in this study revealed the following: 1) the more self instructional material the children mastered the stronger was the mathematical self efficacy; 2) the faster the children completed each lesson the more efficacious they judged themselves; 3) the stronger the children's self perceived efficacy the longer they perservered. For all children high perserverance was accomplished by high performance attainments on more difficult problems; 4) the higher the level of self efficacy at the end of the posttest, the higher the interest shown in arithmetic activities and 5) the more competent children were at mathematical computation and problem solving the more subtraction problems they completed in a free choice situation.

Self Efficacy Strategy Training

The way in which instruction is presented can affect students' learning self efficacy (Winne, 1985). Those students who have no difficulty comprehending their teachers' verbal instructions and explanations

are likely to feel more efficacious in learning situations than those who experience less understanding. Many times teachers model the application of cognitive skills or make use of instructional aids such as films or videotapes during classroom instruction. Combining verbal explanations with cognitive modeling has been shown to promote skill development better than verbal explanations alone (Rosenthal & Zimmerman, 1978). Modeling, a vicarious source of efficacy information, has also been utilized in the literature (Bandura, 1977, 1981, 1982). It is reasoned that observing a teacher perform cognitive skill operations may increase a student's self efficacy, because modeling directly conveys that they also have the capabilities to succeed, and will be able to do so if they perform the same sequence of actions (Schunk, 1984).

Schunk (1981) conducted a study where children deficient in division skills participated in either a cognitive modeling of division skills, or a didactic instruction treatment, after which they solved division problems while simultaneously applying the treatment methods to the problems. The didactic treatment had children reviewing instructional pages that explained

and portrayed the same division operations applied to problems in a stepwise fashion. Both treatments enhanced division self efficacy equally well, however, the cognitive modeling treatment led to higher skill development. This suggests that the children who participated in the didactic treatment were overly influenced by the minimal successes, and did not completely comprehend the nature of the division process. The children assigned to the didactic condition initially studied explanatory pages on their own and then worked the practice problems. When they confronted conceptual difficulty during practice, the trainer referred them to the relevant section of the instructional pages and told them to read the section aloud. Modeling was not provided during instruction or practice.

The children who were assigned to the modeling and didactic-attribution conditions had the trainer attribute their successes to high effort and their difficulties to low effort, on the average of every 5-6 minutes during the practice phase of each of the training sessions. The children received each type of attribution about 20 times during training, making the effort attributions more salient.

The modeling treatment provided children with corrective modeling during the practice phase, when the children encountered perceptual difficulties. During these occasions, the trainer modeled the relevant strategy while referring to the appropriate explanatory page. The underlying issue relating to the modeling paradigm, is whether a teacher flawlessly demonstrating cognitive skills has much effect on students' self efficacy, especially among low achievers who may perceive their teachers as far too superior in competence.

The majority of classroom learning involves the understanding and application of strategies. Especially in mathematics the student must learn successive steps in an algorithm, or a set of sequenced operations that are applied in an inductive way to information during task engagement (Winne, 1985). However, many students fail, or are unable to acquire algorithmic knowledge, or the comprehension of its application through traditional instructional methods. Explicit training in the use of strategies promotes skill acquisition and utilization, therefore, helping to develop self efficacy.

Schunk and Rice (1985) conducted a study with

children in grades two through four who were experiencing language deficits. They participated in a listening comprehension training program which spanned over several sessions, and included teacher modeling of comprehension strategies and student practice. Half of the children in each grade recited each strategy aloud before applying it to a question. It was reasoned that self verbalization, as a type of rehearsal, would aid in focusing the attention of these remedial students on the strategies, and consequently assist strategy coding and attention.

Performance feedback is also a factor in developing self efficacy. To develop self efficacy students require clear information that they are acquiring knowledge and skills, and mastering the material being presented. Performance feedback is thought to influence self efficacy by highlighting performance outcomes and patterns. Feedback that students are making progress focuses their attention on the fact that they are acquiring skills and knowledge which in turn can sustain motivation and increase learning self efficacy.

Schunk (1983) conducted a study which revealed that explicit performance feedback enhanced self

efficacy for students who participated in a subtraction training program. Elementary students who were weak in subtraction skills received instruction and solved problems individually in a training packet over several sessions. At the conclusion of each session, one group recorded the number of pages of problems they completed; another group had their number of completed pages recorded by an adult proctor; and a third worked on the packet but received no explicit feedback. Results indicated that both forms of feedback were equally effective in raising self efficacy and skillful performance, in comparison to the no feedback condition. The three groups did not differ in the number of problems solved during the training program, supporting the idea that, while self efficacy is influenced by prior performances, it is not merely a reflection of them.

Ascribing past failures to not enough effort is felt to produce motivational effects. When people believe that increased effort will lead to success they usually persist longer. Telling students that their past failures resulted from too little effort can promote effort attributions and persistence (Dweck, 1975).

Effort attributional feedback has been seen as a persuasive source of efficacy information. Telling a person that they can achieve better results through harder work can motivate them, and can indicate to them that they have the requisite capability to succeed. Also, providing effort feedback for prior successes can reinforce students' perceptions of acquiring skills, which in turn, should sustain motivation and increase self efficacy for further learning.

Concurrently, attributional feedback can provide differential efficacy information, depending on how it is linked to outcomes. If students are told that their effort is responsible for their achievement, their perceptions of progress will be sustained and they will be more likely to continue good performance even with difficult work. On the other hand, attaching effort to future successes could convey that they are not doing well, and they may conclude that they are less capable at the task and wonder if more effort will produce better results. Schunk (1982) demonstrated support for these hypotheses in a study of children who lacked subtraction skills. They engaged in a subtraction training program, where they received instruction and solved problems individually over several sessions. An

adult proctor monitored their progress periodically. Some children received effort attributional feedback for prior achievement and others received effort feedback for future achievement. Students in a third group received no attributional feedback, and those in a fourth group were not monitored at all. The results indicated that attributing prior achievement to effort led to the highest self efficacy and skills. Focusing on future achievement had no benefit over the straight training alone.

Schunk (1983) in an attempt to support the hypothesis that success achieved with less perceived effort tends to raise self efficacy more than when greater effort is needed, studied children deficient in subtraction skills. The children received either ability attributional feedback for their prior achievement, effort feedback, both forms of feedback, or no attributional feedback. The three forms of feedback resulted in equally high task motivation during training, as measured by rate of problem solving. However, the children who received only ability feedback developed the highest self efficacy and subtraction skill. The effort only and ability plus effort groups did not differ on any measure, but

each out-performed the no feedback group. The ability only group also judged their effort expended during training, as lower, than the other groups. These results lend support that ability plus effort students dismissed the ability feedback, and may have questioned their ability because they had to work so hard.

Educational Implications of Self Efficacy Strategy

Training

The role of perceived self efficacy during classroom learning of cognitive skills has been a focal point of recent educational research. The central idea is that self efficacy is an important variable in understanding motivated learning, that is, motivation to acquire skills and knowledge, as opposed to, just the completion of activities. Students who have a low sense of self efficacy for acquiring cognitive skills may attempt to avoid tasks, whereas, those students who perceive themselves as more efficacious tend to participate more eagerly. Self efficacy can also affect motivation, in that, students who have a higher sense of efficacy tend to expend greater effort, and persist longer than their low efficacious counterparts,

when faced with difficult tasks (Bandura and Schunk, 1981).

Efficacy appraisal is an inferential process involving weighing the relative contributions of ability and inability factors such as self perceptions of ability, amount of effort expended, task difficulty, amount of external aid received, situational factors under which the performances occurred, and the temporal patterns of successes and failures (Bandura, 1982). Schunk (1985) has shown that educational practices supply important contextual influences on self efficacy, and that self efficacy affects subsequent achievement. Schunk (1984) designed a study to investigate the effects of performance contingent rewards and proximal goals on childrens' task motivation, self efficacy, and skillful performance. He attempted to compare the effects of performance contingent rewards to those of proximal goals, and examine the effects of combining rewards with goals. During a division skill development program, children were assigned to one of three groups; contingent rewards, proximal goals, and both rewards and goals. The study indicated that combining contingent rewards with proximal goals led to higher self efficacy and

division performance than either treatment alone. This supported the notion that self efficacy bears an important relationship to subsequent achievement. The rewards plus goals group made higher self efficacy judgments than the rewards and goals alone groups.

