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THE INFLUENCE OF INSTRUCTIONAL CONDITIONS ON STUDENT LEARNING AND ACHIEVEMENT

Joanne Anania

Saint Xavier College, 3700 West 103rd Street, Chicago, Illinois 60655, U.S.A.

CONTENTS

CHAPTER 1

THE PURPOSE OF THE STUDY

Most of what is known about the effects of instruction on the cognitive and affective learning of *individuals* has been gained from research on students receiving conventional group instruction. Group-based instruction is an economic necessity for any society attempting to educate a large segment of its population. However, it is not an appropriate context in which to determine the full extent of what individual students are *capable* of learning. As Bloom (1976) has noted, "We can only determine the full limits of what the student can and will learn when we have provided qualities of instruction which are optimal for the individual learner". Conventional group instruction cannot provide optimal qualities of instruction for all members of the group because of individual differences in students' cognitive and affective entry characteristics. Conventional instruction is not designed to alter these entry characteristics in ways which could enable most of the students to attain high levels of achievement and positive affect toward learning. Also, teachers are rarely able to provide optimal learning conditions for all the students in a classroom.

The study presented here examines the degree to which the learning outcomes students attain are a function of the quality of the instruction they receive. The cognitive and affective learning of students was investigated under three different quality of instruction conditions: conventional group instruction, mastery learning, and tutoring. The study also examines whether qualities of instruction which are adaptive to individual learning needs alter the relation between initial student characteristics (i.e., aptitude and prior achievement) and the subsequent achievement students attain.

In addition, the study is concerned with the following related issues: (a) Will students who learn under different quality of instruction conditions exhibit differences in the extent to which they actively engage in learning? (b) Are the interests and attitudes which students develop toward learning a reflection of the way they perceive themselves as learners? Can these interests and attitudes be altered by more effective instructional conditions? Each of these questions was explored by examining the learning outcomes and learning processes of students under the three different quality of instruction conditions.

There is abundant evidence that under conventional group instruction the degree of academic success which a student will attain is largely predictable on the basis of personal characteristics and home background. This phenomenon has been well documented in schools around the world (Walker, 1976; Wolf, 1977). The relationship between student characteristics and school achievement has been used to support a variety of positions. The recent report of the Carnegie Council on Children (de Lone, 1979), for example, accepts the relationship as an inevitability of the existing social system in the United States and recommends sweeping changes in social and economic structures. Such political interpretations neglect findings which have shown this phenomenon in countries with extreme philosophical, political, and cultural differences. They also direct attention away from the teaching-learning process by implying that solutions to the inequities in learning outcomes lie outside the domain of schools and educators.

Although educational resources and curricula vary among schools around the world, there is considerable uniformity in the instructional practices of schools. Schools traditionally assign students to groups averaging from 20 to 40 for instruction, and most or all of the instruction received by students during the school term occurs within the group. Schools also designate periods of time for instruction and at the end of the allotted time, test the students to determine their rank on the basis of academic achievement. There is no procedure in this system of instruction for ensuring that students gain the cognitive prerequisites they need to successfully deal with subsequent learning tasks. What results at the end of the instructional period is a normal distribution of achievement, with students' positions within the distribution largely determined by the cognitive and affective characteristics they possessed when they entered the instruction.

Since the effects of prior student characteristics on subsequent achievement are not unique to one social or economic system, it seems essential to examine student achievement under conditions more favorable than what is normally provided before concluding that solutions are beyond the context of schools. Theoretically, instructional processes can be altered to reduce the effects of prior student characteristics on subsequent achievement.

The relationship between achievement and students' prior characteristics might be accepted as inevitable were it not for the accumulating evidence that the relationship is not maintained when instruction is *qualitatively different from* what is available under conventional instruction. The work of Bloom and others with mastery learning strategies has been primarily responsible for redirecting the concern of educational research away from stable student characteristics and toward alterable variables within schools. Bloom (1978) has concluded that the differences we observe in students' learning and school achievement are manmade, rather than innate and that "What any person in the world can learn, almost all persons can learn if provided with appropriate prior and current conditions of learning". This conclusion presupposes the possibility of instructional conditions under which almost all students would achieve equally high levels of learning, regardless of variations in the prior characteristics of the students.

Mastery learning studies have already established instructional conditions that enable 80% of the students to attain the same criterion for receiving a grade of A, a level achieved by only 20% of the students who receive conventional

instruction. It seems essential now to explore the upper boundaries of Bloom's (1976) theory. Theoretically, 95% of the student population should attain the highest levels of learning when the instructional environment approximates a maximal condition for learning. Bloom qualifies the applicability of the theory by noting that 2 - 3% of the school population may have extreme physical or emotional problems which limit learning and that an additional 1 - 2% may learn in such extremely capable ways that they, also, should be considered as exceptions to the theory. Before considering the components of a learning environment which would enable 95% to excel, it is important to consider the components of an instructional environment which enables 80% to excel.

Mastery learning strategies enhance conventional instruction. Students, who do not meet the criterion for achievement after the initial group-based instruction, are provided with alternative cues, additional opportunities for reinforcement and participation in learning, and pertinent feedback and correctives. This enhanced group instruction enables most of the students to enter each new phase of study with a mastery of the prerequisites for the new learning task. However, even under these conditions about 20% remain who should have, but did not achieve the highest levels of learning.

In both conventional and mastery learning classes, initial instruction occurs in a group. Regardless of the teacher's skills, the cues and reinforcement supplied during group instruction are directed to some students more than others and are more appropriate for some students than others. In group situations, some students participate more actively than others. Although mastery learning strategies are designed to overcome these problems, there is a delay between initial instruction and the *needed adjustments in cues, reinforcement, and participation and in feedback and correctives*. Since 80% reach mastery levels under these strategies, apparently most students are not adversely affected by the delays, but it is possible that the delays inhibit the learning of approximately 20% of the students. Is it possible that if the delays were eliminated, 95% would reach the highest criterion for achievement?

Tutoring has the potential to provide a maximal learning environment. Unlike group-based conditions, tutoring focuses on the learning needs of an individual during the initial presentation of a task. If the student lacks prerequisite cognitive entry behaviors, the tutor can immediately adjust instruction and assist the student in attaining the needed knowledge and skills before proceeding with the new task. When the student's response indicates misunderstandings or confusion, more appropriate cues and additional practice can be provided at once. An effective tutor also supplies the kinds of reinforcements that are appropriate to the individual and which serve to maintain the individual's active involvement in learning.

The constant interchange between student and tutor assures high levels of participation in learning for the student, and the immediacy of adjustments in the initial instruction constitute an informal system of feedback and correctives not possible under group instruction. When the learning environment described here as a potential of tutoring is further enhanced by periodic formative tests and additional correctives so that the student maintains a consistently high criterion for performance on each learning

task, it is argued that a maximal quality of instruction exists. Under this condition, there should be little relation between the prior characteristics of students and the achievement they attain, and all but the most extreme portions of the student population should attain the highest level of achievement.

If a learning environment can enable 95% of the students to attain the highest achievement, then the responsibility for academic failure can no longer be attributed to stable, unalterable variables. The study presented here attempted to create a maximal learning environment, without regard for existing practices or resources available to schools. The results of this study can serve as a "yardstick" against which the learning outcomes of other, more constrained and practical instructional conditions could be measured.

The central question which the study investigated is: Are the cognitive and affective outcomes students attain a function of the quality of the instruction they are given? An experimental study was undertaken, using two different content areas and three different grade levels, in order to examine this question and the related questions posed previously. The learning outcomes and learning processes of students were examined under the three qualities of instruction which have been discussed: (a) conventional instruction, a minimal quality of instruction, (b) mastery learning, a more favorable quality of instruction, and (c) tutoring, a maximal quality of instruction. Probability was taught to fourth and fifth grade students, and cartography was taught to eight grade students. It was expected that the effects of learning under the different qualities of instruction would be similar in the two content areas as well as in the three grade levels.

The school in which the study was undertaken exemplifies conventional educational practice in United States schools. Class sizes range from 25 to 30 students, and from grade four on, all formal instruction is directed toward the class as a whole. All students in a class are expected to use and learn from the same set of textbooks and instructional materials. Tests are administered at regular intervals in each class for the purpose of measuring student achievement. These practices are consistent with what is normally found in schools throughout the United States.

CHAPTER 2

RESEARCH RELATED TO THE STUDY

The theoretical and empirical literature relevant to the conceptual orientation of the study spans several areas. In the first section of this chapter, definitions of quality of instruction are introduced, and the relation between individual components of quality of instruction and learning outcomes is examined. Studies of time-on-task and the relation between prior student characteristics and achievement are also discussed. The second section examines the uses and effects of tutoring. The final section is concerned with studies of the relation between affect and achievement and the development of perceptio of achievement.

QUALITY OF INSTRUCTION

Carroll (1963) refers to quality of instruction as the most elusive element in his model of school learning. Carroll includes the characteristics of teaching materials in addition to teacher performance in discussing quality of instruction, but he defines the term as a series of instructional behaviors:

> The learner must be told, in words that he can understand, what he is to learn and how he is to learn it. It means that the learner must be put into adequate sensory contact with the material to be learned ... that the various aspects of the learning task must be presented in such an order and with such detail that, as far as possible, every step of the learning is adequately prepared for by a previous step ... that the instruction must be adapted for the special needs and characteristics of the learner, including his stage of learning. (p. 726)

Quality of instruction is concerned with organizing and presenting the learning task so that it can be learned as efficiently as possible, considering the student's ability to understand instruction. In Carroll's view, students who receive a less than optimal quality of instruction are likely to need more time for learning than they would otherwise require.

In contrast to the concept of quality of instruction as consisting primarily of the teacher's instructional behaviors, Bloom (1976) conceives of it as the *interactions* between teacher and student during instruction. This view developed from inferences concerning the quality of instruction available when an excellent tutor instructs a single student. His explanations of the teaching-learning behaviors in tutoring are based on learning theories, most notably the work of Dollard and Miller (1950). Stated briefly, Bloom defines quality of instruction as:

> the *cues* or directions provided to the learner, the *participation* of the learner in learning activity (covert or overt), and the *reinforcement* which the learner secures in some relation to the learning. Because much of school instruction is group instruction and because any attempt at group instruction is fraught with error and difficulty, a *feedback and corrective* system must be also included. (p. 115)

Bloom's inferences about effective tutoring dyads identify the interactions which occur when instruction is geared to the needs of an individual. Tutoring is potentially capable of providing a learning environment which maximizes each component of quality of instruction.

In Bloom's theory of school learning, quality of instruction is one of three major variables which determine learning outcomes and is sufficiently powerful that it is capable of effecting changes in the other two variables, *cognitive entry behavior* and *affective entry characteristics*. The results of mastery learning studies, which will be discussed later in this chapter, reveal that quality of instruction not only affects learning outcomes, but also affects learning processes.

Because the study reported here is concerned with the effects of differing quality of instruction conditions, it is important to examine the relation of each component to learning outcomes. In the following portion, each component is briefly discussed, and the research pertaining to each is summarized. It should be noted that most of the research on components other than feedback-correctives is based on observer codings or ratings of the extent to which the component is present, and that the majority of the studies on components are concerned with the effects on groups of students, rather than on individual learners.

Cues

Carroll's (1963) definition of quality of instruction deals primarily with what Dollard and Miller (1950) term *cues*. Cues refer to communications of what is to be learned and how the learner should proceed. Communication may occur through verbal or non-verbal means and may emanate from either the teacher or the instructional materials. Cues given during group instruction possess different degrees of meaningfulness to individual learners, depending on the individual's prior familiarity with the cues and ability to learn from the cues in the form they are presented. Cues also differ in the extent to which they gain and hold the attention of the learner. According to Dollard and Miller, cues determine when and where an individual responds and which response is made.

Although Bloom's concern is with the salience of cues to individual learners, studies, which share Bloom's definition of cues, examine the relation between the quality of cues and the achievement of groups of students. The results of these studies have been summarized (Bloom, 1976), and the median correlation between quality of cues and final achievement was found to be +.38. The median correlation for quality of cues and achievement gains was +.53. Based on the existing research, quality of cues accounts for about 14% of the variance in achievement of groups of students.

In Nordin's (1979) study, students who received *enhanced* cues attained significantly higher levels of achievement and positive affect toward learning than did students in the control group. Although limited in number and in scope, the research clearly indicates the importance of cues in influencing learning outcomes.

Participation

Individuals differ in their ability to benefit from specific cues, and they also differ in the amount and kind of participation needed to succeed in learning. Participation refers to an active involvement in learning and includes both overt and covert behaviors. Researchers and theorists use a variety of terms to indicate that the learner must be actively engaged in the task before learning can occur. For example, Dollard and Miller (1950) and most S-R theorists label this component *response*. In Carroll's (1963) model, the term most compatible with participation is *perserverance-in-learning*.

Teachers have traditionally used a variety of methods to involve students in learning. They attempt to assure overt and covert participation by posing problems or questions for the class and requesting responses from individual students. Teachers also give assignments which require students to practice some aspect of a task in class and again later as homework. However, it is often difficult for the teacher to provide the right amount and kind of participation each student needs because of the considerable differences in cognitive and affective entry behaviors which exist within most groups of students.

Large variations in percent of time-on-task (TOT), one measure of student participation in learning, have been reported for students in conventional instruction groups, regardless of age, grade level, or subject area. Bennett (1978) reports studies in which the active participation of students within the same classroom ranged from 20 to 100%. Good and Beckerman observed students in conventional conditions and found high-achieving students averaged 76% TOT, in contrast to an average of 64% TOT for low-achieving students. Good and Beckerman conclude that the amount of time a student spends engaged in learning is related to the level of achievement the student has previously attained.

The relation between participation and achievement has been the subject of research for about 50 years, and a variety of methods has been used to measure each of the variables. Hoge and Luce's (1979) review of research from 1965 to 1977 concludes that only a moderate relation exists between

observed task behaviors and achievement. However, others have pointed out that the strength of the relation seems to depend on the length of the study and how time-on-task and achievement are measured. Anderson and Scott (1978) find that longer studies and studies measuring achievement with standardized tests report lower correlations, but shorter studies and studies using domain or criterion referenced tests report higher correlations. O'Brien and Ginsberg (1980) note that higher correlations are more often found when time-on-task is measured as both overt and covert behaviors.

Anderson (1973) compared the involvement in learning of students in mastery learning and conventional classes, using both overt and covert measures of TOT. During the initial learning task, TOT was similar for both mastery and conventional groups (74 and 76%, respectively). However, by the final task, mastery students were on task 83% of the time and control students, only 63%. Anderson reports a correlation of +.75 for active engagement in learning and achievement on the final task. A later study by Hecht (1977) reported similar findings. Both the Anderson and the Hecht studies occurred over relatively brief periods of time, measured TOT as overt and covert behaviors, and measured achievement with criterion-referenced, subject-specific tests.

Bloom (1974) summarized the results of studies comparing time-on-task in mastery learning and control classes. In control groups, students spend about 50% of their time actively learning, but under mastery conditions where approximately 80% of the students attain high levels of achievement TOT increases to about 85%. Block and Burns (1977) suggest that this phenomenon is due to a "homogenizing effect" which mastery learning strategies produce on the time students spend in learning, increasing the level and reducing variability in active involvement in learning.