Modeling the importance of task strategy use and positive achievement beliefs has been demonstrated to affect self efficacy and skill acquisition (Schunk and Gunn, 1985). Forty students who were deficient in division skills took part in a training program which included instruction and practice. The instruction consisted of students observing a model demonstrate division solution strategies. The students observed an adult model solve two division problems. The model verbalized aloud the division solution strategies and their application to the problems as he reached the correct solutions. When completing a second problem, the model summarized the solution strategies verbally while referring to a sample problem. For a second group the model emphasized the importance of positive achievement beliefs. Self efficacy, effort, and ability attributions were conveyed in statements: " I can do this one " (self efficacy), " I can finish it if I work hard " (effort attribution), and " I'm pretty

good at this " (ability attribution). A third group received modeled importance of task strategy plus positive achievement beliefs. Results indicated that modeling the importance of using task strategies enhanced students' motivation and skill development, but emphasizing both task strategy use and achievement beliefs led to the highest self efficacy. Stressing the importance of positive achievement beliefs led to no benefits over those obtained from cognitive modeling alone.

Schunk and Cox (1986), investigated how verbalization of subtraction with regrouping operations influenced learning disabled students' self efficacy and skillful performance. In addition, they explored how effort attributional feedback affected achievement behaviors. In the first condition students verbalized aloud while solving problems (continuous verbalization), the second condition had students verbalize only during the first half of their training (discontinuous verbalization), and the third condition had students work silently. The students received effort feedback during the first half of training, the second half of the training, or no effort feedback at all. The continuous verbalization condition led to

higher self efficacy and skill performance than did the discontinuous or no verbalization conditions. Effort feedback promoted achievement behaviors especially if provided during the first half of training.

Theoretical Model For The Present Study

The theoretical model for this study involves a number of relationships between key variables which have been discussed extensively. In this model successful self efficacy strategy training and subsequent skill development is hypothesized to be a function of the student's cognitive style of field dependence / independence.

Successful self efficacy training and subsequent skill development is hypothesized to be a function of the following variables: a) field dependence, b) field independence, c) cognitive modeling, d) didactic instruction, and e) performance feedback.

Educational practices are hypothesized to be important influences on students' self efficacy, (Schunk ,1984) as is how information acquired from performance accomplishments, vicarious experiences,

social persuasion, and inferences from physiological stimulation is appraised or processed cognitively (Bandura, 1977). All cognitive processing is subject to an individual's cognitive style (Witkin, Moore, Goodenough, & Cox; 1977). Schunk (1985) presents a model where he feels students enter learning situations or tasks with individual characteristics. He also feels students may differ at the onset of learning, in whether they believe that situations are influenced by external factors or internal factors. This correlates highly with whether or not a student possesses a field dependent or field independent cognitive style (Ismail & Kong, 1985; Witkin et al., 1977).

According to Winne (1985), classroom learning is dependent on: a) attending: which focuses on incoming information from instructional events and activating concepts in memory, b) associating: which refers to relating new information with information in memory, c) rehearsing: which involves maintaining information in an activated state without altering it, and d) monitoring: which includes processes such as comparing one's level of learning to the task goal and deciding whether further cognitive processing is needed. These factors have also been found to be influenced by an

individual's relative field dependence / independence cognitive style (Andrews, 1981; Shade, 1983; Witkin & Goodenough, 1979).

Schunk (1985) also believes that a student's view of the situational circumstances surrounding the learning activity has an influence on self efficacy. Efforts such as teacher corrective feedback or peer assistance are helpful in initiating skill development, but do little to promote self efficacy if students attribute their improvement to external factors, as do field dependent students. Students who master tasks with little or no aid (field independent) may be likely to form positive ability attributions and develop higher self efficacy than those who require greater assistance (field dependent).

How instruction is presented can also affect students' learning self efficacy (Winne, 1985). Students who easily understand the teacher's instructions and explanations tend to feel more efficacious for learning than those who don't understand easily. Teachers often model the application of cognitive skills during classroom instruction. Rosenthal and Zimmerman (1978) found that combining explanations with cognitive modeling can

promote skill development better than explanations alone.

Schunk (1981) conducted a study where children deficient in division skills received either cognitive modeling of division operations or didactic instruction, after which they solved problems. During the cognitive modeling, children observed an adult model verbalize aloud division operations while simultaneously applying them to problems. The didactic treatment consisted of children reviewing instructional pages that explained and portrayed the same division operations applied to problems step by step. Both treatments promoted division self efficacy equally as well, but cognitive modeling led to higher skill development. Schunk reasoned that the didactic treatment children may have been overly influenced by their modest training successes while not fully understanding the nature of the division process. However, the cognitive style (field dependence / independence) of his sample may have influenced his results. In general, low achievers tend to be more field dependent (Blaha & Chomin,1982; Blaha, 1982; Roach, 1985; Ismail & Kong, 1985; Shade, 1983). Shade (1983) found high achieving students to be more field

independent and 1) more able to impose structure on tasks; 2) are more self directed and able to handle abstract material; 3) more self motivated; 4) prefer to work alone; 5) able to make better use of written instruction; and 6) use a hypothesis testing approach to learning. Lower achievers tended to be predominantly field dependent. They: 1) require cues from the environment to solve problems; 2) have difficulty providing their own structure; 3) perform well in a cooperative work environment; 4) prefer to learn in an auditory or kinesthetic mode; 5) remember material better when placed in a social context; and 6) respond best to teachers who are warm and use positive reinforcement techniques. Field dependent students also tended to learn better in more interpersonal socially oriented situations, while field independent students perform better in situations which make use of textbooks, handouts, and lectures (Andrews,1981).

Proposed Research and Hypotheses

As the literature indicates, researchers have identified many variables important to a study investigating the effects of cognitive style and self efficacy on academic achievement. The issues of cognitive style field dependence / independence, and self efficacy have been studied in isolation from one another and the research relative to the model derived from these issues has also been conducted in relative isolation. Therefore, a need to examine these issues in an integrated manner exists.

The present study will examine the proposed model by means of a three factor factorial ANCOVA as it relates to the following hypotheses:

H1: Self efficacy judgments of field independent students will be higher overall than those of field dependent students.

H2: Division performance of the field independent students will be generally higher than that of field dependent students.

H3: Field independent children who received the didactic strategy training will have higher self efficacy judgment posttest scores than field independent students who received the cognitive modeling strategy training.

H4: Field independent students who experienced the didactic strategy training will have higher division performance posttest scores than field independent students who received the cognitive modeling strategy training.

H5: Field dependent students who received cognitive modeling strategy training will have higher posttest self efficacy judgments than those field dependent students who received the didactic strategy training.

H6: Field dependent students who received the cognitive modeling strategy training will demonstrate higher division performance posttest scores than those field dependent students who received the didactic strategy training.

H7: All children regardless of cognitive style will

have greater posttest self efficacy judgments and division performance posttest scores if they received performance feedback.

H8: Field dependent children who received performance feedback will have higher posttest self efficacy judgments than field dependent children who received no performance feedback.

H9: Field dependent students who received performance feedback will have higher posttest division performance scores than field dependent students who received no performance feedback.

H10: Field dependent students who received performance feedback will have higher self efficacy judgment posttest scores than field independent students who received performance feedback.

H11: Field dependent students who received performance feedback will have higher posttest division performance scores than field independent students who received performance feedback.

H12: The field independent students who experienced the didactic strategy training, no performance feedback condition will have higher posttest self efficacy judgments than the field dependent students who received the cognitive modeling strategy training, performance feedback condition.

H13: Field independent students who experienced the didactic strategy training with no performance feedback will have higher posttest division performance scores than the field dependent students who received cognitive modeling strategy training and performance feedback.

Chapter III

Method

Subjects

The 80 subjects (39 males and 41 females) for this study consisted of students in the fourth and fifth grades from a predominately middle class, ethnically mixed, integrated suburban school district. They were drawn from a pool of 500 students who were administered the GEFT. The sample analyzed ranged in age from 9 years 5 months to 11 years 4 months. The children were administered the formal preassessment and the Group Embedded Figures Test by an adult tester. The breakdown of the sample consisted of 20 field independent and 19 field dependent males; and 19 field independent and 22 field dependent females. Different adults administered the assessment and treatment procedures. All students were of at least average intellectual potential, as measured by student's ability index of the California Achievement Test ($M = 115.37$; $SD = 14.14$).

Materials

The Group Embedded Figures Test (GEFT) developed by Oltman, Raskin, and Witkin, (1971) was administered to all subjects. The GEFT remains one of the most widely used tests of determining a person field dependence / field independence, and its psychometric properties have remained consistent over time (Witkin, 1979). It consists of 18 complex figures, each having one of eight simple forms embedded within it. The task is to locate and trace as many of the simple forms as possible during two 5 - minute test periods. The greater the number of simple forms correctly identified, the greater the person's relative field independence. However, because the population involved in the present study consisted of children the modified time limits based on the research of Mahlios and D'Angelo (1983) were applied. Therefore, the administration time for sections 2 and 3 were set at at 7 minutes each. The GEFT has been proven to be a valid assessment of children's field dependence / field independence by Thompson, Pitts, and Gipe (1983). Their study affirms the validity of this measure with children. The mean latent trait ability estimates for

students in grades 4 through 6 were, respectively, -1.07, (SD = 1.44), -.42 (SD = 1.37), and .05 (SD = 1.47). The internal consistency reliability equivalent was computed to be .80.

Pretreatment Assessment

The pretreatment assessment consisted of that used by Schunk (1981). The **arithmetic performance test** is a pretest consisting of 18 division problems of increasing difficulty. It includes 6 problems with one digit divisors, 6 with two digit divisors, 3 with three digit divisors, and 3 with four digit divisors. The three and four digit divisor problems are included to test the generalized effects of treatment, which includes only one and two digit divisor problems. Therefore, the performance test consists of 12 training problems and 6 generalization problems. In addition, the arithmetic tasks are graded in difficulty, by having progressively more digits in the dividends. The problems are presented individually in order of increasing difficulty within the common divisor level, with the four digit divisor problems appearing in positions 6, 12, and 18. This was done in an attempt

to control for a cumulative fatigue effect.

Each division problem was presented on a single page of paper. The children were instructed to examine each problem and place the page of paper on a completed pile when they were finished solving the problem or had decided not to work on it any longer. The tester recorded the number of problems each child solved correctly.

The **efficacy judgment** scale was also developed by Schunk (1981), where the children's pretest level of efficacy was measured after the division performance test, insuring familiarity with the different types of problems. The efficacy scale ranged from 10 to 100 in intervals of 10. Several intervals had corresponding verbal descriptors. They occurred at the following points: 10 = not sure, 40 = maybe, 70 = pretty sure, 100 = real sure. Initially the children were given practice with the efficacy assessment procedure by judging their ability to jump increasingly longer distances. A variety of distances ranging from a few inches to several yards were included to insure that the children understood both the scale direction and the general meaning of each of the 10 points. Following this practice procedure the children were

shown 18 pairs of division problems with increasing level of difficulty. Each pair presentation was 2 seconds in duration. This brief exposure is sufficient to present the nature of the tasks yet too brief to attempt any solutions. For each of the samples, the children were to privately judge, on separate efficacy scales their capability to solve that type of problem, according to the following directions:

"Circle the number on the line that matches how sure you are that you could work the problems like those shown and get the right answers. Remember that the higher the number the more sure you are while the lower the number the less sure you are. Please be honest and mark how you really feel right now."

Each sample pair corresponds in form and difficulty to one problem on the preceding test. However, the problems in the efficacy set are not the same as those on the performance test. Since the self-efficacy measures tap new applications of the cognitive skill, the children had to rely on their generalizable perceptions of capabilities in making the judgments. Scores were averaged across the 18 judgments.

Field Dependence/Field Independence

The GEFT was administered to all subjects according to the instructions outlined in the test manual (Oltman, Raskin, & Witkin, 1971). The subjects were placed into field dependent/field independent groups based upon the norms established by Witkin, et al. (1971), and Mahlios and D'Angelo (1983).

Experimental Assignments

Following the pretest assessments subjects were first classified into field dependent / field independent groups (40 in each) and then randomly assigned to one of eight treatment groups (N's=10). They were: 1) field dependent, cognitive modeling, performance feedback; 2) field dependent, cognitive modeling, no performance feedback; 3) field dependent, didactic instruction, performance feedback; 4) field dependent, didactic instruction, no performance feedback; 5) field independent, cognitive modeling, performance feedback; 6) field independent, cognitive

modeling, no performance feedback; 7) field independent, didactic instruction, performance feedback; 8) field independent, didactic instruction, no performance feedback (see figure 1).

Training Sessions

The subjects received three 55 minute training sessions, each of which contained three phases. These occurred over three separate days. The first phase provided instruction on division strategies (10 minutes). The second provided subjects the time to practice the strategies they had learned (35 minutes). The third phase, self mastery, had subjects solving problems on their own (10 minutes). Training was administered individually with the trainer and subject sitting side by side during the instruction and practice phases. The subject worked alone during the self mastery phase with the trainer moving out of the subject's sight.

Instructional Materials

Different packets were used for each session, however, their format was the same. The first two pages explained the solution strategies, and provided examples that displayed the application of the strategies step by step. The solution strategies were based on the distributive algorithm, requiring a separate division to arrive at each digit in the quotient and bringing down numbers one at a time from the dividend. Each of the the next several pages contained one division problem. The subjects worked these problems one at a time during the practice phase, with enough pages being included so that no subject was be able to complete them all. The subjects were informed of the correctness of their solutions. For small computational errors, trainers asked subjects to check their work by saying "that's not quite right, please check your work." Several self-directed mastery problems appeared on the last two pages.

Treatment Conditions

At the start of each training session, each

subject received the appropriate treatment depending on their experimental assignment.

Cognitive modeling

In this condition the subjects observed an adult model solve two division problems displayed on the explanatory page of the training packet. The model verbalized aloud the division solution strategies and their application to problems as they arrived at the correct solutions. At the completion of the second problem, the model summarized the solution strategies verbally while referring to a sample problem. An example appears in appendix G. During the practice phase corrective modeling was provided when children encountered difficulties. While this occurred, the trainer modeled the relevant strategy while referring to the appropriate explanatory page.

Didactic treatment

Subjects in this condition silently read and studied the same explanatory pages independently, after which they worked the practice problems. When the subjects encountered conceptual difficulty during

practice, the trainer referred them to the relevant sections of the explanatory pages and instructed them to review it. If the subjects remained confused after the referral, they were asked to read the section aloud.

Performance feedback

In this condition the subjects either had the number of problems they completed correctly during self mastery recorded by an adult proctor, or received no performance feedback whatsoever. Thus the feedback provided was positive feedback.

Posttest Assessment

The posttest assessment was conducted within one week after the completion of training. The procedures were identical to those outlined in the pretreatment assessment, with the exception that efficacy judgments were collected before the division performance test. The self efficacy scores that were obtained prior to this test provided the measure for testing their predictive value.

The division performance test was similar in form and level of difficulty used in the preassessment, but included different problems. A parallel form was used to control for practice effects. For each subject, the same tester administered the pre and posttest, but did not serve as the subject's training model, and was blind to the subject's treatment condition. All tests and materials were scored by a different adult who was unaware of the subject's experimental assignment.