Harnischfeger and Wiley (1975) contend that the most important determiner of achievement is the level of active learning engaged in by the student. Bloom's position differs. Bloom views active participation in learning as the best *indicator* of the *quality of instruction* students receive. In his framework, the quality of instruction influences the cognitive entry behavior and affective entry characteristics, as well as the extent of active involvement in learning, and these in turn influence the level of achievement the student attains.

Reinforcement

Dollard and Miller (1950) define reinforcement as "Any specified event ... that strengthens the tendency for a response to be repeated" (p. 39). Reinforcement for learning may be provided by a variety of sources (i.e., self, teacher, or significant others) and may assume a variety of modes (i.e., tangible rewards, verbal, approval, or social acceptance by peers). Dunkin and Biddle (1974) report the research indicates that a variety of reinforcements have been found effective in changing or maintaining student behavior. Whatever the source or mode of reinforcement, learning theories generally agree that the learner must be able to secure some reward if the learning is to be successful. What serves as a reward and an effective reinforcement for one student will not necessarily be effective for another.

Bloom (1976) summarized the results of studies concerned with the relation between teacher reinforcement for learning and the final achievement of groups of students. The median correlation was found to be +.26. The median correlation between reinforcement and achievement gains for groups was found to be +.24. From these studies, Bloom estimates that the quality of reinforcement accounts for about 6% of the variation in achievement for groups of students.

Although little is presently known about the effects of reinforcement on the learning of individual students, there is evidence that individuals within a class receive different amounts of positive and negative reinforcement. Brophy and Good (1970) found that teachers praised high-achieving students for their correct responses about 12% of the time, but the correct responses of low-achieving students were praised only 6% of the time. When incorrect responses were given by low-achieving students, they received teacher criticism 18% of the time. However, incorrect responses by high-achieving students were criticized only 6% of the time. These findings indicate that the amount and kind of reinforcement available to learners may depend on the level of achievement they attain.

Feedback and Correctives

Feedback is the information the student receives about the extent of the learning which has occurred up to a particular point in the instruction, and correctives refer to the additional instruction which the student receives on elements of the task which are not yet mastered. Although the term *feedback/correctives* is closely identified with mastery learning strategies, Broudy's (1963) discussion of historic exemplars of teaching method reveals that "practice trials" were incorporated in the various methodologies to allow for the correction of errors in learning prior to a final evaluation. The "practice trials" served much the same function as the formative tests of mastery learning, providing diagnostic feedback to be used as the basis for additional, adjusted instruction. There is a renewed concern evident in the literature on the importance of supplying feedback frequently during instruction (i.e., Kulhavy, 1977) and on the necessity of accompanying the feedback with clear instructions about what the student should do in order to correct insufficient learning (i.e., McKeachie, 1974).

The attention to feedback and correctives may be an outgrowth of the widely disseminated findings of mastery learning studies, where quality of instruction is usually defined as the presence versus the absence of feedback/correctives. In these studies, feedback is operationalized as a series of brief, formative tests administered at appropriate points in a learning unit. Correctives consist of alternative cues, additional time and practice, and reinforcement which is provided in tutorials or small group instruction. Block and Burns' (1977) analysis of 97 studies comparing the achievement of mastery and conventional groups concludes that mastery groups attain higher levels of achievement 89 % of the time and have about 52% less variance in achievement than conventional instruction groups.

Criterion Levels. In mastery learning studies, students in the mastery group are required to maintain an absolute performance level on formative tests and are given the assistance needed to meet the criterion. The maintenance of a high criterion for learning is a means of assuring that

students attain the necessary cognitive entry behaviors for succeeding with the next learning task. Usually, the criterion is set at 80%. Block (1970) attempted to determine whether a single criterion level could maximize both cognitive and affective learning. He found that requiring a 95% criterion on formative tests resulted in the highest level of summative achievement, but it also resulted in a marked decrease in interest and attitude among students. An 85% criterion resulted in lower levels of summative achievement, but the highest level of positive affect. In concluding that no one criterion maximized both kinds of learning, Block recommended using an 85% criterion. However, it is possible that cognitive and affective learning could be maximized at a higher level if the quality of the instruction students received during their initial instruction were enhanced and feedback/correctives were available.

Enhanced Components. As previously noted, most mastery learning studies define quality of instruction in terms of the absence or presence of feedback/correctives and do not attempt to enhance the other components of quality of instruction during the initial instruction. Enhancement of cues, participation, and reinforcement is expected to occur during the corrective process as students are given adjusted, more appropriate cues, additional opportunities to participate, and more pertinent reinforcements.

Nordin's (1979) study was the first attempt to examine and compare the effects of enhancing components during the initial, group instruction. Nordin studied achievement, time-on-task, and affect under each of the following four conditions: cue enhancement, participation enhancement, cue and participation enhancement, and feedback/correctives. He found that enhancing any of the components, either singly or in conjunction with another component, or providing feedback/correctives resulted in significantly higher levels of summative achievement, total time-on-task, and positive affect than occurs for students receiving conventional instruction.

Quality of Instruction and Prior Characteristics

Under conventional learning conditions, intelligence and aptitude scores have been found to be highly predictive of achievement, with correlations between intelligence and achievement or between aptitude and achievement ranging from about +.50 to +.70 (Bloom, 1980; Thorndike and Hagen, 1961).

Nordin (1979) found that the relation between intelligence and summative achievement was less strong for each of his experimental groups than for the control, but it was significantly different from the control only for the feedback/corrective group. The correlation between intelligence and summative achievement was +.35 for the feedback/corrective group, in comparison to +.67 for the control.

The student's prior achievement in a subject has long been recognized as a strong predictor of the subsequent achievement the student will attain. Bloom's (1976) summary of longitudinal studies reveals a correlation between achievement at grade 3 and achievement at grade 12 of about +.70. Achievement during adjacent years of school is correlated about +.90. Aiken (1970, 1976) summarized studies of achievement in mathematics and found that prior

achievement in high school mathematics is the strongest predictor of achievement in college mathematics.

Froemel (1980) investigated the relation between subsequent achievement and different kinds of cognitive entry behaviors, including intelligence and prior achievement. Froemel found an average correlation between intelligence and achievement of +.45 for students receiving conventional instruction. This relation remained unchanged during the six month period of his study. However, for students receiving mastery learning, the initial correlation of +.46 between intelligence and achievement decreased to +.21, and finally to +.11 during the course of the study. Froemel also reports that the average correlation between prior achievement and subsequent achievement during the third month and the sixth month remained at about +.75 for the conventional instruction groups. However, the average correlation between prior achievement and subsequent achievement for mastery learning groups was +.39 during the third month, and it decreased to +.21 during the sixth month. The most important finding of this study is that the relation between prior student characteristics and achievement is sharply reduced when students receive the more favorable quality of instruction provided by mastery learning.

In the past, the strong correlation between intelligence and achievement and between prior and subsequent achievement have been interpreted as evidence that some students are capable of learning well while others are not. The increasing evidence from mastery learning studies indicates that providing feedback/correctives results in a diminishing of the effects of intelligence and prior achievement on subsequent achievement. The literature on individual components of quality of instruction demonstrates that each component accounts in some measure for the variation found in achievement for groups of students. Bloom (1976) finds that at least 20% of the variation in student achievement can be accounted for by the qualities of cues, participation and reinforcement; 25% of the variation can be accounted for when feedback/correctives are provided. He estimates that at least one-fourth of the variance in student achievement can be accounted for by quality of instruction.

Until the present study, the limits of the effects of quality of instruction remained theoretical because no research had studied learning outcomes or learning processes when all components of quality of instruction are adapted to the needs of individuals. The study reported here attempted to provide individual students with a quality of instruction which approximated a maximal learning condition for each and to determine the effects of learning under optimal conditions on achievement and learning processes. The extent to which a maximal quality of instruction affects the relation between prior student characteristics and learning outcomes was also investigated.

TUTORING

Examples of the uses of tutoring can be found in circumstances as diverse as the training of an Olympic athlete, the instruction which a seasoned factory worker gives a new co-worker about operating a piece of complex machinery, the meetings between a dissertation chairman and a doctoral student and the

historic relationship of a journeyman to an apprentice. In the larger society, tutoring is often used when a high level of learning or performance is desired. For example, opera singers maintain voice coaches (i.e., *tutors*) throughout their careers.

Unlike the larger society, schools use tutoring almost exclusively for remediation. Most studies of tutoring compare the effects on reading or math achievement of supplementing classroom instruction with remedial tutoring versus classroom instruction, only (e.g. Ellson, Harris and Barber, 1968). In these studies, the actual effects of tutoring are difficult to determine because the tutoring expands the instructional time available to one group of students, confounding tutoring with time for learning (Devin-Sheehan, Feldman and Allen, 1976). There are also studies in which individual or small group tutorials periodically replace regular classroom instruction (e.g., Bernstein, 1979). While the instructional time available to the tutoring group is not expanded in these studies, the tutoring is usually intended to remediate some aspects of the tutees' reading performance.

Studies, which are obstensibly focused on the relation between tutoring and student achievement, are often concerned more directly with a comparison of teaching methods. An extreme example of this kind of comparison can be found in Scudder's (1979) study of two intact programs for teaching English as a foreign language. In one program, students received group instruction from trained, experienced teachers who used a diagnostic/prescriptive approach. In the other, students received individual tutorials from paraprofessionals who were not trained and did not use a diagnostic/prescriptive approach. Although Scudder views the results as indicating that diagnostic/prescriptive group instruction is more effective than individual tutoring, what the results seem to indicate is the importance of training teachers to diagnose student learning and to adapt instruction to the needs of individuals.

Although few experimental studies of tutoring were found to be related to the concerns of the research reported here, two studies are of particular interest (i.e., Bausell, Moody and Walzl, 1972; Klosterman, 1970). Unlike the majority of tutoring studies, subjects in the Klosterman and Bausell *et al.* studies were randomly assigned to experimental and control groups and were not preselected because of academic, social, or physical problems. In both studies, the tutoring is non-remedial and is used as a *substitute* for group instruction, rather than a supplement to it. Both studies also control for the total instructional time students in experimental and control groups receive.

Bausell, Moody and Walzl studied whether tutoring results in higher achievement than classroom instruction. The tutees were fourth and fifth grade students. College education majors served as classroom teachers and as tutors. The college students were not instructed in methods or techniques for teaching the unit. Each taught the unit to a classroom of elementary students, and also individually tutored a different group of elementary students. The tutoring group scored significantly higher at the .05 level on a test measuring achievement of the objectives than did the control.

The significantly higher level of achievement attained by the tutored group is especially interesting in view of the brevity of the experiment. The elementary students received only 30 minutes total instructional time before being tested. Unfortunately, the study did not attempt to identify the teaching behaviors or interactions in the tutoring dyads which might explain the success of tutoring. As the researchers point out, the study was designed to "definitively" demonstrate the superiority of tutoring, not to explain the phenomenon.

Klosterman (1970) also used college students as tutors for elementary students. The tutors were enrolled in a reading methods course and given training in using a diagnostically structured reading program before the study began. At the conclusion of the six-month long study, the elementary students who received either individual or small group tutoring scored significantly higher at the .05 level than did students in the control groups. There were no significant differences in achievement between students who were tutored individually and the students tutored in small groups.

Klosterman, like Bausell *et al.*, did not monitor or examine the teaching-learning interactions of the tutoring groups. However, the differences between the tutored groups and the control groups suggest that the higher levels of achievement exhibited by the tutored students result from the diagnostically structured approach they were given. That is, the study does not provide evidence that tutoring *per se* enables students to attain greater achievement, but rather that the emphasis in the tutoring groups on diagnosis and adaptation of instruction to the learning needs of individuals provided the experimental groups with a feedback/corrective procedure which was absent from the control. A similar reservation was forwarded earlier about Scudder's (1979) conclusions.

Tutoring and Class Size

Tutoring essentially reduces class size, in most instances to a pupil-teacher ratio of 1:1. The same generally insignificant and mixed findings which occur in the literature on tutoring prevail in the literature on class size. However, recent investigations, which include the analysis of data from previously untapped sources (Walberg and Rasher, 1974) and the re-analysis of existing data on class size (Lindsey, 1974; Glass and Smith, 1979) report more consistent evidence of the effects of class size on achievement than had been previously recognized.

Walberg and Rasher (1974) examined the relation between Selective Service tests scores of United States males during 1969-1970 and specific educational resources, among them pupil-teacher ratio. They report that lower pupil-teacher ratios are significantly related at the .01 level to lower rates of failure on the tests.

Lindsey (1974) reanalyzed data from the IEA mathematics study (Husén, 1967) and found there were no instances in which the highest levels of mean achievement were associated with larger class sizes. According to Lindsey's analysis, as class size increases in United States schools, there is a distinct drop in achievement for all except those receiving the largest number of hours of instruction in mathematics.

Glass and Smith's (1979) meta-analysis of data from studies conducted between 1900 and 1979 is probably the most ambitious, and also controversial, work on class size. Their analysis indicates that a sharp increase in achievement level occurs in class sizes of five or less. Elsewhere, Glass (1979) states that a *typical student* taught in a class of 30 - 40 students will score at the fiftieth percentile on an achievement test, but if the class size is reduced to 15 the student scores at the sixtieth percentile. He further proposes that the student would score in the seventy-fifth percentile if class size were decreased to five and in the eightieth percentile if taught individually. Although Simpson (1980) criticizes Glass and Smith's conclusions, he suggests that an analysis of a few of the well-controlled studies they used would support a more general conclusion - that is, students taught in groups less than 10 attain higher achievement than do students taught in groups larger than 20.

Although Glass and Smith's conclusions will doubtlessly continue to be disputed, their findings, considered along with those of Walberg and Rasher (1974), Lindsey (1974), and the tutoring study by Bausell *et al.* (1972), reveal an unmistakable trend - smaller class sizes are related to higher achievement. Unfortunately, studies of tutoring and class size provide, at best, limited information about the quality of instruction student receive. Shapson *et al.* (1980) report their study of class sizes ranging from 16 to 37 found there were "virtually no changes in methods of instruction" related to class size. Even in the class size of 16, instruction was geared almost entirely to the group, rather than to individuals.

The few studies which have used tutoring as a substitute for group instruction have shown significantly higher achievement for the tutored students in comparison with the group instructed students. In general, smaller teacher-pupil ratios are associated with higher levels of student achievement. Although Klosterman's (1970) use of on-going diagnosis in the tutoring groups *may* be comparable to the feedback/corrective component discussed earlier, no studies surveyed used the systematic feedback/correctives and criterion levels found in mastery learning studies. There were also no studies which attempt to enhance other components of quality of instruction, or even to observe the quality of the instruction provided in tutoring or class sizes of five or less.

In the research reported here, tutoring was used to provide a maximal quality of instruction for individual students. Feedback/correctives were systematically provided, and an attempt was made to enhance each of the other components of quality of instruction. The tutorials were monitored in an effort to assure that a maximal quality of instruction was maintained throughout the studies.

AFFECT AND ACHIEVEMENT

This section is concerned with the relation between achievement and two dimensions of affect-attitude and interest. Most studies do not attempt to establish causality, but rather to determine the strength of the association between measures of achievement and measures of affect.

Generally, studies which report that achievement can be predicted from measures of affect have examined the relation for older students and concentrate on interest and achievement for a specific subject area (e.g., Lehrer and Hieronymus, 1977; Gilkey, 1978). An alternative explanation for the predictive relation will be discussed further on.

A wide variety of approaches has been used to measure both general school and subject-specific affect. Studies which measure affect as an overall satisfaction with school tend to report the relation between affect and achievement is statistically insignificant (Jackson, 1968). Studies using a subject-specific rather than a global measure of affect tend to report stronger relations (e.g., Neale, 1969), although not always (e.g., Gable, Roberts, and Owne, 1977). In some instances only one dimension of affect is found to be significantly related to achievement. The IEA study of mathematics achievement (Husén, 1967) found that the correlations between *interest* and achievement were positive and statistically significant at each level of instruction. Correlations between *attitude* and achievement, although positive, were small and statistically insignificant.

Bloom's (1976) summary of IEA and other studies examining the relation between subject-specific affect and achievement reveals that correlations between the two variables are lowest during the early elementary school years and highest during the later years of junior and senior high school. The correlations generally range from .20 to .40, indicating that affect toward a subject may account for 4 - 17% of the variation in achievement. While the studies do not indicate direction of causality, they do provide evidence that students' affect and achievement become more closely related as students progress through school.

Quality of Instruction and Affect

During the past decade a number of studies have examined the relation between affect and achievement under the higher quality of instruction provided by mastery learning and under conventional instruction. These studies have been summarized by Bloom (1976) and by Block and Burns (1977). Bloom notes that when the content taught during the studies is relatively unrelated to the previous learning of the students the median correlation between interest at the beginning of a series of learning tasks and summative achievement is about .06, but the correlation between interest measured at the completion of a series of learning tasks and summative achievement is about .31. This is a large increase in the relation between affect and achievement, considering that the studies occurred over relatively brief periods of from one week to three months. In discussing how these changes in the relation could occur, Bloom points out that the median correlation for interest at the beginning of a task and achievement at the completion of the task is .30 and that the median correlation between achievement at the completion of a task and interest in the subsequent task is also .30. These correlations are very different from the .06 found for initial interest and summative achievement, but basically the same as the correlation for final interest and summative achievement. The findings suggest that prior achievement influences affect, an opposing conclusion about the direction of causality proposed by Lehrer and Hieronymus (1977) and Gilkey (1978), who contend that affect influences achievement.

The mastery learning studies included in the Bloom (1976) and Block and Burns (1977) summaries enhanced the quality of instruction students received by providing feedback/correctives. Both summaries report that students receiving feedback/correctives exhibit higher levels of positive affect than is found for students in conventional instruction.

Nordin (1979) found that students in each of the experimental treatments, which enhanced the quality of instruction, exhibited significantly higher levels of positive affect than the control on all three affective measures used in the study. At the completion of the first learning task, the difference in measured affect between control and the *enhanced cue* and *feedback/corrective* groups was significant at the .001 level. This level of significance was maintained on each of the remaining affective measures. The difference between control and the *enhanced participation* and *enhanced cue + participation* groups was significant at the .05 level on the first affective measure; however, the difference was significant at the .001 level for successive affective measures.

The results of mastery learning studies (i.e., Arlin, 1973; Anderson, 1973; Block, 1970) and of Nordin's (1979) study indicate that the quality of instruction students receive influences the affect they develop toward learning. There are, however, no studies which examine the development of affect when all components of quality of instruction are maximal.

Perception of Achievement

One explanation for the lack of consistency in the findings of most studies of the relation between affect and achievement may be that there is an additional variable which is not usually accounted for in the studies. Bloom (1971) posits a causal relationship between the student's perception of the adequacy or inadequacy of the achievement which has been attained for a specific learning task and the affect the student develops toward that task. He reasons that as students receive accumulating evidence of their success in learning a task they develop more positive attitudes toward the task and greater interest in pursuing similar tasks. The effects of an accumulation of unsuccessful learning experiences would result in the opposite effect. Kifer's (1973) research on the affective characteristics of students who have consistent patterns of high academic success or low academic success provides strong evidence that affective characteristics develop as a *response* to an accumulated history of success or failure in learning.

Although Uguroglu and Walberg's (1979) synthesis of correlations for motivation and achievement is not concerned with determining causality, it does report a higher correlation for self-concept and achievement than for the other types of motivation measures included in their summary. Uguroglu and Walberg used correlations compiled by Bloom (1976) and correlations from studies cited over a three year period (1974-1976) in *Psychological Abstracts International* and *Reading Research Quarterly* annual summaries. They found a mean correlation of .41 for the 76 correlations reported for achievement and academic self-concept. Correlation between achievement and other measures of motivation ranged from .29 for general self-concept to .32 for locus of control.

Uguroglu and Walberg's synthesis does not distinguish between studies which measure achievement as standardized test scores, grade point average, or as scores on general, verbal, or non-verbal ability tests, when reporting the mean correlation for academic self-concept and achievement. Such a distinction would have been valuable. Several studies have shown that students' perceptions of their achievement are significantly related to the grades they receive from teachers. Malpass (1953) found a significant relation between students' comments about their own school work and end-of-semester grades given by teachers. Torshen (1969) found that student achievement, as measured by the grades they received during the marking period immediately preceding the onset of the study, and their academic self-concept were correlated at .46, a .01 level of significance. Kifer (1973) reports that the correlation between academic self-concept and teacher grades for fifth grade students was .23 and for seventh grade students, .50. Like Kifer, Uguroglu and Walberg also found stronger correlations between measures of motivation and achievement for students in higher grade levels.

Most studies of affect and achievement use standardized achievement test scores in examining the relation between the two variables. Bloom (1977) argues that students do not view their achievement in terms of standardized test scores or in terms of any absolute norm, but rather from comparisons with the achievement of others in their immediate learning environment.

> Subject-related affect is ... largely a perceptual phenomenon based on the way in which students classify learning tasks and based on the judgments they make of the adequacy of their performance relative to the other students in the school or class they attend. (Bloom, 1977, p. 195)

Support for this view of the evolvement of perception of achievement is provided from an unexpected source, a reanalysis of the data from a study by Brookover *et al.* (1976) on the relation between self-concept of academic ability and achievement. Brookover *et al.* found that self-concept of academic ability and grade point average were closely related and that a change in one was accompanied by a change in the other. This was interpreted as evidence of the effects of self-concept of academic ability on achievement. Recently, Calsyn and Kenny (1977) reanalyzed Brookover's data and found higher correlations between achievement on the *first* measure and self-concept on the *second* than were found for self-concept on the *first* measure and achievement on the *second* measure. Calsyn and Kenny conclude that academic achievement influences self-concept of ability and perceived evaluation of ability by others. Scheirer and Kratu's (1979) review of the literature on self-concept and achievement reaches a similar conclusion. These reviewers point to the "overwhelmingly negative evidence" that self-concept determines achievement and suggest that a more likely explanation is that self-concept is an outcome of achievement.

The literature reveals that students learning under different quality of instruction conditions develop correspondingly different affect toward learning. Students receiving a more favorable quality of instruction (i.e., mastery learning strategies) develop more positive interest and attitude toward learning than occurs when students receive conventional instruction.

The literature also suggests that students' perceptions of their achievement influence their subsequent affect.

However, the literature does not provide information about the extent to which affect is influenced by a combination of the student's achievement and perception of achievement. Nor does the literature provide information about the development of interest, attitude or perception of achievement when students receive a maximal quality of instruction. The research reported here investigated these issues.

CHAPTER 3

THE THEORETICAL MODEL AND THE DESIGN OF THE STUDY

The chapter is divided into several major sections. The first focuses on the model underlying the study and on the interrelationships between the various elements of the model. A discussion of each of the variables of concern in the study follows, with explanations of how each was operationalized. The major questions addressed by the study are then introduced and discussed. The final section describes the design of the study.

MODEL

In the model underlying the study, instruction is viewed as intervening between individual characteristics of students, such as aptitude and prior achievement, and the cognitive and affective outcomes they attain. Instruction is assumed to involve a qualitative continuum which ranges from minimum to maximum, depending on the availability and appropriateness to the individual of cues, reinforcement, participation, and feedback and correctives. A wide variety of instructional conditions lie along this continuum, from instruction which consists primarily of cues directed toward only one group of learners in a classroom to instruction which schematically enhances each of its components to meet the needs of individual learners. Whether the instruction maintains, diminishes, or neutralizes the effects of students' prior characteristics on learning outcomes is dependent on the *quality* of the instruction. The direction of causality hypothesized to exist between components of the model is indicated by arrows (see Fig. 3.1).

Each variable of the model is defined briefly here, with more complete definitions and descriptions of the instruments used in measuring each included in a later section. The variables can be summarized in the following manner:

(1) Aptitude refers to an individual's ability to deal with general and abstract concepts, including the ability to interpret and use verbal and quantitative symbols and identify relationships among them.

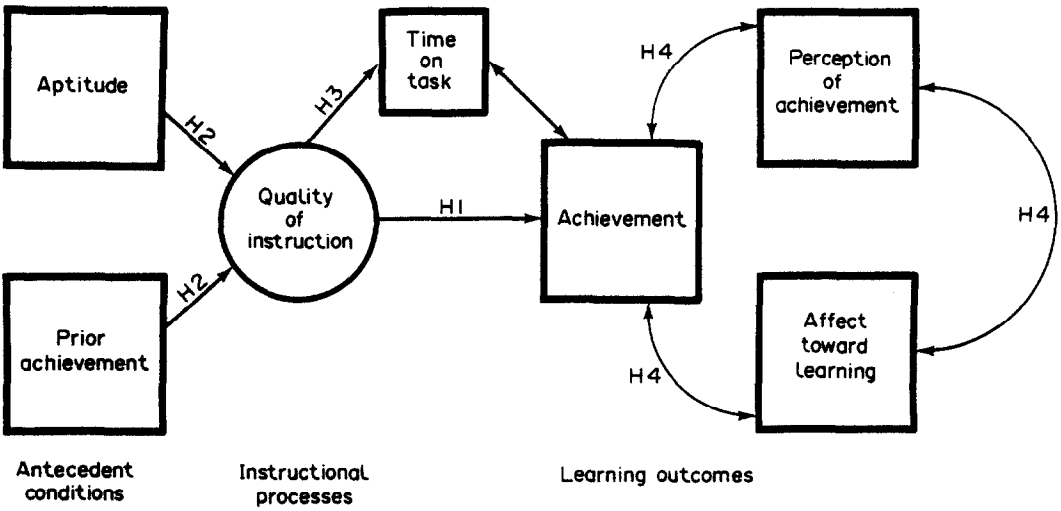

Fig. 3.1. Model of the Effects of Quality of Instruction

(2) Prior achievement refers to the student's history of academic success or failure in the general subject areas taught during the study.

(3) Quality of instruction is the extent to which cues, reinforcement, participation, and feedback/correctives are accessible and appropriate to individuals (Bloom, 1976) and the extent to which students are held to an absolute criterion level on formative tests.

(4) Achievement is the level of learning exhibited by students on formative tests administered at the completion of each learning task and the summative test administered at the completion of the entire learning unit.

(5) Time-on-task is the percent of time the student is observed to be engaged in the learning task and the percent of overt and covert time the student reports being actively engaged in learning.

(6) Perception of achievement is the judgment made by students about the adequacy of the level of learning which they attain.

(7) Affect toward learning refers to attitude and interest. Interest is the extent of the students' willingness to pursue additional learning of the subject matter taught during the learning unit. Attitude is the disposition which students develop toward the subjects.

Discussion of Relationship Specified in the Model

Quality of instruction is the prime variable of the model. Although the model is not limited to specific quality of instruction conditions, the study, which explores the relationships depicted by the model, is concerned with three *qualitative different* instructional conditions: (a) conventional group-based instruction, which typifies a minimal quality and is the most common kind of instruction provided in schools, (b) tutoring, less commonly found in schools, exemplifies a maximal quality, and (c) mastery learning, a quality less than the maximal of tutoring, but considerably higher than the minimal provided by conventional instruction.

When students are given instruction of a minimal quality, the levels of achievement they will reach are predictable on the basis of aptitude and prior achievement because the instruction has no systematic means for correcting errors in learning or for assuring that most students acquire the cognitive entry behaviors they need to benefit from the instruction. There is evidence that teachers in conventional settings direct cues more toward students in the upper achievement range of the class and provide these students with more positive reinforcements and opportunities to participate (Brophy and Good, 1974). The result is that students within the same class may receive different qualities of instruction on the basis of their prior achievement.

A maximal quality of instruction should be adaptive to individual needs. Tutoring, for example, allows a constant readjusting of cues and reinforcement to the needs of the individual. A skillful tutor provides the right amount and kind of practice to insure that the student maintains a high level of participation in learning. In addition to the informal feedback given during the initial instruction as the tutor responds to the student's work, the tutor also provides systematic opportunities for the student to display the level of learning attained and to receive corrective instruction as it is needed. The feedback/corrective process, which is essential to a maximal quality of instruction, enables the student to acquire the cognitive entry behaviors needed to succeed with new learning tasks, despite prior characteristics.

To return to the model and the problem of students with varying prior characteristics, the same individual who is predicted to meet with little success under a minimal quality of instruction is predicted to achieve a high level of learning if given maximal instruction. In a maximal condition, each aspect of the instruction is adapted to the needs of the individual during the initial presentation of the task, and learning is systematically assessed and corrected as needed. These procedures enable the student to enter each successive learning task with an optimal readiness for achieving well.

The arrows connecting quality of instruction, time-on-task, and achievement indicate that both time-on-task and achievement are interactional and both are dependent on the quality of instruction. The mean percentage of time-on-task in a minimal quality of instruction condition is expected to be low, with large disparities between the on-task behaviors of high and low

achieving students. Since this quality of instruction does not incorporate a procedure which enables students to acquire the prerequisite learning they need to succeed with the task, students who do not approach the task having previously acquired the cognitive prerequisites will find themselves increasingly unable to comprehend the instruction and meet with success. The tendency of teachers to direct instruction toward and encourage participation from the high-achieving segments of the class further limits both the desire and ability of the remaining students to spend high levels of time in active engagement in learning.

A maximal quality of instruction takes care to provide that students possess the essential cognitive entry behaviors, which, in turn, enable students to benefit from instruction and participate actively in learning. Corrective procedures make it possible for most to learn as well as the small percent who attain the highest level of learning under minimal conditions. Tutorials, with their concentration on the needs of individuals and reliance on active participation, should affect the student's ability and desire to actively engage in learning. As a result, students under maximal learning conditions should behave as the high-achieving students of conventional instruction and exhibit high levels of time-on-task.