Procedure

The current study was carried out in four separate stages. First, all subjects were administered the GEFT. They were assigned to field dependent or field independent conditions based upon the norms established by Witkin, et al. (1971), and revised by Mahlios and D'Angelo (1983) for identification of field dependence in children. Based upon the norms established for children, (the sample consisted of fourth and fifth graders) a score of 3 or below categorized a subject as field dependent, and a score of 10 or above categorized a subject as field independent. Second, all subjects

were administered the self efficacy judgment pretest, and the division skills performance pretest. Third, the subjects received, on separate days, three 55 minute training sessions, each consisting of three phases. Phase A (10 minutes) provided instruction on division strategies. Phase B (35 minutes) provided the children time to practice the strategies they had learned. Phase C (10 minutes), the self directed mastery phase, had the children solving problems on their own. Lastly, the posttest assessments were conducted within a week after completion of training.

During phase C the subjects either had the number of problems they completed correctly recorded by an adult proctor, or received no performance feedback at all. The feedback provided was positive in nature.

Method of Data Analysis

Data relative to the five variables in the present investigation was analyzed by a 3 factor factorial ANCOVA. The independent variables were field dependence/field independence, treatment condition, (i.e., cognitive modeling or didactic, and performance feedback). The dependent variables were post self

efficacy judgment scores and post division skill performance scores, with the covariates being the respective pretest measures.

Figure 1. Model for present study

	FIELD DEPENDENT		FIELD INDEPENDENT	
	PERFORMANCE FEEDBACK	NO FEEDBACK	PERFORMANCE FEEDBACK	NO FEEDBACK
COGNITIVE MODELING				
DIDACTIC				

CHAPTER IV

RESULTS

This chapter presents the findings related to the testing of thirteen hypotheses. The determinants of the self efficacy judgment posttest scores, and division performance posttest scores included: 1) cognitive style (field dependent / field independent); 2) strategy training condition (cognitive modeling / didactic); and 3) performance feedback (performance feedback / no performance feedback).

Each posttest measure was analyzed with a 2x2x2 (cognitive style, strategy training, performance feedback) analysis of covariance (ANCOVA), using the appropriate pretest measure as the covariate. The eight experimental conditions constituted the treatment factors. Means and standard deviations of all measures are shown by experimental condition in Tables 1 and 2. Adjusted posttest means and standard deviations for all measures are shown in Tables 3 and 4.

Table 1

Means and (Standard Deviations) for Self Efficacy
Judgement^(a) Pretest and Posttest Scores

	<u>Cognitive Modeling</u>		<u>Didactic</u>	
	Perform. Feedback	No Perform. Feedback	Perform. Feedback	No Perform. Feedback
n = 80, ns = 10				
<u>FIELD DEPENDENT</u>				
Pretest	69.06 (15.54)	78.25 (15.40)	73.94 (14.18)	80.74 (12.63)
Posttest	74.88 (16.94)	77.13 (15.86)	80.13 (11.50)	80.13 (11.35)
<u>FIELD INDEPENDENT</u>				
Pretest	91.31 (7.84)	90.31 (6.00)	82.50 (21.84)	90.63 (7.38)
Posttest	92.18 (9.36)	85.51 (8.95)	88.06 (19.54)	93.06 (6.79)

(a) average judgement over 18 trials; range of scale
 10(low) - 100

ns = number of subjects per cell

Table 2

Means and (Standard Deviations) for Division Performance^(a) Pretest and Posttest Scores

	<u>Cognitive Modeling</u>		<u>Didactic</u>	
	Perform. Feedback	No Perform. Feedback	Perform. Feedback	No Perform. Feedback
n = 80, ns = 10				
<u>FIELD DEPENDENT</u>				
Pretest	8.00 (.94)	7.90 (2.69)	7.40 (2.17)	9.20 (2.15)
Posttest	7.20 (1.69)	8.30 (2.54)	8.90 (1.91)	7.80 (3.36)
<u>FIELD INDEPENDENT</u>				
Pretest	10.70 (2.63)	10.60 (2.88)	10.10 (1.73)	12.10 (2.23)
Posttest	11.10 (2.96)	9.20 (2.49)	10.40 (4.09)	13.40 (2.17)

(a) number of correct solutions on 18 problems

ns = number of subjects per cell

Table 3

Adjusted Posttest Means and (Standard Deviations)
for Self Efficacy Judgements (a)

	<u>Cognitive Modeling</u>		<u>Didactic</u>	
	Perform. Feedback	No Perform. Feedback	Perform. Feedback	No Perform. Feedback
n = 80, ns = 10				
Field Dependent	85.17 (16.94)	80.16 (15.86)	86.57 (11.50)	81.20 (11.35)
Field Independent	87.59 (4.79)	79.02 (8.95)	87.74 (19.54)	86.32 (6.79)

(a) average judgement over 18 trials; range of
 scale 10(low) - 100

ns = number of subjects per cell

Table 4

Adjusted Posttest Means and (Standard Deviations)
for Division Performance (a)

n = 80, ns = 10	<u>Cognitive Modeling</u>		<u>Didactic</u>	
	Perform. Feedback	No Perform. Feedback	Perform. Feedback	No Perform. Feedback
Field Dependent	8.38 (1.69)	9.56 (2.54)	10.55 (1.91)	8.04 (3.36)
Field Independent	10.16 (2.96)	8.34 (2.49)	9.93 (4.09)	11.35 (2.17)

(a) number of correct solutions on 18 problems

ns = number of subjects per cell

The use of ANCOVA required demonstration of homogeneity of regression, i.e. slope of homogeneity across treatment groups (Keppel, 1982). Tests of slope differences for each measure were made by comparing a linear model which permitted separate slopes for the eight treatment groups against one that contained only one slope parameter for estimating the pretest - posttest relationship pooled across the eight treatments. These analyses found the assumption of homogeneity of slopes across treatments to be tenable. The F test with 7 and 64 degrees of freedom was not significant for either dependent variable.

HYPOTHESIS TESTING

Hypotheses 1 and 2 examined the effect of cognitive style (field dependent / field independent) on the self efficacy judgments and division performance. Hypotheses 3 - 6 predicted the effects of cognitive style and self efficacy strategy training on self efficacy judgment posttest scores, and division performance posttest scores. Hypothesis 7 examined the effect of performance feedback on the self efficacy judgment posttest scores and division performance

posttest scores. Hypotheses 8 - 11 predicted the effect of cognitive style and performance feedback on self efficacy judgment posttest scores and division performance posttest scores. Hypotheses 12 and 13 examined the effect of cognitive style, performance feedback, and self efficacy strategy training on self efficacy judgment posttest scores and division performance posttest scores.

SELF EFFICACY

Hypothesis 1 predicted that self efficacy judgment posttest scores would differ as a function of cognitive style. Table 5 summarizes the results of the ANCOVA testing the effects of cognitive style, strategy training, and performance feedback on the self efficacy judgment posttest scores. There was no significant main effect of cognitive style on self efficacy judgment posttest scores and Hypothesis 1 was not supported. Self efficacy judgment means for each independent variable collapsed over cells are shown in Table 6.

The cognitive style x strategy training condition interaction also failed to reach significance. While

the field independent students had higher self efficacy scores under the didactic treatment, the difference between the cognitive modeling and didactic strategy training conditions for field dependence / field independence was not large enough to reach significance. Therefore Hypothesis 3 was rejected. Hypothesis 5 was not supported since the field dependent / cognitive modeling group did not demonstrate higher self efficacy judgment posttest scores than the field dependent / didactic group.