The model also depicts an interactional relationship between achievement, perception of achievement, and attitude and interest. The tendency to develop positive affect toward what one does well and what is prized by the individual and the society is well documented. Academic success, prized by the general society, is accessible to only a few students under conventional instruction conditions, leaving most students to perceive of themselves as less capable of learning and of meeting a criterion for success. Perceptions of inadequacy as a learner lead to apathetic or negative attitudes and interest toward learning, resulting in lower levels of achievement and perception of achievement. However, when the quality of instruction is maximal, almost all students should attain the highest levels of achievement and perceive of themselves as successful, academically capable individuals. This should, in turn, result in more positive attitudes and interest toward learning. It is expected that the interactional relationships which result in low levels of achievement, perception of achievement, and affect toward learning under a minimal quality of instruction will result in high levels of achievement and affect under a maximal quality of instruction.

The cognitive and affective outcomes students attain are expected to change over a series of sequential learning tasks, depending on the quality of instruction available. As students in minimal quality conditions enter successive tasks, their achievement should either remain at a low level or decrease even further, and this should be accompanied by decreasing levels of time-on-task and affective characteristics. Maximal quality conditions should result in high levels of achievement among students. Students learning under this condition should develop increasingly high levels of on-task behaviors and positive affective characteristics as they progress through the learning tasks.

Following the model, students in mastery learning would be expected to exhibit levels of achievement, perception of achievement, time-on-task and affect which are similar to students in conventional conditions for the

first learning task. However, because instruction in the mastery learning classes is periodically individualized through the use of feedback/correctives, it would be expected that these students would attain increasingly higher levels of achievement, positive perception of achievement, time-on-task, and positive affect on successive learning tasks.

VARIABLES

The variables, which were introduced briefly in discussing the implications of the model, and the methods used in measuring them are discussed here in greater detail. As the model indicates, the study is concerned with both stable and alterable variables.

Aptitude

For the purpose of the study, aptitude is defined as an individual's general reasoning ability and ability to deal with abstract concepts. It includes the ability to interpret and use verbal and quantitative symbols and identify relationships among them. Aptitude is viewed as a stable characteristic of the learner.

The instrument used in measuring aptitude is the Cognitive Abilities Test (CAT), Multilevel, Form 3 (Throndike and Hagen, 1978), which is is administered by the cooperating school's personnel as part of their regular testing program. The CAT is composed of items which measure each of the abilities included in the definition of aptitude used for the study. The CAT provides three separate batteries: verbal, quantitative, and nonverbal. Each is heavily loaded with a general reasoning factor, and the verbal and quantitative batteries are predictive of academic achievement as measured by the Iowa Test of Basic Skills.

When the academic content taught during the study is mathematics (probability), scores on the quantitative battery are used as the measure of aptitude. The quantitative battery is composed of tests of quantitative relations, number series, and equation building. When the academic content is social studies (cartography), the verbal battery scores are used as the measure of aptitude. The verbal battery is composed of tests of vocabulary, sentence completion, verbal classification, and verbal analogies.

Prior Achievement

Prior achievement refers to the students' academic performance in the general subject areas which incorporate the specific topics taught during the study. Teachers' grades for mathematics or social studies, awarded during the marking period which immediately preceded the study, are used as the measure of prior achievement.

Quality of Instruction

Quality of instruction is the major experimental variable of the study. It is defined as the extent to which cues, reinforcement, participation, and feedback/correctives are accessible and appropriate to individual students (Bloom, 1976) and the extent to which students are held to an absolute criterion level on formative tests. Three qualitatively different instructional conditions are used in the study: (a) conventional, (b) mastery learning, and (c) tutoring. Each is described in the following paragraphs.

(1) Conventional quality of instruction classes are the control groups for the study. Instruction is group-based; however, teachers' cues and positive reinforcements tend to be directed toward the students who are most able to benefit from the instruction, the high-achieving students who comprise the upper third or fourth percent of the class. These students are also provided with greater opportunities to participate in learning than their lower achieving classmates. In conventional instruction, students are tested at the completion of tasks or units to provide a basis for assigning grades, but students proceed to new learning regardless of their test performance. Teaching practices which direct greater attention to the learning of some students than to others and allow students to enter new learning without the necessary cognitive prerequisites are considered to provide a minimal quality of instruction.

(2) Mastery learning classes are an enhanced version of conventional instruction. Although the primary instructional mode is group-based, feedback from diagnostic formative tests provides information about progress in learning to individual students and the teacher. Students who do not initially meet an 80% criterion set for mastery are given additional opportunities to participate in learning and are not introduced to new learning until most acquire the cognitive entry behaviors needed to succeed. Corrective strategies provide students with alternative cues and reinforcements, allowing for a periodic individualization of instruction.

(3) Tutoring approximates a maximal quality of instruction because of its adaptability to the learning needs of individuals. A skillful tutor continually assesses the effectiveness of cues by observing the responses of the student, readjusting and adding cues when the need is indicated, and gauges the amount and kind of practice required to assure maximal participation by the student. Reinforcement is also based on individual need, and the close working relationships which evolve in successful tutorials allow the tutor to identify and supply the forms of reinforcements most effective for the individual. Although the feedback/corrective process occurs informally throughout tutorials as tutors make spontaneous assessments of student learning and adjustments in instruction, good tutors also arrange for more formal evaluations of student learning through formative testing and set standards which the student is required to meet before proceeding to new learning. In the tutorials of the study, students were held to a criterion of 90% accuracy on formative tests.

Quality of instruction is measured by the extent to which each component, included in the definition of the term, is present and by the students' perceptions of the quality of the instruction they receive, as indicated by their responses on questionnaires administered weekly. In addition, the

tutorials were observed, and the extent to which each tutor maintained a maximal quality of instruction was recorded.

Achievement

Achievement is the level of learning exhibited by students on formative and summative tests. For students who are required to maintain an absolute criterion level on formative tests, achievement on formative tests is the number of correct responses on the first form of the test plus the number of correct items on alternative forms administered to students who do not initially meet the criterion set for their group. Achievement was measured at the completion of each learning task by formative tests and at the conclusion of each unit by a summative test.

Formative tests were based on the content and objectives of the learning tasks introduced during each week of the study. The tests serve as diagnostic, progress measures for students in mastery learning and tutoring groups, providing teachers and students with information about the extent of the learning which has occurred and indicating where correctives are needed by individuals. The tests served as weekly quizzes for the conventional groups, and students received information about their scores only, in keeping with conventional practice. Three formative tests were administered during the cartography unit and during the probability unit.

Time-on-Task

Time-on-task is the percent of time the student is observed to be engaged in the learning task and the percent of overt and covert time the student reports being engaged in learning. Time-on-task was measured in two ways: (a) observer ratings, and (b) student self-reports.

Observations were made by persons trained to use a scale developed by Good and Beckerman (1978) for coding student involvement in learning. The categories used in coding students' task behaviors were: *definitely involved; definitely not involved; misbehaving*. If the observer found no behavioral evidence for determining the extent of the student involvement in learning, *can't tell* was coded. The *definitely involved* category was marked when there was behavioral evidence that the student was appropriately engaged in the task and *definitely not involved*, when the behaviors were inappropriate but not disruptive of others. *Misbehaving* was coded only when the student's behavior distracted others from the task. Student self-reports of both overt and covert time-on-task were obtained from pertinent items on questionnaires administered once each week.

Perception of Achievement

Perception of achievement is the subjective judgments made by students about the adequacy of the level of learning they attain. It refers to judgments about their achievement with the subjects taught during the brief, three week period of the study. The judgments are probably based on a

variety of sources, including reactions to scores they receive on formative tests, interpretations of comments by teachers, parents, and peers, and comparisons which students draw between their own level of learning and that of others.

Students' perception of achievement were obtained from their responses to items on questionnaires administered once each week. Items on the questionnaire were adapted from the Brookover Self-Concept of Ability measure and from scales developed for the National Longitudinal Study of Mathematics Achievement. The items require students to rank their achievement in comparison with classmates, to project how their achievement is ranked by others, and to indicate how they feel about overtly participating in class. Students who perceive their achievement as adequate are expected to respond more favorably to opportunities for publicly displaying what they have learned than are students who view their achievement as inadequate.

Affect Toward Learning

Affect toward learning refers to the attitude and interest students develop toward the subjects taught during the study. Interest is the extent of the student's willingness to pursue additional learning of the subject taught during a learning unit. Attitude is the disposition which students develop toward the subject. The definitions for interest and attitude are adapted from Getzels (1969). In the study, an individual should report similar levels of attitude and interest toward the subject being taught because the subject had not been previously studied, and the content was not value laden.

Information about student interest and attitude toward the learning units was obtained from pertinent items on questionnaires. The items were adapted from affective scales developed for the National Longitudinal Study of Mathematics Achievement studies and from scales developed by Dolan (1974). Items dealing with interest ask if the student enjoys the learning task, finds the subject has become a favorite, and wants to learn more about it. Attitude items ask if the student considers the subject useful and important to learn. Attitude and interest were measured once each week.

DIFFERENTIAL EFFECTS OF QUALITY OF INSTRUCTION ON ACHIEVEMENT

The literature provides evidence that higher levels of achievement with less variation in achievement are found when the quality of instruction students receive is improved either by providing feedback/correctives or by enhancing the other components of quality of instruction during the initial group instruction (Bloom, 1976; Block and Burns, 1977; Nordin, 1979). It would follow that the highest levels of achievement and the smallest variation in achievement should occur in a learning environment which enhances all components of quality of instruction for the individual during the initial instruction and provides systematic feedback/correctives. An argument has already been forwarded here that tutoring is capable of providing this kind of maximal quality of instruction.

The study addressed the following question: *Is level and variation in student achievement a function of the quality of instruction given to students?* This is the primary question of the study.

It was expected that the highest levels of achievement and the smallest variation would be found when students receive a maximal quality of instruction, provided by tutoring, and the lowest levels of achievement and largest variation would be found when students receive a minimal quality of instruction, provided by conventional group instruction. Achievement under mastery learning, a quality of instruction between thw two extremes of minimal and maximal, was expected to be significantly higher than the level of achievement for students receiving conventional instruction, but lower than for students receiving tutoring. Tutoring and mastery learning were expected to effect higher levels of achievement with less variation than conventional instruction because they both incorporate procedures for enabling students to enter new learning tasks with high cognitive and affective entry behaviors. Tutoring was expected to result in the highest levels of achievement because it adapts all other components of quality of instruction to individual needs as the task is initially presented.

The hypothesized causal relationship between achievement and quality of instruction was tested by examining the means and standard deviations on formative and summative tests for students learning under the three different conditions. It was expected that the means and standard deviations for formative test achievement would reveal that students in tutoring and mastery learning classes attained increasingly higher levels of achievement on successive tests, with progressively smaller variation than found for conventional groups. It was expected that the means for achievement in conventional conditions on formative tests would either remain at a relatively constant, low level or would decrease on each successive test and that the standard deviation would remain large for achievement on each test.

RELATIONS BETWEEN ANTECEDENT CONDITIONS AND SUBSEQUENT ACHIEVEMENT

Previous research has shown that under conventional instructional conditions aptitude and prior achievement are predictive of subsequent achievement. Research has also shown that under the more favorable quality of instruction provided by mastery learning the effects of aptitude and prior achievement on subsequent achievement are diminished (e.g., Nordin, 1979; Froemel, 1980).

The model posits quality of instruction as intervening between the effects of students' prior characteristics and their subsequent achievement. The study addressed the question *Is the relation between student achievement and prior measures of achievement and aptitude determined by the quality of the instruction given the students?*

When the quality of the instruction is adaptive to the needs of individual learners and students are enabled to acquire the cognitive prerequisites for succeeding with new learning, there should be little relation between aptitude and prior achievement and the achievement the students subsequently attain. However, if the quality of the instruction does not systematically

enable students to gain cognitive prerequisites, aptitude and prior achievement would be expected to exert a strong influence on the subsequent achievement the students are able to attain.

Correlations between prior achievement and achievement on formative and summative tests and between aptitude and achievement on formative and summative tests were examined for students in the different quality of instruction conditions provided by tutoring, mastery learning, and conventional instruction. The lowest correlations were expected for the tutoring group, where instruction was focused on the needs of individuals and feedback/correctives were provided. Correlations for the mastery were also expected to be small because this condition, like tutoring, enables students to enter new learning with prerequisite cognitive behaviors, regardless of prior characteristics. Strong relations between prior characteristics and subsequent achievement were expected for the conventional instruction group. It was expected that the few students who entered the learning with optimal prior characteristics would succeed in learning, but since the majority of students did not possess optimal characteristics, they would have limited success in learning.

The correlations between aptitude and prior achievement and formative test achievement were expected to decrease in both the tutoring and mastery learning conditions as students progressed through the sequence of learning tasks. However, the correlations were expected to remain large and relatively stable for students receiving conventional instruction.

RELATIONS BETWEEN INVOLVEMENT IN LEARNING AND QUALITY OF INSTRUCTION

Studies comparing time-on-task under mastery learning and conventional instruction generally report that students in the more favorable quality of instruction provided by mastery learning exhibit significantly higher levels of task involvement with less variation than is found for students in conventional instruction conditions (Bloom, 1976; Block and Burns, 1977; Anderson, 1973). Nordin (1979) found that enhancing components of quality of instruction during group instruction also results in significantly higher levels of time-on-task than occurs during conventional instruction.

In the absence of studies which examine the extent of students' engagement in learning when they are given a maximal quality of instruction, the following question was posed: *Is level and variation in the percentage of time students are actively engaged in learning a function of the quality of instruction they are given?*

It was expected that the highest levels of time-on-task and the smallest variation would be found when students receive a maximal quality of instruction. This was expected, in part, because the teacher to pupil ratio of tutoring allows for greater interaction between teacher and student. Tutoring also allows the teacher to adapt each component of instruction to the needs of an individual so that the prerequisites for understanding and succeeding with the tasks can be attained by the individual.

It was also expected that students in the two group-based conditions (i.e., conventional and mastery learning) would be fairly similar in time-on-task during the first learning task. However, the mastery learning and conventional instruction groups were expected to become increasingly divergent as the mastery learning group received the feedback/corrective procedures and entered subsequent tasks with the cognitive prerequisites for participating in learning. Mastery groups were expected to show increases in time-on-task as they progressed through the unit, and variations in time-on-task were expected to decrease. However, students in the conventional instruction groups were expected to become less actively involved in learning as they entered subsequent tasks with fewer of the necessary prerequisite learnings. The learning tasks of the units were sequential, and students who did not achieve a high level of learning on one task would have difficulty with the next. The frustrations of attempting to learn without having acquired the necessary prerequisites for learning are likely to lead a large proportion of students to become discouraged and make fewer attempts to learn. This should be reflected in lower levels of time-on-task and increased variation within the conventional instruction groups, as a small percentage of students continue to learn despite the minimal quality of the instruction, and the majority fail because of it.

The means and standard deviations for time-on-task under each condition were examined. Observed time-on-task and self-reports of time-on-task were examined for each learning task to determine whether an association exists between quality of instruction and changes in students' active engagement in learning.

RELATIONS BETWEEN AFFECT, ACHIEVEMENT AND PERCEPTION OF ACHIEVEMENT

Although the literature provides mixed reports on the relation between affect and achievement and offers conflicting hypotheses about the direction of causality between the two, there is a growing body of evidence that affect develops as a response to the students' accumulated experiences of attaining high levels or low levels of achievement. The literature also indicates that students' percentions of their achievement most likely evolve from the achievement they attain, as measured by teachers' grades.

The study addressed the question *Do attitude and interest toward learning develop as a function of the achievement students attain and of their perception of the adequacy of their achievement?* The model depicts the relationships between these variables as complex and interactional.

Following the relationships posited in the model (see Fig. 3.1), a maximal quality of instruction should result in students attaining high levels of achievement, and this should result in high levels of positive perceptions of achievement. The combination of high achievement and positive perception of achievement should effect high levels of positive attitude and interest toward learning. The opposite effects are expected when the quality of instruction is minimal. A minimal quality of instruction should result in low levels of achievement and perception of achievement, and this, in turn, would be expected to result in low levels of attitude and interest in learning.

It was expected that the attitude and interest reported by students in tutoring groups would be higher throughout the study than the attitude and interest of students in mastery learning and conventional groups. Students in tutoring were expected to attain the highest levels of achievement and, therefore, perception of achievement. It was also expected that because mastery learning provides a more favorable quality of instruction than conventional instruction the levels of positive attitude and interest in mastery learning groups would be higher than found for conventional instruction groups.

The multiple correlations between final measures of attitude and interest and achievement and perception of achievement under each quality of instruction condition were examined. The predictiveness of achievement and perception of achievement was explored by examining the regression of attitude and interest on achievement and perception of achievement at the beginning and end of each learning unit.

DESIGN OF THE STUDY

The study conformed to Campbell and Stanley's (1963) criteria for an experimental, posttest-only, control group design. The academic content students were taught during the study had not been previously encountered by them; therefore, pretest measures would have been inappropriate. Students were randomly assigned to control and experimental conditions in an attempt to assure the initial equivalence of the groups. Means and standard deviations for the students' aptitude, as measured by the Cognitive Abilities Test, and prior achievement, as measured by teachers' grades, were examined to determine if random assignment resulted in comparability of the students in each condition.

The study involved students from three different grade levels and two different content areas. Fourth and fifth grade students were taught probability, and eighth grade students were taught cartography. The quality of instruction conditions used were: (a) tutoring, (b) mastery learning, and (c) conventional, which serves as the control. These conditions are described in the previous section. Briefly, tutoring provides students with a maximal quality of instruction and conventional, with a minimal quality. Mastery learning provides a quality between the two extremes.

All students assigned to tutoring conditions were taught by undergraduate education majors enrolled in a private college. Although the original intent was to provide one-on-one tutoring for students assigned to this condition, it was not possible to obtain a sufficient number of tutors for students in the fourth and fifth grades. In the fourth and fifth grades, every tutor was responsible for three students each. However, one-on-one tutoring was provided in the eighth grade.

Subjects

All students participating in the study attended a parochial school located in a middle-income neighborhood on the Southwest side of Chicago. The total population of the school's fourth, fifth, and eighth grades were involved.

The students' mean aptitude scores on the Cognitive Abilities Test (CAT), which the school administers annually at the end of fourth and sixth grade, fall within the range of mean scores reported for the norming sample in the CAT technical manual. The mean score on the quantitative battery for the norming sample is 104.4 with a standard deviation of 18.4 (Thorndike and Hagen, 1974). The mean score for fourth grade students in the studies is 112.90 and for fifth grade students is 111.16. The mean score on the verbal battery for the norming sample of sixth grade students is 125.0 with a standard deviation of 20.0. The mean score for eighth grade students, who were tested during the sixth grade, is 107.86. This mean is within one standard deviation of the norming group mean. Thus, in the author's opinion, these scores indicate that the groups of students participating in the studies are similar in aptitude to the larger student population sampled during the norming of the CAT.

The school has a history of cooperation with college methods courses, and students assigned to tutoring conditions did not appear to view their participation in tutorials as unusual or special. An attempt was made to avoid disruptions in the normal procedures of the school as much as possible, considering the experimental nature of the study.

Academic Content

Probability and cartography were selected as the academic content to be taught during the study because both depend on sequential learning and neither had been previously studied by the students. In addition, the content of probability and cartography could be presented in an intellectually honest way to students in grades four and five or eight and would make positive contributions to the students' educational development.

It was important that students entered the study with no prior experiences of either success or failure in learning the specific content taught during the study. The students, doubtlessly, recognized the connection between the specific subjects taught during the study and more general subject areas. Probability was taught during the period normally reserved for mathematics and cartography, during the social studies period. Also, mastery and conventional groups were taught by teachers who are usually responsible for mathematics and social studies instruction in the school. However, by introducing the content as new and unrelated to the students' previous work and by referring to the learning units as probability and cartography, terms unfamiliar to the students, an attempt was made to diminish the effects of general subject affect.

Materials for teaching probability were adapted from the following sources: *Probability for Intermediate Grades* (School Mathematics Study Group, 1966); *A Study of the Development of a Unit in Probability and Statistics for the Elementary School* (Shepler, 1969); *What Are My Chances, Book A* (Shulte and Choate, 1977). The following sources were used in preparing the cartography unit: *The Rand McNally Handbook of Map and Globe Usage, 4th ed.* (Harris, 1967); *Steps in Map Reading* (Anderzhon, 1970); *Mapping* (Greenhood, 1964). Teachers and tutors were given copies of the unit materials before the study began. The materials included unit objectives and content outlines, suggestions

for teaching strategies, background information for the teachers, copies of the instructional materials and answer sheets. In addition, teachers and tutors were given the same set of pupil practice sheets, manipulatives, and visuals needed for each unit.

Procedure

A schedule of instruction, observations, and testing is provided in Table 3.1. Each learning unit (i.e., probability or cartography) was conducted during a three-week period and incorporated three sequential learning tasks. As Table 3.1 indicates, during the first two weeks, students received four periods of instruction (each lasting 40 minutes) before formative tests were administered. Students in the tutoring and mastery groups, who did not initially meet the criterion set for their respective groups, were given additional help in learning the material sampled by the test items they missed. The additional help was provided by the tutor or by teachers and peers, depending on the condition. An alternative form of the test was administered, and if students still did not meet the criterion, the feedback and corrective process was repeated.

Table 3.1. Schedule of Instruction, Observations, and Testing for Cartography and Probability Studies

	Week 1	Week 2	Week 3
Instruction	4 periods	4 periods	3 periods
Observation of Tutors	2 periods	2 periods	2 periods
TOT Observations of All Groups	3 periods	3 periods	2 periods
Student Questionnaires*	4th period	4th period	3rd period
Formative Tests for All Groups	5th period	5th period	4th period
Feedback/Correctives for Tutoring and Mastery Groups	5th period	5th period	4th period
Summative Tests			5th period

* Student Questionnaires are composed of items from instruments measuring students': (a) perception of quality of instruction, (b) perception of achievement, (c) perception of overt and covert time-on-task, and (d) attitude and interest.

In the third week (see Table 3.1), students received three periods of instruction (40 minutes each) on the final task before the formative test was administered. Again, students in mastery and tutoring groups received correctives as needed to meet the criterion set for their group. Summative achievement tests were administered to all groups on the following day, the final day of the study.

Student questionnaires were administered once each week (see Table 3.1). Items for the questionnaires were taken from instruments for measuring the students' perceptions of achievement, overt and covert time-on-task, and attitude and interest. Items from an instrument for measuring the students' perceptions of quality of instruction were also included on the questionnaire, as part of the effort to monitor the quality of instruction available under the three different conditions. Observations of time-on-task for students in each condition were made three times each week during the first two weeks and twice during the final week. Methods for observing time-on-task and the instruments used in measuring each variable are described in the previous section, which discusses the variables.

Observations of the quality of instruction provided by tutors were made twice each week by the college instructor responsible for training the tutors. The following categories were coded when tutors were observed: (a) arrives on time for the tutorial, (b) has organized materials for instruction, (c) provides a clear explanation of each task, (d) provides additional and altered cues when needed, (e) reinforces correct responses and appropriate behaviors, (f) uses a variety of verbal and nonverbal behaviors to encourage participation.

Instruments for measuring the following variables are provided as appendices: (a) perception of quality of instruction, (b) perception of achievement, (c) perception of overt and covert time-on-task, (d) attitude and interest. The coding sheet for observing tutors is also included.

CHAPTER 4

RESULTS AND INTERPRETATIONS

INITIAL COMPARABILITY OF GROUPS

The study was conducted in a parochial school located in a middle-income neighborhood of Chicago. The school's entire population of fourth, fifth, and eighth grade students were involved. In order to secure comparability, students within each of the grade levels were randomly assigned to tutoring, conventional, or mastery learning conditions. The extent to which random assignment resulted in comparable groups was determined by examining the means and standard deviations for aptitude and prior achievement for the groups at each grade level. In the fourth and fifth grades, where probability was taught, aptitude was operationalized as the students' scores on the quantitative battery of the Cognitive Achievement Test and prior achievement as teacher grades for mathematics. In the eighth grade, where cartography was taught, aptitude was operationalized as students' scores on the verbal battery of the Cognitive Achievement Test and prior achievement as teacher grades for social studies.

Table 4.1 summarizes the means and standard deviations for aptitude and for prior achievement. In all but one instance, random assignment of students to conditions resulted in comparable means and standard deviations in aptitude for the three groups within each grade level. The one exception involves the fifth grade tutoring group, where the mean level of aptitude was three standard errors higher than the mean for the conventional group. However, the mean levels of prior achievement for the fifth grade tutoring and conventional groups were similar. No significant differences at or above the .05 level in means or variation for prior achievement were found between students learning under the different conditions within each grade level.

Table 4.1 provides data for only those students who remained in the study. In the study, there were students who were absent on testing days. Data for these students were not retained in the study. The greatest losses at each grade level were due to absence on the day when the final formative test was administered or absence for the summative test. The smallest loss occurred under tutoring conditions. This is understandable because tutors could arrange to administer tests which had been missed, while such arrangements

TABLE 4.1. Comparison of Aptitude and Prior Achievement

Groups	N		Aptitude	N		Prior Achievement
Fourth Grade						
Tutoring	20	$\bar{x}$	110.45	20	$\bar{x}$	2.45
		s	12.69		s	.69
Mastery	26	$\bar{x}$	114.00	26	$\bar{x}$	2.50
		s	10.08		s	.76
Conventional	24	$\bar{x}$	113.75	24	$\bar{x}$	2.58
		s	12.61		s	.78
Total Fourth	70	$\bar{x}$	112.90	70	$\bar{x}$	2.51
		s	11.69		s	.74
Fifth Grade						
Tutoring	20	$\bar{x}$	116.45*	20	$\bar{x}$	2.75
		s	11.97		s	.72
Mastery	22	$\bar{x}$	109.45	26	$\bar{x}$	2.58
		s	11.77		s	.50
Conventional	28	$\bar{x}$	108.71	28	$\bar{x}$	2.68
		s	13.49		s	.55
Total Fifth	70	$\bar{x}$	111.16	74	$\bar{x}$	2.66
		s	12.82		s	.58
Eighth Grade						
Tutoring	21	$\bar{x}$	107.24	21	$\bar{x}$	2.67
		s	9.06		s	.73
Mastery	28	$\bar{x}$	109.18	28	$\bar{x}$	2.75
		s	11.63		s	.70
Conventional	29	$\bar{x}$	107.03	33	$\bar{x}$	2.58
		s	12.15		s	.71
Total Eighth	78	$\bar{x}$	107.86	82	$\bar{x}$	2.66
		s	11.11		s	.71

*$p < .05$

Comparisons were made between tutoring and conventional groups and between mastery and conventional groups in determining differences in means and standard deviations.

were more difficult in the group-based conditions. All losses which occurred in the fourth and fifth grade tutoring were due to absences on the day of the summative test. In the eighth grade tutoring, three students were lost because of extended absences, but three additional students were lost to the study because their tutors were consistently unprepared to instruct and frequently did not appear for the tutoring sessions. With the exception of five students in the eighth grade mastery group, all losses from mastery conditions were due to absences on testing days. The five eighth grade students were either unable to remain after school for corrective instruction when needed or chose not to participate in the study. Losses in mastery and conventional groups were proportionately equal. No particular pattern emerged which might be used to characterize the students who were absent during the study.

EFFECTS OF QUALITY OF INSTRUCTION ON ACHIEVEMENT

In the earlier discussion of the model underlying these studies, a causal relationship was posited between the quality of instruction students receive and the achievement they attain. Quality of instruction is the extent to which *cues, reinforcement, participation,* and *feedback* and *correctives* are present and appropriate to the needs of individuals (Bloom, 1976) and the extent to which students are held to a high criterion level for achievement on formative tests. Achievement refers to the level of learning exhibited by students on formative and summative tests during a unit of study.

Instruction is viewed as a qualitative continuum, ranging from minimal to maximal. In order for an instructional condition to be classified as maximal, it must adapt cues so they can be understood and used by the individual, provide reinforcements which maintain or increase the individual's desire for further learning, and arrange for the individual to receive the amount and kind of practice needed to succeed in learning. It must also incorporate a means of providing teacher and student with feedback about the level of learning which has been attained and of providing students with corrective instruction as weaknesses or errors in learning are identified so that the student is able to maintain a high level of achievement throughout a series of learning tasks.

Tutoring is probably the best example of a condition *capable* of providing a maximal quality of instruction. When tutoring meets the requirements for classification as a maximal quality of instruction, it is expected that students learning under this condition will attain higher levels of achievement than students under less favorable conditions. It is also expected that the achievement levels of the students will be more similar because they receive instruction adapted to their individual learning needs. When students in tutoring conditions are taught a series of sequential learning tasks, their initial level of learning should be high and, because the quality of instruction should enable them to enter each successive task with prerequisite cognitive entry behaviors, their levels of learning should remain high or increase over the series of learning tasks.

The quality of instruction normally provided in schools is viewed as approximating a minimal quality of instruction, as argued previously in the

first chapter. Much of the instruction provided in schools gives clear cues, frequent reinforcements, and encouragement for participation primarily for the high achieving students. Feedback and corrective components are rarely available. Conventional instruction is not adaptive to individual learning needs and does not attempt to assure that the majority of students attain high levels of learning. There is ample evidence that only a few students reach high levels of learning under conventional conditions and that large variations in achievement exist among the students. Under conventional conditions, the achievement levels of students over a series of sequential tasks would be expected to progressively decrease because the condition has no provision for enabling almost all of the students to attain the entry behaviors they need to succeed with each new task.

Mastery learning is a quality of instruction which lies between the two extremes exemplified by tutoring and conventional instruction. Although students in mastery and conventional conditions receive initial instruction which is essentially the same, mastery students receive periodic feedback and corrective instruction, assuring that they meet a predetermined criterion for learning and enter new tasks with the necessary cognitive entry behaviors. Under mastery learning conditions, students would be expected to attain levels of achievement which are above the levels of conventional groups, but below the levels of tutoring groups. The students should also attain more similar levels of achievement than conventional groups.