Table 5

Analysis of Covariance Summary Table
for Self Efficacy Judgements

Source	SS	df	MS	F	p
Cognitive Style	56.82	1	56.82	1.08	.30
Strategy Training (condition)	122.10	1	122.10	2.33	.13
Cognitive Style X Strategy Training	30.80	1	30.80	0.59	
Feedback	493.74	1	493.74	9.42	.003**
Cognitive Style X Feedback	0.21	1	0.21	0.004	
Strategy Training X Feedback	57.35	1	57.35	1.09	.30
Cognitive Style X Strategy Training X Feedback	69.87	1	69.87	1.33	.25
Error	3723.08	71	52.49		

** $p < .01$

Table 6

Mean Adjusted Self Efficacy Judgements Broken Down
By Independent Variables

<u>Cognitive Style</u>	
Field Dependent 83.27	Field Independent 85.17
<u>Strategy Training</u>	
Cognitive Modeling 82.99	Didactic 85.46
<u>Cognitive Style x Strategy Training</u>	
Field Dependent x Cognitive Modeling 82.66	Field Dependent x Didactic 83.88
Field Independent x Cognitive Modeling 83.31	Field Independent x Didactic 87.03
<u>Feedback</u>	
Performance Feedback 86.77	No Performance Feedback 81.67
<u>Cognitive Style x Feedback</u>	
Field Dependent x Performance Feedback 85.87	Field Dependent x No Performance Feedback 80.68
Field Independent Performance Feedback 87.67	Field Independent No Performance Feedback 82.67
<u>Strategy Training x Feedback</u>	
Cognitive Model x Performance Feedback 86.38	Cognitive Model x No Performance Feedback 79.59
Didactic x Performance Feedback 87.15	Didactic x No Performance Feedback 83.76

There was a significant main effect for performance feedback, $F(1, 71) = 9.42, p < .003$. Examination of marginal means revealed that receipt of performance feedback generally led to higher self efficacy judgments than no performance feedback. As a result Hypothesis 7 was partially supported.

The results indicate that there is also no significant interaction effect for cognitive style x performance feedback. The difference between feedback and no feedback for the field dependent students was no different than that of the field independent students. Therefore, hypothesis 8 was rejected. Hypothesis 10 was rejected since the field dependent / performance feedback group did not yield higher self efficacy judgment posttest scores than the field independent / performance feedback group.

Lastly, the results indicate that there was no significant cognitive style x strategy training x performance feedback interaction effect and consequently, Hypothesis 12 was rejected.

DIVISION PERFORMANCE (SKILL)

Hypothesis 2 predicted that division performance posttest scores would differ as a function of cognitive style. Table 7 summarizes the results of the ANCOVA testing the effects of: 1) cognitive style; 2) strategy training; and 3) performance feedback on division performance posttest scores. There was no significant main effect for cognitive style, and hypothesis 2 was not supported.

There was no significant interaction between cognitive style and strategy training condition. While the difference between cognitive modeling and didactic strategy training conditions was greater for the field independent students, the difference for field dependent and field independent students was not large enough to reach significance. Consequently Hypothesis 4 was not supported. Table 8 presents the division performance means for each independent variable collapsed over cells.

Table 7

Analysis of Covariance Summary Table
for Division Performance

Source	SS	df	MS	F	p
Cognitive Style	9.30	1	9.30	2.07	.15
Strategy Training (condition)	14.67	1	14.67	3.26	.07
Cognitive Style X Strategy Training	5.74	1	5.74	1.28	.26
Feedback	3.60	1	3.60	.80	
Cognitive Style X Feedback	1.11	1	1.11	0.25	
Strategy Training X Feedback	.24	1	.24	.05	
Cognitive Style X Strategy Training X Feedback	60.24	1	60.24	13.39	.0008***
Error	319.33	71		4.50	

 $p < .001$

Table 8

Mean Adjusted Division Performance Scores Broken Down
By Independent Variables

<u>Cognitive Style</u>	
Field Dependent 9.13	Field Independent 9.94
<u>Strategy Training</u>	
Cognitive Modeling 9.11	Didactic 9.97
<u>Cognitive Style x Strategy Training</u>	
Field Dependent x Cognitive Modeling 8.97	Field Dependent x Didactic 9.29
Field Independent x Cognitive Modeling 9.25	Field Independent x Didactic Didactic 10.64
<u>Feedback</u>	
Performance Feedback 9.75	No Performance Feedback 9.32
<u>Cognitive Style x Feedback</u>	
Field Dependent x Performance Feedback 9.47	Field Dependent x No Performance Feedback 8.80
Field Independent x Performance Feedback 10.04	Field Independent x No Performance Feedback 9.84
<u>Strategy Training x Feedback</u>	
Cognitive Model x Performance Feedback 9.27	Cognitive Model x No Performance Feedback 8.95
Didactic x Performance Feedback 10.24	Didactic x No Performance Feedback 9.70

Hypothesis 6 was not supported since the field dependent / cognitive modeling group did not yield higher division performance scores than the field dependent / didactic group.

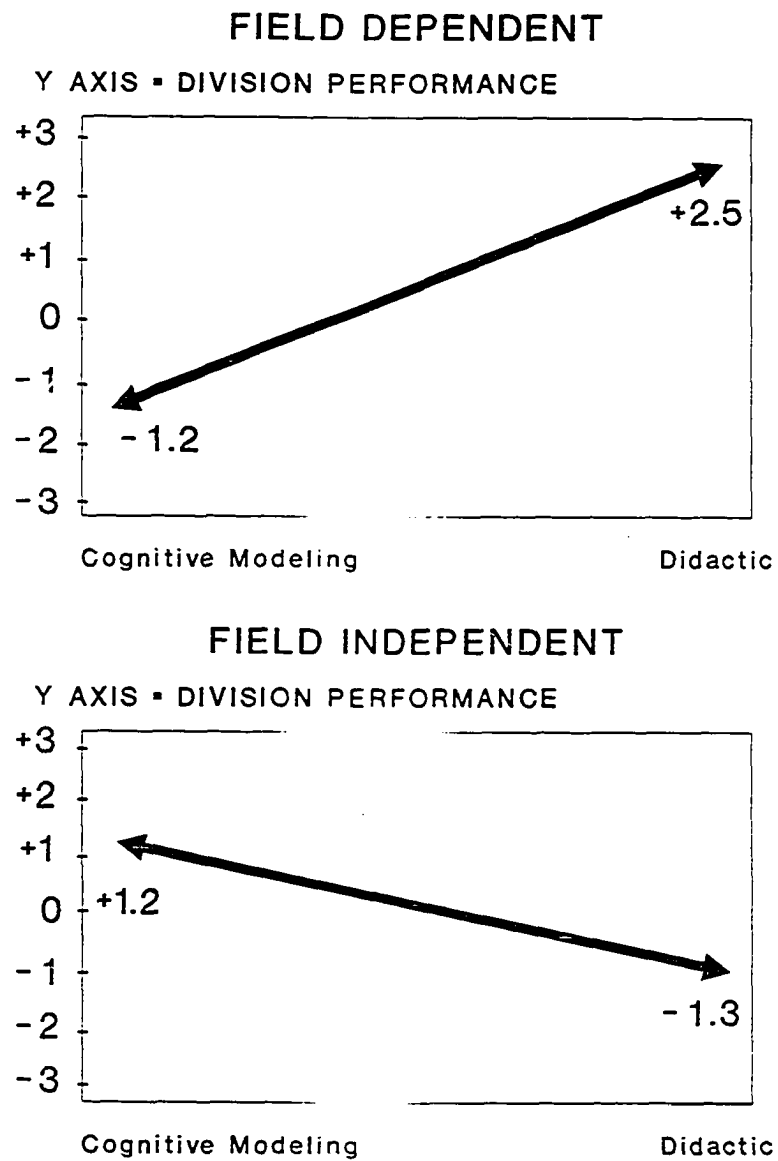
There was no main effect for performance feedback on division performance, i.e. performance feedback did not enhance division performance. Therefore, as discussed previously Hypothesis 7 was only partially supported.

The cognitive style x performance feedback interaction was not significant. The difference between feedback and no feedback for the field dependent students was no different than that of the field independent students, and Hypothesis 9 was not supported. Hypothesis 11 was not supported since the field dependent / performance feedback group did not demonstrate higher division performance than the field independent / performance feedback group.

Finally, the ANCOVA applied to the posttest division performance skill test measure yielded a significant cognitive style x strategy training x performance feedback, 3 way interaction, $F(1, 71) = 13.394$, $p < .0008$. One way of interpreting this result is to plot the performance feedback / no performance

feedback difference as a function of strategy training condition separately for field dependent and field independent subjects (figure 2). The division skill benefit due to performance feedback increases from the cognitive modeling condition to the didactic condition for the field dependent subjects. Conversely, the division skill benefit due to performance feedback decreases from the cognitive modeling condition to the didactic condition for the field independent subjects. These findings suggest that as a student moves from a condition which is compatible with their cognitive style to one which is less compatible, they are affected more positively by performance feedback.