In discussing the results of the study, the first question to be addressed is whether the achievement students attain is a function of the quality of instruction they are given. The question of whether variation in students achievement is a function of quality of instruction is also addressed.

Summative Test Results

The highesr mean levels of summative achievement are found for students who received tutoring, the condition used to approximate a maximal quality of instruction for individuals. As Table 4.2 indicates, the summative achievement of tutoring groups is significantly different at the .001 level from the achievement of conventional groups at each grade level. The achievement levels attained by tutoring groups are an average of 32% higher than for conventional groups.

Levels of summative achievement are also higher for the mastery learning groups than for the conventional instruction groups, by about 17%, and as shown on Table 4.2, the differences in summative achievement for mastery and conventional groups are significant in each grade level. The summative achievement for fifth and eighth grade mastery groups is significantly different at the .001 level from conventional groups, and in the fourth grade, the achievement of the mastery learning groups is significantly different at the .05 level from the achievement of the conventional group's achievement.

TABLE 4.2. Comparison of Means and Standard Deviations for Formative and Summative Achievement

Group		FT 1A	FT 1B	FT 2A	FT 2B	FT 3A	FT 3B	Summative
Fourth Grade								
Tutoring	$\bar{x}$	77.75	94.75	68.50***	93.75	57.14***	89.64	78.21***
(N=20)	s	17.73	5.25	20.40	6.04	20.34	13.80	13.75
Mastery	$\bar{x}$	78.46	88.46	53.85**	80.19	40.93	64.29	58.52*
(N=26)	s	14.95	7.97	21.51	9.64	15.06	14.57	17.41
Conventional	$\bar{x}$	72.08		38.33		37.80		48.07
(N=24)	s	15.53		20.14		13.73		17.05
Fifth Grade								
Tutoring	$\bar{x}$	94.00***	95.50	80.50***	92.75	54.29***	93.93	84.82***
(N=20)	s	9.95*	4.56	16.30	5.50	13.19	9.35	11.87
Mastery	$\bar{x}$	80.00	90.19	62.12	83.65	45.88	75.00	72.80***
(N=26)	s	13.78	10.72	19.40	6.86	16.68	12.00	14.47
Conventional	$\bar{x}$	80.00		51.96		36.22		52.55
(N=28)	s	15.09		18.02		13.87		15.64
Eighth Grade								
Tutoring	$\bar{x}$	80.95***	95.48	75.87***	97.78	80.32***	98.10	81.14***
(N=21)	s	12.91	4.45	16.53	3.85	12.38	3.09	10.37*
Mastery	$\bar{x}$	64.82*	81.61	72.14***	88.81	72.62***	91.43	67.14***
(N=28)	s	18.48	10.37	17.78	8.52	19.06	8.09	17.87
Conventional	$\bar{x}$	54.39		43.23		42.22		49.21
(N=33)	s	18.40		15.82		18.23		16.36

Comparisons were made between tutoring and conventional and between mastery and conventional in determining differences in means and standard deviations.

*p <.05
**p <.01
***p <.001

Earlier, Bloom (1976) estimated that at least one-fourth of the variance in student achievement could be accounted for by quality of instruction. When the data from the studies presented here are analyzed using multiple regression procedures (stepwise inclusion), quality of instruction accounts for 36% of the variance in summative achievement for the fourth grade, 48% of the variance for the fifth grade, and 41% for the eighth grade. These results indicate that the achievement students attain is strongly affected by the quality of instruction they receive.

Within the different instructional conditions, the least variation in summative achievement is found among students in tutoring groups. Variance within tutoring groups is an average of about 46% less than the variance found for conventional groups. The most dramatic difference occurs in the eighth grade, where the variance for the tutoring group is less than one-half the size of the variance found for the conventional group.

In the fifth grade, variance found among mastery students is smaller than for the students receiving conventional instruction, by about 14%. However, variation in achievement is not consistently smaller for mastery than for conventional groups. In the fourth and eighth grades, variance in achievement is slightly larger for mastery than for conventional groups. Although the corrective strategies were effective in increasing the level of achievement for the eighth grade mastery group, it is possible that the instruction was not sufficiently adaptive to enable all of the students to retain and apply the learning acquired during corrective sessions to the problems posed on the summative test. The larger variation which occurs for the fourth grade mastery group is probably due to insufficient corrective instruction following the third learning task. As Table 4.2 indicates, the corrective instruction the fourth grade mastery students received did not enable the majority of the students to reach an 80% mastery criterion on FT 3B, and many students left the third task with low levels of learning and inadequate preparation for the problems posed on the summative test. However, with the exception of variation within the fourth and eighth grade mastery groups, achievement on the summative test provides the predicted pattern of higher levels and smaller variations for students who received instruction adapted to their learning needs.

The cumulative effects of providing students with a learning condition which approximates the maximal quality of instruction for individual learning needs is graphically illustrated by Fig. 4.1. In the study, more than 90% of the students in tutoring groups meet or exceed achievement levels reached by only the top 20% of the students in conventional conditions. Fig. 4.1 also illustrates the differences in achievement distributions between students in mastery and conventional conditions. An average of nearly 70% of the students in mastery conditions met or exceeded the levels of achievement attained by only 20% of the highest scoring students in conventional conditions.

While the considerable differences in the distribution of achievement between tutoring and conventional groups can be attributed to the extreme differences in the quality of instruction available in the two learning conditions, the differences in the summative achievement of mastery and conventional groups are due to the addition of only one component to a group-based instructional

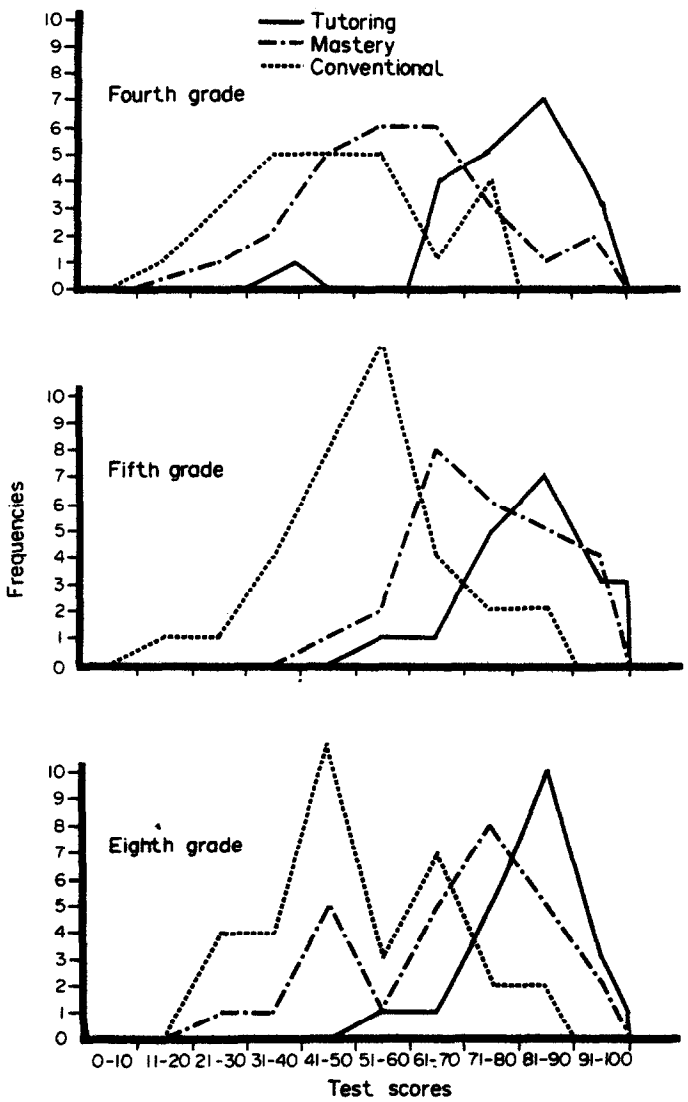

Fig. 4.1. Summative Achievement Distributions

condition - the feedback/corrective strategies. In contrast to the constant adaption of instruction which occurred in the tutoring groups, in mastery and conventional groups there was no emphasis on adjusting either teaching behaviors or instructional materials to the needs and interests of each student during the initial presentation of a learning task. The amount of attention to individual needs which is possible in tutoring is not possible in group-based conditions. Students in mastery and conventional instruction received the same explanations and worked with the same materials during the initial presentation of the tasks, regardless of the extent of their success in comprehending the instruction. In addition, the reinforcements provided in conventional and mastery groups were generally directed to the group, rather than to individuals.

However, in the mastery condition, group instruction was periodically supplemented with individualized instruction. At the completion of each learning task, students who did not meet the 80% criterion for learning, which was required for the mastery condition, received additional, corrective instruction on the specific elements of the task which were not learned well during the initial instruction. This corrective instruction was provided primarily by volunteers from among the undergraduate education majors working with the tutoring group. With the one exception noted earlier concerning the use of correctives with the fourth grade mastery group following the third task, the corrective instruction enabled students to attain high levels of learning over each of the tasks of the learning units and to approach new tasks with the cognitive prerequisites for comprehending the instruction. The availability of the feedback/corrective component to mastery students accounts for levels of summative achievement consistently higher than the conventional groups. The role of feedback/correctives in providing tutoring and mastery students with a higher quality of instruction becomes more apparent in examining the changes which occurred in achievement between students in different learning conditions over the series of tasks for each learning unit.

Achievement on the First Learning Task

The mean levels of achievement for students receiving tutoring are an average of 15% higher than the means for conventional group students on the first formative test (FT 1A), despite a procedural problem which curtailed the amount of instructional time available to the fourth grade tutoring group during the first learning task. The greatest difference in mean achievement for tutoring and conventional groups occurs in the eighth grade, where the mean for the tutoring group is about 27% higher than the mean for the conventional group.

In the fourth and fifth grades, tutors were responsible for the instruction of three students each, and it is likely that they had to devote some time to differentiating the learning needs of each student during the first task before they could begin providing an optimal learning environment for every individual. In the eighth grade, tutors were responsible for a single student and so it would be expected that their focus on the learning of just the one individual would result in their being able to adjust instruction to individual needs more rapidly.

The quality of instruction provided to students in mastery and conventional groups was essentially the same during the first learning task, and theoretically, the mean levels of achievement for these groups should have been very similar. In the fifth grade, the mean achievement for mastery and conventional groups were exactly the same (e.g., 80%). However, the levels of achievement for fourth and eighth grade mastery students were an average of 8% higher than the conventional groups. It is possible that mastery group students, who were informed that they would be receiving assistance in meeting a criterion of 80% correct on formative tests, were slightly more motivated to attend to the initial instruction for the first learning task. This could account for the minor differences in level of achievement found on FT 1A.

Achievement After Corrective Instruction. In tutoring and mastery groups, the results of the first formative test were used to identify areas of weakness and errors in learning. Corrective instruction was then provided on an individual basis, and an alternate version (FT 1B) of the original test was administered to determine if students met the achievement after corrective instruction increased to an average of about 95% in the tutoring groups and about 87% in the mastery groups, assuring that students in these groups entered the second learning task with the cognitive entry behaviors they needed to benefit from the instruction. As Table 4.2 indicates, variation in achievement after corrective instruction is very small for both tutoring and mastery groups.

Achievement on the Second Learning Task

On the second learning task, the differences in the achievement levels attained by tutoring and conventional groups increase further. The mean achievement for tutoring groups on the second formative test (FT 2A) is an average of 30% higher than for conventional groups. The disparity between the quality of instruction available to tutoring and conventional groups during the presentation of a task would account for the groups' different levels of achievement. However, the disparity in initial instruction is not in itself sufficient to explain why the average spread between the achievement levels of the groups should double on the second task from 15 to 30%.

Although the average distance between the levels of achievement for tutoring and conventional groups on the first learning task was only 15%, it increased to an average of 26% after the tutoring groups received corrective instruction on the first learning task (see Fig. 4.2). The extent to which the tutoring and conventional groups have acquired the prerequisite learning for succeeding with the second task is reflected in the widening gap between the achievement of the groups on the second formative test.

Achievement for mastery groups was also higher on the second learning task than for conventional groups. The mean achievement for mastery groups is an average of 18% higher than for conventional groups on the second formative test (FT 2A). Corrective instruction following the first formative test resulted in the mastery groups attaining mean levels of achievement on the alternate test (FT 1B) which averaged about 18% higher than the levels for

conventional groups - the same distance which appears between the means for the two learning conditions on the second formative test.

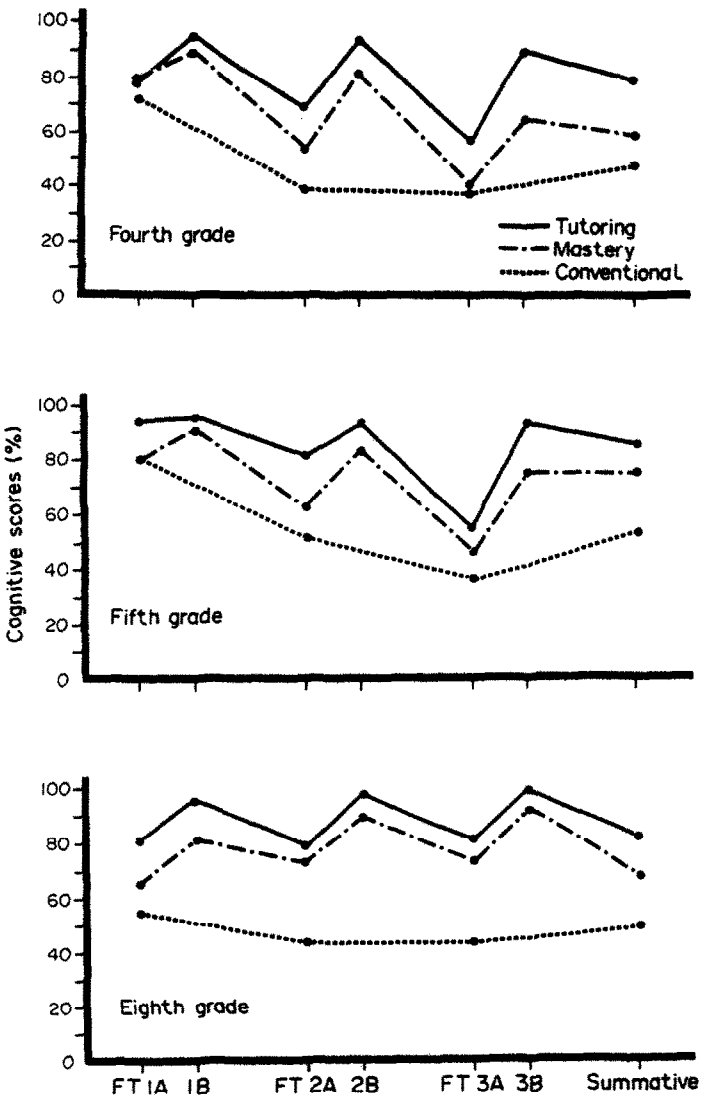

Fig. 4.2. Changes in Achievement Over Learning Tasks

Corrective Instruction on the Second Task. The initially higher levels of achievement attained by tutoring and mastery students on the second task increased through the use of corrective instruction. The scores of tutoring and mastery students on the alternate form of the second test (FT 2B) indicate that the corrective instruction enabled tutoring groups to attain mean levels of achievement which average about 50% higher than the means for conventional groups and enabled mastery groups to gain achievement levels which average about 40% higher than conventional groups.

Achievement on the Third Learning Task

In the fourth and fifth grades, the third learning task of the probability unit was especially difficult, and the mean achievement for all groups is low. However, the pattern of higher levels of achievement for tutoring and mastery groups remains evident, and the mean achievement for fourth and fifth grade tutoring groups is an average of 19% higher than for conventional groups, while the mean achievement for mastery groups is an average of 6% higher. The eighth grade, where cartography was taught, provides the kinds of expanding distances expected between the tutoring, mastery, and conventional groups. The mean for the tutoring group is 38% higher than the mean for the conventional group and the mean for the mastery group is 30% higher.

As expected, the conventional groups show a steady decrease in level of achievement over the series of learning tasks, and the means for these groups on the third task average only about 39%. Students in conventional groups, without access to corrective instruction, found themselves entering progressively more difficult tasks with fewer and fewer of the prerequisite learnings for comprehending the instruction. In each of the learning units, success in the learning the final task depended heavily on having acquired a high level of learning during the previous tasks.

Corrective Instruction on the Third Task. After corrective instruction, the levels of achievement for tutoring groups were an average of 55% higher than for conventional groups, and the levels for mastery groups were an average of 38% higher than for conventional groups. The corrective instruction provided in tutoring groups was effective in assisting almost all students to meet or exceed the 90% criterion. Corrective procedures were also effective with the fifth and eight grade mastery groups. However, insufficient corrective help was given in the fourth grade mastery group, and only 15% of the students met the 80% criterion set for this condition. It is likely that had the corrective instruction been further extended the majority of the fourth grade mastery group would also have met the criterion.

Summary

The data support the hypothesis that level and variation in achievement is a function of the quality of instruction students are given. The achievement distributions we are accustomed to finding in schools are a phenomenon of the quality of instruction we traditionally provide - a quality which enables a few students to learn well, but inhibits the learning of many

students. The achievement levels reached by tutoring groups indicate that students who receive instruction which is responsive to their learning needs are capable of attaining the high levels of learning which are normally attained by only a few students under conventional conditions. The data also strongly indicate the importance of a feedback/corrective component in maintaining a high quality of instruction condition and assuring that students attain the prior knowledge and skills required for succeeding with new learning. The only difference between the mastery and conventional conditions was in the provision of feedback/correctives to the mastery groups. However, this single enhancement of the quality of instruction was sufficient to enable students learning under mastery conditions to acquire higher levels of achievement with less variation than were found in conventional groups.

EFFECTS OF QUALITY OF INSTRUCTION ON RELATIONS BETWEEN STUDENTS' COGNITIVE CHARACTERISTICS AND ACHIEVEMENT

In addition to examining the effects of quality of instruction on achievement, the study was also designed to examine the relations which develop between students' characteristics and their subsequent achievement under different conditions. The student characteristics of concern to the study are *prior achievement* and *aptitude*. Teacher grades were used as the measure of prior achievement and scores on selected batteries of the Cognitive Abilities Test as the measure of aptitude.

Strong relations between aptitude and achievement and between prior and subsequent achievement are usually found when students receive conventional group-based instruction. These strong relationships between the characteristics of students and the achievement students attain have often served as the basis for generalizations about *human potential* for learning, although the position taken here is that such findings would be more appropriately used as the basis for statements about the effects of prior characteristcs when students learn under *conventional* conditions. The accumulating evidence from mastery learning studies strongly indicates that the influence of aptitude and prior achievement on subsequent achievement can be diminished by enhancing the quality of instruction the students receive.

In conventional conditions, relations between prior characteristics and achievement are understandably strong because the quality of instruction available to students is not altered to suit the needs of individuals and because there is no systematic means of correcting the errors in learning which frequently occur as students encounter new tasks. Students with high levels of prior achievement or aptitude for school learning would be expected to learn well under conventional conditions, but the majority of students, who possess lower levels of prior achievement or aptitude, would be expected to encounter problems with tasks and to achieve less success in learning.

The second question addressed by the study, *Is the relation between student achievement and prior measures of achievement and aptitude determined by the quality of the instruction given the students?*, is an elaboration of the first question. Theoretically, a quality of instruction which approximates

a maximal learning condition should enable students to attain equally high levels of learning, regardless of their prior characteristics. The argument was forwarded in previous chapters that tutoring is potentially capable of providing a maximal quality of instruction which would enable most individuals to attain high levels of achievement despite variations in such characteristics as prior achievement or aptitude. Weaker relations between prior characteristics and achievement should also occur under mastery conditions, where the instruction is periodically adapted to individual needs and errors in learning are corrected before new tasks are introduced.

Prior Achievement and Summative Achievement

In the tutoring groups, the correlations between prior achievement and summative achievement are weak, averaging only about .08. In contrast, correlations in conventional groups averaged about .50, with the strongest relations occuring in the fourth grade group (r = .75). Correlations in mastery groups are also weaker than in conventional groups. Correlations between prior and summative achievement for mastery groups average about .24, roughly half the average size found in conventional groups. However, in the eighth grade, the correlations for mastery and conventional groups are very similar (see Table 4.3).

TABLE 4.3. Correlations Between Prior Achievement and Subsequent Achievement

Group	N	Prior Achievement and Achievement on Original Formative Tests			Prior Achievement and Achievement on Summative Test
		FT 1	FT 2	FT 3	
Fourth Grade					
Tutoring	20	.26	.31	.11	.14
Mastery	26	.26	.21	.06	.27
Conventional	24	.33	.41	.55	.75
Fifth Grade					
Tutoring	20	.30	.01	-.12	.11
Mastery	26	.29	.14	.33	.10
Conventional	28	.47	.48	.27	.38
Eighth Grade					
Tutoring	21	.11	.32	.45	.00
Mastery	28	.47	.03	.00	.36
Conventional	33	.51	.54	.30	.38

The corrective instruction provided to mastery students after each initial formative test was expected to diminish the relations between prior achievement and summative achievement. This occurred in the fourth and fifth grade groups, where correlations for mastery groups average 38% less than for conventional groups. The corrective strategies were not as effective in diminishing the effects of prior achievement in the eighth grade. It is

likely that the cues used in corrective instruction for the eighth grade mastery students relied too heavily on reading and verbal skills and did not sufficiently adapt the instruction to students who needed other kinds of explanations and practice materials in order to retain and apply the learning acquired during the corrective sessions to the problems presented on the summative test. More adaptive approaches were taken for the fourth and fifth grade mastery students by using visuals and manipulatives.

In general, the study found lower correlations between prior and summative achievement in the conventional conditions than are usually reported. Bloom (1976) examined longitudinal studies and found an average correlation of about .80 between the two variables. Froemel (1980) reports average correlations of .75 for students in conventional instruction at the end of a six-month study. The lower correlations found for conventional groups in the study reported here are probably due to the brief duration of the study (e.g., three weeks) and to the selection of subject matter which would be relatively unrelated to the previous work students had encountered in mathematics or social studies. Neither the probability nor the cartography units would logically follow the work students had completed before the study began. The rationale for selecting unfamiliar topics for the study was discussed in the previous chapter. Briefly, the intent was to reduce as much as possible the effects of students' affective responses to mathematics or social studies.

The differences in the quality of instruction available to students under each learning condition are reflected in the relative strength of the relations between prior and summative achievement which develop for tutoring, mastery, and conventional groups. In conventional groups, where the relations are strong, prior achievement accounts for an average of about 25% of the variance in summative achievement. However, in tutoring groups, the relations are weak, and prior achievement accounts for an average of only 1% of the variance. In mastery groups, an average of about 6% of the variance is due to prior achievement.

Aptitude and Summative Achievement

The relations found between aptitude and summative achievement are weaker in tutoring and mastery groups than in conventional groups. Correlations average about .31 in tutoring and about .37 in mastery conditions. In conventional groups, the correlations average about +.61 (see Table 4.4).

Aptitude usually accounts for about 50% of the variance in summative achievement (Bloom, 1976). It accounts for about 38% of the variance in summative achievement for the conventional groups in the study reported here. Far less of the variance in achievement can be accounted for by aptitude when students received a quality of instruction adaptive to individual learning needs. In tutoring groups an average of about 10% of the variance in summative achievement can be explained by aptitude and in mastery groups, about 15%.

TABLE 4.4. Correlations Between Aptitude and Achievement

Group	N	Aptitude and Achievement on Original Formative Tests			Aptitude and Summative Achievement
		FT 1	FT 2	FT 3	
Fourth Grade					
Tutoring	20	.50	.41	.25	.38
Mastery	26	.27	.09	.23	.44
Conventional	24	.27	.49	.47	.70
Fifth Grade					
Tutoring	20	.51	.32	.20	.37
Mastery	22	-.01	.22	-.06	.30
Conventional	28	.44	.69	.29	.55
Eighth Grade					
Tutoring	21	.40	.28	.19	.17
Mastery	28	.68	.32	.21	.42
Conventional	29	.62	.42	.55	.59

Both the cartography and the probability units placed heavy demands on students' general reasoning abilities and abilities to deal with abstract concepts. In tutoring groups, the demands cound be alleviated during instruction by providing individuals with the kinds of demonstrations and concrete examples which would enable them to grasp the more abstract elements of the learning task, but in conventional and mastery groups, the tasks were presented at a level of difficulty which was not adjusted to individual needs. The explanation for the differences which appear between the correlations in mastery and conventional groups is found in the differences between the quality of instruction available in the two conditions. In conventional groups, each formative test signaled the termination of a learning task. However, in mastery groups, the formative tests served a different purpose and became the basis for providing individualized assistance with specific elements of a task. The corrective instruction, which was provided before new learning was introduced, diminished the relationship between aptitude and summative achievement in the mastery groups.

CHANGES IN THE RELATIONS BETWEEN PRIOR CHARACTERISTICS AND ACHIEVEMENT OVER A SERIES OF LEARNING TASKS

In tutoring and mastery conditions, the relations between students' prior characteristics and their subsequent achievement were expected to decrease over a series of related learning tasks because the instruction available to students in these conditions should enable almost all to succeed with each of the teasks. However, the relations between prior characteristics and subsequent achievement were expected to increase over the series of tasks in conventional groups, where instruction was not responsive to the needs of individuals. The results pertaining to prior achievement and achievement over the series of tasks are discussed first, followed by a discussion of changes in the relations between aptitude and achievement.

Prior Achievement and Achievement Over Learning Tasks

Correlations between prior achievement and achievement on the first learning task are an average of about 21% less for tutoring than for conventional groups (see Fig. 4.3 and Table 4.3). On the second task the differences in

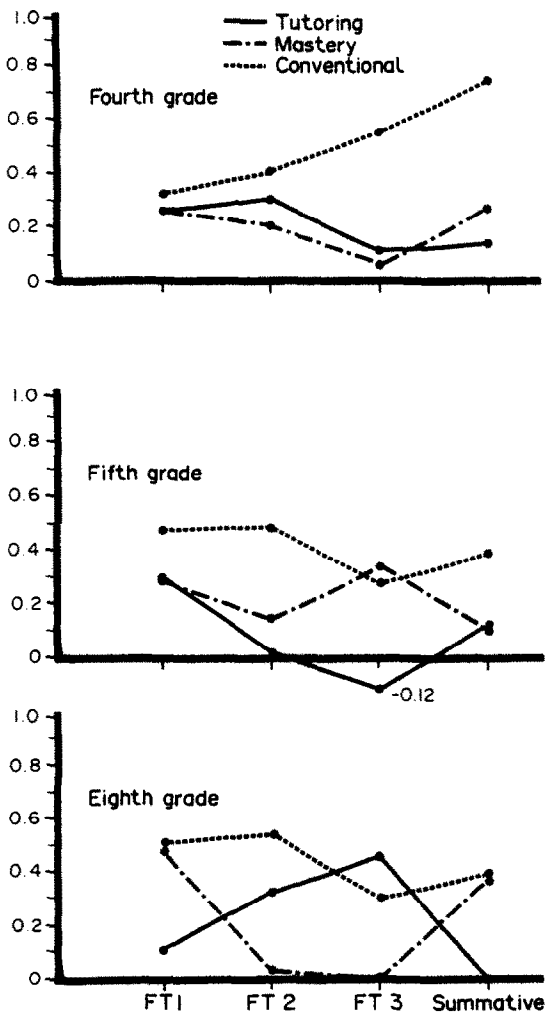

Fig. 4.3. Correlations Between Prior Achievement and Formative and Summative Achievement

the relations which develop between prior achievement and achievement for tutoring and conventional groups increase slightly so that correlations for tutoring groups are an average of 26% less than for the conventional groups. On the third task, correlations for the eighth grade tutoring group deviate from the pattern of weaker correlations, but in the fourth and fifth grades, correlations for tutoring groups continue to be much weaker than for conventional groups.

Some fluctuation in the correlations over the series of learning tasks should be expected. Each learning task was taught during a very brief period of time, and the formative tests were relatively short. However, despite this, a pattern of weaker relations between prior achievement and achievement for tutoring groups over the series of related tasks clearly emerges from the data.

A pattern of weaker correlations for mastery than for conventional groups also emerges over the series of learning tasks. On the first task, correlations are an average of about 10% lower for mastery than for conventional groups. The relations for mastery and conventional groups on the first task were expected to be fairly similar because students in the two conditions received essentially the same quality of instruction before the first formative test was administerd and mastery groups received feedback/ correctives. On the second learning task, correlations are an average of 35% less for mastery groups. Correlations are also considerably weaker for fourth and eighth grade mastery groups on the third task, but slightly stronger for the fifth grade mastery group.

As Fig. 4.3 illustrates, the relation which evolve between prior achievement and achievement over the series of related learning tasks are generally weaker for tutoring and mastery groups than for conventional groups. Despite the brief amount of time allowed for each learning task, differences do appear in the correlations for prior achievement and achievement for students learning under tutoring, mastery, and conventional conditions.

Aptitude and Achievement Over Learning Tasks

Correlations between aptitude and achievement for the tutoring groups progressively decrease over the series of learning tasks so that by the third task the correlations for each tutoring group are only one-half or less the size of the correlations which are found for these groups on the first task. Correlations between aptitude and achievement are an average of .47 for tutoring groups on the first task, but only .21 on the third task. In contrast with the diminishing relations found in tutoring, the correlations for conventional groups are an average of .44 on both the first and third learning tasks (see Fig. 4.4 and Table 4.4).

Although correlations for mastery and conventional groups in the fourth and eighth grade studies are similar on the first learning task, by the third task the correlations for these mastery groups are less than one-half the size of correlations for the conventional groups. In the fifth grade, where the relations between aptitude and achievement are weaker for mastery than for conventional groups on the first task of the series, weaker correlations also appear for the mastery group on the third task.