Figure 2. Performance feedback differences as a function of strategy training for field dependent and field independent subjects



CHAPTER V

DISCUSSION

The purpose of the present study was to examine how differing self efficacy strategy training methods (cognitive modeling or didactic) can best support the child's cognitive style (field dependent / field independent) in enhancing self efficacy judgments and division performance, so that all children, regardless of their cognitive style can function at their optimal level. In addition, this study sought to measure the differential effects of performance feedback on children's self efficacy judgments and division performance, as a function of their cognitive style. It was hypothesized that children who received performance feedback would have higher self efficacy and division performance posttest scores than those who received no performance feedback. In addition, it was hypothesized that there would be an interaction such that posttest scores for self efficacy judgments and division performance would be greatest for field dependent children who received performance feedback. This study also sought to extend the research of Schunk

and his associates regarding the effects of differing strategy training methods on self efficacy judgments and division performance to include cognitive style. It was hypothesized that there would be an interaction such that posttest scores for self efficacy judgments and division performance would be optimal for field dependent children who experienced cognitive modeling strategy training and field independent children who experienced didactic strategy training.

Hypotheses 1 and 2 stated that field independent students would have overall higher self efficacy judgments and division performance posttest scores than

field dependent students. The results do not support these hypotheses. Field independent students did not have significantly higher self efficacy judgment or division performance posttest scores.

Self efficacy judgments are generally self referent cognitions about a person's capabilities and, therefore, a person may feel they are capable regardless of their performances (Bandura, 1977). Furthermore, self efficacy judgments also determine how much effort a person will expend and how long they will persist in the face of difficult tasks. In the face of

difficulties people who have doubtful thoughts about their capabilities diminish their efforts or tend to give up altogether, whereas, people who have a strong sense of efficacy expend greater effort to meet challenges. Also, high perserverence most often produces high performance attainments (Bandura, 1982). In the present study self efficacy judgments and division performance did not differ significantly for field dependent and field independent students, as expected. It appears that the field dependent students have attained cognitions about their capabilities from their current learning environments which have fostered positive feeling of efficacy. With regard to division performance the current results are consistent with the literature that feelings of high self efficacy lead to higher performance attainments. It should be noted that the strategies used in the current study emphasized teaching division concepts and were not as concerned with actual computation abilities. With that in mind, these findings are consistent with the research of Blaha (1982) where it was found that field independence contributed to arithmetic computation but did not significantly effect the more abstract reasoning involved in arithmetic concepts. This was

also supported by the research of Wallbrown, Wallbrown, and Engin (1977), who found that field dependent youngsters "quit" more frequently when engaged in the more mechanical aspects of mathematical achievement, but perservered more on tasks requiring more abstract reasoning of mathematics concept problems. Lastly, the findings that field dependent / independent students did not differ in their self efficacy judgments and division performance may be in part be an artifact of the sample used. That is, the students who participated in the study are from an upper middle class, academically oriented school district which has incorporated an affective education program emphasizing self esteem development into the general curriculum. In addition, the district is a model district for the state of New York in the areas of mathematic and reading development.

It was hypothesized that performance feedback would yield higher self efficacy judgments and division performance posttest scores. This hypothesis was partially supported since performance feedback led to generally higher self efficacy judgment posttest scores only. These results support Schunk's (1981, 1983, 1984, 1985) work that performance feedback influences

self efficacy by highlighting performance outcomes and patterns. Feedback that students are making progress can sustain motivation and enhance learning self efficacy. In the present study all children who received performance feedback showed greater self efficacy than their no performance feedback counterparts regardless of cognitive style. These findings are consistent with those of Ferrel, 1971; Pasclisanu, 1970; and Steinfeld, 1973; who found that when external reinforcement for learning is provided, the difference between field dependent / field independent styles becomes negligible. This holds true whether the rewards are tangibles or praise. The fact that performance feedback had more of an effect on self efficacy judgments, which refers to personal judgments or cognitions relating to one's performance capabilities in a given activity, than division performance may have been influenced by the way in which the field dependent / independent students differentially weighed and combined multiple sources of performance feedback information (Schunk, 1986). For example, field dependent students would rely more heavily on environmental feedback situations (i.e. peer models, teacher modeling, teacher encouragement) than

would field independents students, who rely more on internal types of feedback. Schunk (1986) suggests that understanding how students acquire information about their self efficacy from vicarious classroom (environmental) practices will promote their self efficacy.

It was hypothesized that there would be an interaction between the child's cognitive style and performance feedback. It was assumed that the more field dependent children would be affected by performance feedback, because they are influenced more by environmental factors, than the field independent children who are more internally motivated. Therefore, it was expected that there would be little difference in self efficacy and division performance posttest scores for the field independent children whether or not they received performance feedback. Conversely, it was expected that the field dependent children would benefit from performance feedback as evidenced by their self efficacy and division performance posttest scores. This was not supported. The results indicate that all children, regardless of cognitive style benefited from performance feedback. Performance feedback is so powerful that all children, regardless of cognitive

style, improved on the posttests. The results support Schunk's (1981) notion that to develop self efficacy, students need clear information that they are acquiring knowledge and skills, mastering the material, and so on. Self acquisition of such information becomes difficult when progress is slow, such as during complex skill learning, where students may master some component skills readily, but fail to grasp others. Feedback that points out correct operations and remedies troublesome task aspects provides valid capability information, and appears to benefit all children regardless of cognitive style.

These finding are also supported by the research of Kagan and Zahn (1982), who found that field dependent and field independent students responded equally as well to nonpunitive and noncontingent feedback, such as that used in the present study. However, other types of feedback such as negative feedback did have differential effects dependent on a youngster's cognitive style. Also, the present investigation sampled generally high achieving normal children many of whom were in the gifted program, in whom reading and math abilities were high. In both their classroom settings and enrichment settings the

students in the sample are provided with positive feedback as a matter of course. These facts may have contributed to a generally higher sense of efficacy for the sample to begin with and set a case against finding differences in performance between field dependent / independent students due to performance feedback.

Hypotheses 3 - 6 predicted that the type of strategy training (cognitive modeling or didactic) would have an optimal effect on self efficacy and division performance as a function of cognitive style. That is field dependent students would yield higher self efficacy and division performance if they experienced cognitive modeling strategy training, and field independent children would yield higher self efficacy and division performance if they experienced the didactic strategy training. The results did not support these hypotheses. While the field independent students did perform better in terms of self efficacy and division performance under the didactic strategy training, so did the field dependent students. These findings are consistent with those of Schunk (1981) and Schunk and Gunn (1985), where modeling did not enhance self efficacy or performance. These results may be a function of the modeling paradigm used. Schunk and

Gunn (1985) found that modeling the importance of both task strategies and positive achievement beliefs lead to highest self efficacy and performance. Collectively these two forms of modeling are reasoned to create a high initial sense of self efficacy for performing well (Bandura, 1981,; Schunk, 1984). In the present study and Schunk and Gunn (1985), achievement beliefs were not incorporated into the cognitive modeling condition. The model was an adult whose purported function was to instruct students in division operations only. To fully explore how modeling variables affect self efficacy and performance, future research would need to be designed so that the effects of cognitive modeling, strategy importance, and achievement beliefs could be assessed independently and in combination with one another. In addition, the provision of structure as outlined in the didactic strategy has been found to enhance math achievement for field dependent students (Vaidya & Chansky, 1980). They found that study questions and review paragraphs provided the type of structure and focus which was necessary for field dependent students. Furthermore, the possibility that students verbalize, whether silently and/or subvocally when reading, helps focus their attention on important

task features, and as a form of rehearsal, assists strategy encoding and retention. It is also possible that verbalization conveys to students a sense of personal control over learning outcomes because it makes salient a strategy that can facilitate problem solving. As students effectively use a verbalization strategy they are apt to develop higher self efficacy for continuing to perform well. Schunk, Gunn, and Cox (1985) made use of such verbalizing techniques when studying learning disabled students, who have been found to be relatively field dependent (Cowen & Harway, 1976; Eakin & Douglas, 1971; Guyer & Friedman, 1975; Keogh & Donlon, 1972; Satz, Friel, & Rudegeari, 1974; Stuart, 1967).

Lastly, this study sought to examine the interaction effects of cognitive style, type of strategy training, and performance feedback on self efficacy and division performance. The results indicated that division performance is effected positively by performance feedback for field dependent students as they move from the cognitive modeling strategy training to the didactic strategy training. Conversely, the division skill benefit due to performance feedback decreases from the cognitive

modeling condition to the didactic condition for the field independent students. These results support the research of Blaha (1982) who found children who achieve more in arithmetic concepts tend to be more field independent, and value intrinsic rewards available from reading rather than relying on extrinsic reinforcement from others. The results also confirm Blaha's findings that children who perform better in arithmetic computations tend to be more field independent and have fewer difficulties in reading. The data also supported the findings of Ishmail and Kong (1985); Shade, (1983); Andrews, (1981); and Ruble and Nakamura, (1972). Generally, these researchers have found that field independent students perform best when exposed to teaching modalities which make use of textbooks, handouts, and lectures. They also do not rely heavily on external reinforcers. The current results support these findings in that as the field independent student moves from a less conducive teaching modality to a more conducive one they rely less on external feedback. The researchers mentioned above also purport that field dependent students perform better under more interpersonal teaching modalities and external reinforcement. The current findings support these

theories as well, by demonstrating that the division skill benefit due to performance feedback increases from the cognitive modeling condition to the didactic condition for the field dependent students.

Educational Implications and Future Research

The results of this study indicate that self efficacy judgments are enhanced by providing students with performance feedback, regardless of their cognitive style. These results suggest that teachers could use feedback to optimize their students' feelings of self efficacy regardless of the students' cognitive style. While teachers commonly verbalize feedback to children to promote their learning and performance, students need clear information that they are acquiring information and mastering material in order to gain positive self efficacy. The teacher needs to be aware that feedback that points out correct operations and remedies difficult task aspects provides valid capability information to their students.

Educators may also benefit from this study in terms of its support of the conceptual framework of both cognitive style and social interaction theory,

which indicate that we should not focus primarily on the child or the environment, but rather on the interaction effects of the child with their environment.

An enduring concern of educational psychologists and educators in general, is how to assess and optimize children's ability to profit from instruction. Most often we attempt to predict a child's learning potential from isolated measures such as I.Q., achievement test scores, etc. The results of this study indicate that performance feedback takes an overriding precedent in promoting positive self efficacy and reinforcing teaching strategies leading to improved division performance. We have found that when a student is not engaged in a teaching modality which suits their cognitive style they rely more heavily on performance feedback. This study also revealed that teachers may need to combine techniques suited to children's cognitive styles and provide feedback during instruction in an effort to have their students achieve their optimal potential.

Future studies in other domains such as reading performance may be noteworthy to see if different self efficacy strategy training methods are more beneficial

to students of differing cognitive styles, in terms of skill performance and increasing self efficacy. Also studies which provide cognitive modeling of task strategies and positive achievement beliefs may unravel which factors are more salient to the field dependent student.

Finally, an important limitation to this study involves the standardization of GEFT scores for children. The standardizations available are limited in terms of numbers of subjects involved in the samples, there is a dearth of studies attempting to establish reliable norms for children and the homogeneity of samples used. While subjects in the present study were classified field dependent / field independent based on the norms available, it is questionable that the degree of field dependence / independence is strong enough to support the existing literature.

Appendix A
Pretest Problems

Practice - 5 $\overline{)12}$

1. 6 $\overline{)27}$

2. 8 $\overline{)75}$

3. 7 $\overline{)95}$

4. 9 $\overline{)691}$

5. 7 $\overline{)864}$

6. 1,873 $\overline{)791,331}$

7. 8 $\overline{)6,104}$

8. 16 $\overline{)130}$

9. 62 $\overline{)531}$

10. 23 $\overline{)795}$

$$11. \quad 37 \overline{) 2,709}$$

$$12. \quad 2,468 \overline{) 921,221}$$

$$13. \quad 76 \overline{) 9,037}$$

$$14. \quad 42 \overline{) 31,309}$$

$$15. \quad 187 \overline{) 635}$$

$$16. \quad 413 \overline{) 9,670}$$

$$17. \quad 367 \overline{) 86,987}$$

$$18. \quad 3,763 \overline{) 827,659}$$

Appendix B
Posttest Problems

Practice - 5 $\overline{) 12}$

1. 7 $\overline{) 39}$

2. 9 $\overline{) 77}$

3. 6 $\overline{) 110}$

4. 8 $\overline{) 699}$

5. 7 $\overline{) 974}$

6. 1,747 $\overline{) 849,648}$

7. 8 $\overline{) 5,578}$

8. 23 $\overline{) 177}$

9. 72 $\overline{) 606}$

$$10. \quad 19 \overline{) 1,307}$$

$$11. \quad 51 \overline{) 3800}$$

$$12. \quad 2,618 \overline{) 1,036,120}$$

$$13. \quad 64 \overline{) 7,931}$$

$$14. \quad 37 \overline{) 29,408}$$

$$15. \quad 418 \overline{) 1,717}$$

$$16. \quad 236 \overline{) 9,204}$$

$$17. \quad 352 \overline{) 96,909}$$

$$18. \quad 3,847 \overline{) 955,608}$$

Appendix C Efficacy Judgments

Practice -	2	$\overline{9}$	3	$\overline{14}$
1.	8	$\overline{28}$	7	$\overline{34}$
2.	7	$\overline{64}$	9	$\overline{76}$
3.	8	$\overline{91}$	6	$\overline{147}$
4.	7	$\overline{642}$	8	$\overline{781}$
5.	4	$\overline{743}$	7	$\overline{1,841}$
6.	6	$\overline{5,631}$	7	$\overline{6812}$
7.	35	$\overline{170}$	29	$\overline{225}$
8.	78	$\overline{622}$	57	$\overline{481}$
9.	43	$\overline{997}$	35	$\overline{812}$
10.	15	$\overline{1,421}$	42	$\overline{3,810}$

$$11. \quad 21 \overline{) 6,231} \quad 68 \overline{) 7,527}$$

$$12. \quad 66 \overline{) 57,812} \quad 47 \overline{) 41,113}$$

$$13. \quad 212 \overline{) 811} \quad 191 \overline{) 1,382}$$

$$14. \quad 518 \overline{) 6,221} \quad 339 \overline{) 7,887}$$

$$15. \quad 293 \overline{) 41,808} \quad 118 \overline{) 93,876}$$

$$16. \quad 2,893 \overline{) 581.971} \quad 5,607 \overline{) 991,936}$$

Appendix D
Efficacy Judgment Scale

10	20	30	40	50	60	70	80	90	100
Not			Maybe			Pretty		Real	
Sure						Sure		Sure	

Appendix E
Letter Requesting Parental Permission

Half Hollow Hills
Central School District
Of Huntington And Babylon

Dear Parents,

During the next month, a study will be conducted in this school involving arithmetic performance of the fourth and fifth graders. The results of this research will help clarify how students learn under different instructional conditions. This information may be useful for the development of instructional materials, and for motivating children to do their best work.

Each child who participates in the study will be seen individually. The total time required for three learning trials will be 165 minutes.

The findings may be quite important for the children of our district. As a doctoral dissertation project, the performance of groups of children rather

than individuals will be of primary concern. Although the scores of each child will be confidential, information will be shared with parents if requested. Please sign the form below and have your child return it to his or her teacher as soon as possible. If you have any questions, please call me at 351-6638.

Sincerely,

Leslee Nickel

School Psychologist

_____ I give my permission for my child _____
to participate in the study described above.

----- I do not wish my child _____ to
participate in the study described above.

Date

Signature

Appendix F

Efficacy Judgments

This is the last form we're going to fill out today. This is the same form we used in jumping. It goes from "not sure," through "maybe" and "pretty sure," to "real sure." (Point out the scale on the form.) You see there are lots of lines on this page. What I'll do is to show you some cards. Each card will have two problems on it. I'll also read the problems as I show them to you. Now I don't want you to work these problems in your head. What you have to do for each card is to decide whether you think you could work problems like these, that is, problems about as hard or easy as these, and get the right answers. If you don't think you could work problems like those shown, then check the 10 on the line. If you think you could work the problems like those shown and get the right answers, then mark on the line how sure you are that you can get the right answers to problems like those shown. (Explain that if they think they can work the problems like those shown correctly, they should mark a number between 20 and 100, and that the higher the

number they mark, the more sure they are they could correctly work problems like those shown.) I'm only going to show you the cards for a real short time, so you need to pay close attention so you can get a good idea of the type of problems being shown.

Remember you must be honest. Make your marks on the line on how you feel right now; in other words, do you think that you could work problems like those shown if I gave them to you now and get the right answers? Don't think about what you wished you could do, how you think someone else might want you to answer, or what you think you'll be able to do sometime later, like tomorrow or at the end of school in June.

We'll use a new line for every card, so you can just move down the page as we go on. Don't make more than one mark on any line. The first problem is a practice one, so I'll help you to make sure you understand what to do. After that, I'll read and show you the cards, then you make the marks on your own. After you make your mark, please let me know so I can show you the next one.

(Go over the practice problem now. Make sure the children understand they are to move down the page, and they understand the distinctions between the

descriptors. Once you're satisfied, go on.)

Remember, I'm not asking you whether you think you can work these problems, but rather whether you think you can work and get right answers to problems like those shown. So don't try to figure out the answers in your head.

(Go through them fast. Read the 2 problems and show the children the card as you're finishing reading the second problem. The point is to acquaint them with the problem difficulty, not to give them time to solve the problem. About 2 seconds exposure time per card is fine.) When you finish the last rating, thank the children for their help and tell them to return to their classes.

Appendix G

Lesson 1

$$5 \overline{) 187} = ?$$

To work this problem, we first must figure out what numbers to use in the division.

We ask: What number do we divide 5 into?

To do this, we take 187, start at the left, and move to the right, until we find:

a number that is the same as or more than 5.

1 is less than 5, so go on.

18 is more than 5, so we use this.

We next must work the division.

Our problem now is: $5 \overline{) 18}$

We can do this by multiplication (x) if we know our times tables.

If we don't know our times tables, we can use addition (+).

To work $5 \overline{) 18}$ by multiplication (x), we want to know what number times 5 gives a number that is close to and less than or the same as 18.

You know that: $5 \times 1 = 5$ and that $5 \times 10 = 50$
 18 is closer to 5 than to 50, so the answer is closer
 to 1 than to 10.

Try 3: 5

x3

15 Yes, close to and less than 18.

To work $5 \overline{)18}$ by addition (+), since we know that
 the answer is closer to 1 than to 10, we start
with $5 \times 1 = 5$ and add 5 until we have a
number that is close to and less than or the
same as 18.

$5 \times 1 = 5$ No, too small. Go on.

+5

$5 \times 2 = 10$ No, too small. Go on.

+5

$5 \times 3 = 15$ Yes, close to and less than 18.

3

So far, then, we have: $5 \overline{)187}$

-15

3

Since 3 is less than 5, we know that we used the right
 numbers.

We now bring down the 7, and our problem is: $5 \overline{) 37}$.

We can work this by multiplication (x) if we know our times tables.

If we don't know our times tables, we can work this by subtraction (-).

To work $5 \overline{) 37}$ by multiplication (x), we want to know

what number times 5 gives a number that is close to and less than or the same as 37.

You know that: $5 \times 1 = 5$ and that $5 \times 10 = 50$
37 is closer to 50 than to 5, so the answer is closer to 10 than to 1.

Try 8: 5

x8

40 No, too big, but close. Try 7.

5

x7

35 Yes, close to and less than 37.

To work $5 \overline{) 37}$ by subtraction (-), since we know that the answer is closer to 10 than to 1,

we start with $5 \times 10 = 50$ and subtract 5 until we have a number that is close to and less than or the same as 37.

$$5 \times 10 = 50 \quad \text{No, too big. Go on.}$$

$$\underline{-5}$$

$$5 \times 9 = 45 \quad \text{No, too big. Go on.}$$

$$\underline{-5}$$

$$5 \times 8 = 40 \quad \text{No, too big. Go on.}$$

$$\underline{-5}$$

$$5 \times 7 = 35 \quad \text{Yes, close to and less than 37.}$$

We can now finish working the problem:

$$\begin{array}{r} 37 \\ 5 \overline{) 187} \\ \underline{-15} \\ 37 \\ \underline{-35} \\ 2 \end{array}$$

2 is less than 5, so 2 is the remainder.

$$\text{So, } 5 \overline{) 187} = 37 \text{ r } 2$$

Appendix H

Lesson Instructions

As with the pretest instructions, these are not meant to be literal. The main thing is to convey the relevant strategies in accordance with the particular training condition, and to try and "pick up" on where children seem to be at any given moment.

At the start of the lesson, you might say something as follows: Today we're going to work on a division lesson. This is one of many lessons we're giving a lot of children. The first part of this lesson shows how to work division problems. Then after that, you'll have a chance to work some problems in the same way. Remember, the work we do here is not part of your regular class work for (name of teacher). You're not going to get a grade on this, and no one here at school or in your home will see this work. Is this clear?

(Modeling children only) I have some papers that we'll work on. The lesson will go like this. First, I'll show you some papers that have some division problems worked out. We'll look these over, and I'll show you how to work these problems. After this, there

are some problems that you can work the same way. I'll help you if you need it.

(Didactic children only) I have some pages that we'll work on. The lesson will go like this. First, I'll show you some papers which have some division problems worked out. You'll study these for a few minutes. After this, there are some problems that you can work the same way. If you need help working these problems, you can look back at the papers which have the problems worked out.

(Note: At the beginning of the first training session, tell all children the following:) After today, I'll be back once a week for the next two weeks. That means we'll work together for 3 times. I wish we could work together more since I like working with children, but as I said, we're working with a lot of children, and we only have time to work with each child for 3 times. So please don't ask your teacher if we could work together after that. (The purpose of telling children this is so that they don't build up false hopes of working with you the rest of the school year.)

Division Strategy

The basic strategy being presented in all the lessons is a 2-step procedure:

1. Decide what you divide into what, and then
2. Perform the division, using
 - a. Multiplication, if you know your times tables, or else
 - b. Addition or subtraction

In these instructions, I'm going to use the term "divisor," "dividend," and "quotient," but avoid the with the children, since they don't know what they mean, and there's no reason we need to take the time to explain them.

Of course, the divisor is the number we divide into some other number, and the dividend is that other number. Children know (generally) what to do with the divisor, but they have trouble deciding on the dividend. When they see a problem like $7 \overline{)87}$, they may try to work it in one step. Our goal is for children to see that they first divide 7 into 8, and almost every child can do this.

Once children are ready to perform step 2, we take advantage of individual differences and skill levels.

Some children will know their times tables, maybe not right off the top of their heads, but after a moment's reflection. So we try to capitalize on this, since in the final analysis, this is the way we work division problems. However, if they cannot multiply (and this is something you need to find out soon, and it won't be much problem to discover), then they can use addition or subtraction. Regardless of which process children use, we first get them to estimate the answer. To do this, they write down the divisor $\times 1$ and the divisor $\times 10$, compare the dividend to these two products and see which it is closer to. This helps them in estimating the number to multiply the divisor by if using multiplication. If they're using addition or subtraction, the rule is to subtract divisor from divisor $\times 10$ if dividend is closer to divisor $\times 10$ than to divisor $\times 1$, and add divisor to divisor $\times 1$ if dividend is closer to divisor $\times 1$ than to divisor $\times 10$.

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