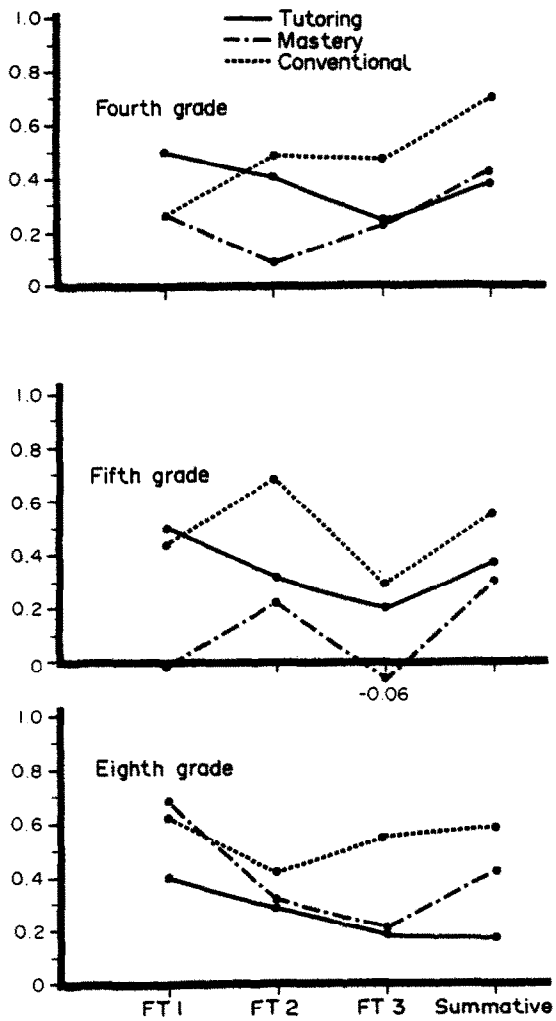

Fig. 4.4. Correlations Between Aptitude and Formative and Summative Achievement

After the first learning task, the relationships between aptitude and achievement are consistently weaker in tutoring and mastery groups than in conventional groups. The differences in correlations between tutoring, mastery, and conventional groups over the series of learning tasks are illustrated on Fig. 4.4.

Summary

The patterns of relations found between prior achievement and summative achievement and between aptitude and summative achievement are consistent. The weakest relations occur when students receive tutoring and the strongest when students learn under conventional conditions. Weaker relatioins between each of the two student characteristics and summative achievement are also found under mastery learning conditions than are found under conventional conditions. When students receive a quality of instruction adapted to individual learning needs, prior achievement and aptitude have little influence on the achievement they are able to attain. However, when the instruction is not responsive to the learning needs of individuals, prior achievement and aptitude exert a strong influence on the achievement students attain.

EFFECTS OF QUALITY OF INSTRUCTION ON ENGAGEMENT IN LEARNING

In discussing the model underlying the study, it was proposed that students' active engagement in learning is influenced by the quality of the instruction they receive. *Engagement in learning* refers to the overt and covert learning behaviors of students during a learning task, including such behaviors as responding to questions posed by the teacher, thinking about possible solutions to a problem, and attending to explanations provided by the instruction. For the study, it was operationalized as students' reports of their overt and covert time-on-task and as observed time-on-task. The study was concerned with whether students who learn under different quality of instruction conditions exhibit differences in the extent to which they actively engage in learning.

Students' reports of their own overt and covert time-on-task were obtained from responses to items taken from an instrument, which included both positive and negative statements about their overt and covert involvement in learning. For example, students were asked to indicate if they had listened carefully to questions posed by the teacher, thought about something other than the subject being taught, completed their assigned work, and responded to a question raised during the class. In addition to the self-reports, observations of time-on-task were made during eight class periods for each quality of instruction condition in each of the grade levels. Observers used a scale developed by Good and Beckerman (1978) for coding students' task behaviors (see Chapter 3).

The literature provides ample evidence that large differences in the extent to which students actively participate in learning occur among students under conventional learning conditions. In general, studies of time-on-task under conventional conditions find higher levels of task involvement for students who are high-achieving than for the students with lower levels of achievement (e.g., Good and Beckerman, 1978). In summarizing the results of time-on-task studies under conventional conditions, O'Brien and Ginsburg (1980) found the median percentage of time-on-task reported by the studies to be about 65%. The variation among students in task involvement and the fairly low median level of time-on-task is understandable because conventional instruction does not incorporate a system for assuring that students acquire the cognitive entry behaviors which will enable them to benefit from further

instruction. Under conventional conditions, few students enter subsequent tasks adequately prepared to participate in the learning activities, while the majority find that they are increasingly unable to comprehend the instruction and that their efforts to participate are not rewarded with a more adequate learning of the tasks. It is unlikely that students who lack the prerequisites for new instruction will continue directing their energies and attention to active engagement in a task which is progressively incomprehensible to them. Both the desire and the ability to become actively involved in learning would be expected to decrease.

Studies comparing time-on-task under mastery learning and conventional conditions indicate that student engagement in learning is affected by the quality of the instruction which is available. Students in mastery conditions are usually reported on-task from 80 to 85% at the end of a series of learning tasks (Bloom, 1976). In these studies, the quality of the instruction given to students in mastery conditions is enhanced by the provision of feedback/corrective strategies which enable almost all students to enter subsequent tasks with the prerequisites for active participation in learning.

In the study reported here, the highest levels and smallest variation in students' engagement in learning were expected for students who received tutoring. The constant interchange which occurs in effective tutorials should enable the tutor to recognize at which points in a task the student is encountering difficulty and to quickly adjust the explanations to the student's need. It should also allow the tutor to closely monitor the amount and kind of practice a student receives, assuring that the student's desire to participate is not diminished by needless practice on what has already been learned. In addition, the reinforcements the student receives for attending to a task should be more effective because they are specific to the individual, rather than generally directed toward a group of students.

In presenting the findings, students' reports of overt and covert time-on-task are discussed first. This is followed by a discussion of observed time-on-task. After examining the levels and variations in time-on-task found between students under different quality of instruction conditions, the changes which occurred within the different conditions are discussed.

COMPARISONS OF STUDENT REPORTS OF TIME-ON-TASK UNDER DIFFERENT QUALITY OF INSTRUCTION CONDITIONS

At the completion of the final learning task, students in tutoring conditions reported significantly higher levels of overt and covert time-on-task than were reported by students under conventional conditions. As indicated in Table 4.5, the differences between tutoring and conventional students in time-on-task were significant at or above the .05 level in each grade level. Students who received tutoring were on-task an average of about 89% of the Instructional time during the final task, but under conventional conditions, students were on-task an average of only about 66%. The higher levels of task involvement in tutoring are accompanied by smaller variations than are found in conventional conditions. Variance for tutoring conditions is an average of almost

TABLE 4.5. Comparisons of Student Reports of Overt and Covert Time-on-Task

Group		Learning Task 1	Learning Task 2	Learning Task 3
Fourth Grade				
Tutoring (N=20)	x	87.50***	89.00*	92.50***
	s	13.10**	7.18**	7.60**
Mastery (N=26)	x	61.53	80.00	75.96
	s	22.50	12.00	21.13
Conventional (N=24)	x	67.37	80.83	68.40
	s	23.30	14.72	23.44
Fifth Grade				
Tutoring (N=20)	x	77.50	87.00**	83.33*
	s	23.12	20.80	17.31*
Mastery (N=26)	x	66.67	58.46	72.12
	s	23.57	27.52	20.94
Conventional (N=28)	x	69.65	70.00	67.86
	s	30.78	19.63	25.23
Eighth Grade				
Tutoring (N=21)	x	93.65***	89.52***	90.48***
	s	12.33**	12.84**	13.77**
Mastery (N=28)	x	58.65	68.89*	73.46*
	s	32.80	23.26	22.18
Conventional (N=33)	x	66.17	58.48	60.86
	s	28.72	24.38	27.13

In the fifth grade study, the mean for the conventional group on the second task was significantly higher at the .05 level than the mean for the mastery group, and the variation for conventional was significantly different from mastery at the .05 level.

* $p < .05$
** $p < .01$
*** $p < .001$

three-fourths less than the variance found for conventional conditions. At the end of the series of learning tasks, students who received instruction which enabled them to comprehend and succeed with the requirements of each task exhibit high levels of time-on-task and appear very similar in the extent of their involvement in learning. Under conventional conditions, levels of time-on-task are much lower, and students vary greatly in the extent of their involvement in learning.

Differences in the mean levels of time-on-task for students under mastery and conventional conditions were also found during the final learning task.

Students under mastery were on-task an average of about 74%, in comparison to the average of 66 % for conventional groups. Variation in time-on-task under mastery conditions was consistently smaller than under conventional conditions. In mastery conditions, variance is an average of one-fourth less than what was found under conventional conditions.

The high levels of time-on-task and small variations under tutoring and mastery conditions were expected. Students in tutoring conditions had immediate access to a teacher whenever they had a question or needed additional assistance. They were able to obtain the help they needed to maintain active involvement in learning during the instructional sessions. Under tutoring, students also received feedback/correctives which assured that they entered each successive task with the understandings and skills essential to comprehending and participating in the lessons. The differences in involvement between mastery and conventional groups can be explained by the availability of feedback/correctives to mastery students. At the completion of each learning task, the learning problems of mastery group students were identified, and students received individual assistance in correcting mistakes in their original learning. As a result of this process, the students in mastery groups entered new tasks with the prerequisites for active and productive involvement in learning.

In addition to the obvious function of the feedback/corrective procedures, that of enabling students to reach high levels of learning before proceeding to new tasks, it is likely that what occurs during the procedure serves to increase student motivation for further engagement in learning. Regardless of how individuals in tutoring or mastery fared during the initial instruction or performed on an initial formative test, the feedback/correctives enabled almost all to obtain *evidence* that they had learned well and were capable of successfully meeting the demands of the task. This evidence was obtained from their achievement on an alternative version of the initial test. As high levels of learning were reached on each task, the student would be expected to develop a more positive concept of ability to learn and stronger motivation for active engagement in further learning.

In contrast with the quality of instruction available to students under tutoring and mastery conditions, students under conventional conditions did not receive instruction which was adaptive to individual learning needs. The majority of the students under conventional conditions had not acquired the kinds of prerequisite learning they needed to comprehend the final task, and this is reflected in the lower levels of time-on-task and larger variations found for these students.

The explanation which has been offered for the differences found in time-on-task between tutoring and conventional and between mastery and conventional has focused on the results at the end of the series of learning tasks. An examination of the task behaviors reported by students under different conditions on the initial task should serve to further support the explanation.

Initial Learning Task

Differences in the mean levels of time-on-task for tutoring and conventional students appeared during the first task. The means for tutoring groups at each grade level were higher than for the conventional groups, and in the fourth and eighth grades the differences were significant at the .001 level (see Table 4.5). The greater initial involvement in learning by students under tutoring can be accounted for by the quality of instruction the students were given. In tutoring, instruction was adapted to the needs of individuals during the initial presentation of the task. This kind of attention to individual learning needs is not possible under conventional conditions. The initial time-on-task under mastery and conventional conditions was similar. Students in the two group-based conditions were expected to have similar levels of on-task behaviors during the initial task because time-on-task was measured before changes were made in the quality of instruction available under the two conditions. The mastery group had not yet received the feedback/correctives.

OBSERVED TIME-ON-TASK UNDER DIFFERENT QUALITY OF INSTRUCTION CONDITIONS

The mean levels of observed time-on-task found for students under all learning conditions were unusually high, particularly in the fourth and fifth grades. During the third learning task, students in tutoring groups were observed to be on-task about 100% of the time, in mastery an average of 91%, and in conventional an average of 79% (see Table A.2 in Appendix A). Very high levels of observed time-on-task were expected for the tutoring conditions. Tutors could respond immediately to any problem an individual encountered in learning and could redirect attention to the task as needed. In the eighth grade tutoring, where each tutor was responsible for only one student, no student was ever coded off-task during the entire study. Considering the student to teacher ratio in the eighth grade tutoring, the observed time-on-task results are understandable.

However, the exceptionally high levels of time-on-task observed in the fourth and fifth grade mastery and conventional conditions raise questions about how accurately the observed behavior represented students' actual engagement in learning. In the fourth and fifth grades, means for time-on-task under mastery were 90% or above and means under conventional conditions were 83% or above throughout the series of learning tasks. Only the results for the eighth grade mastery and conventional groups approximate the levels of time-on-task reported by other studies (e.g., Anderson, 1973; Hecht, 1977).

The study took place in a parochial school where discipline was strictly enforced. Instances of misbehavior or other kinds of observable off-task behaviors were extremely rare. It seems likely that the high levels of observed time-on-task provide an inflated view of students' engagement in learning.

Although observed time-on-task was unusually high, the patterns of mean levels of observed time-on-task under the different learning conditions duplicate the patterns of overt and covert time-on-task which were reported

by the students (see Table 4.5 and Table A.2). The more moderate levels of task behaviors reported by students are believed to offer a more realistic view of the students' engagement in learning, and these reports are used in discussing how students' task behaviors changed within the three different instructional conditions during the study.

CHANGES IN STUDENT REPORTS OF TIME-ON-TASK WITHIN DIFFERENT CONDITIONS

The levels of time-on-task for students under tutoring conditions during the first learning task are high, with the highest mean of about 94% found in the eighth grade tutoring, where students received one-on-one tutoring throughout. Under tutoring, the mean levels of time-on-task either remained at high levels or increased further over the series of learning tasks. Fig. 4.5 illustrates the changes which occurred within each learning condition.

In each of the tutoring conditions, variation in time-on-task among students either remained low throughout, as in the eighth grade, or decreased, as in the fourth and fifth grades. Variance decreased by almost two-thirds in the fourth grade and by more than two-fifths in the fifth grade tutoring condition.

As Fig. 4.5 indicates, mean levels of time-on-task increased from the first to the final task for all mastery groups by an average of about 19%. Variation within mastery conditions decreased from the first to the final task (see Table 4.5). The greatest decrease in variation occurred within the eighth grade mastery condition, where the variance on the final task is one-half less than for the first task.

In the tutoring and mastery conditions, levels of time-on-task increased while variation decreased over the series of learning tasks. Instruction was adapted in ways which enabled students to become successful learners and to develop confidence in their ability to learn. Students responded to the quality of the instruction they received with high levels of active engagement in learning.

During the first learning task, students under conventional conditions were and average of about 68% on-task, slightly higher than the average for mastery students. However, unlike students in mastery conditions, students in conventional conditions did not receive the periodic individualization of instruction which would have enabled the majority of the students to attain prerequisite learnings for the next task as well as increased confidence in their ability to learn. Although time-on-task increased for mastery students from the first to the final task, it decreased under conventional conditions by an average of about 3%. Levels of time-on-task remain comparatively low and variations relatively large from the first to the final task for the conventional groups. As students under conventional conditions progressed through the series of tasks without having attained the necessary cognitive entry behaviors, they became less involved in learning and increasingly dissimilar in their task relevant behaviors.

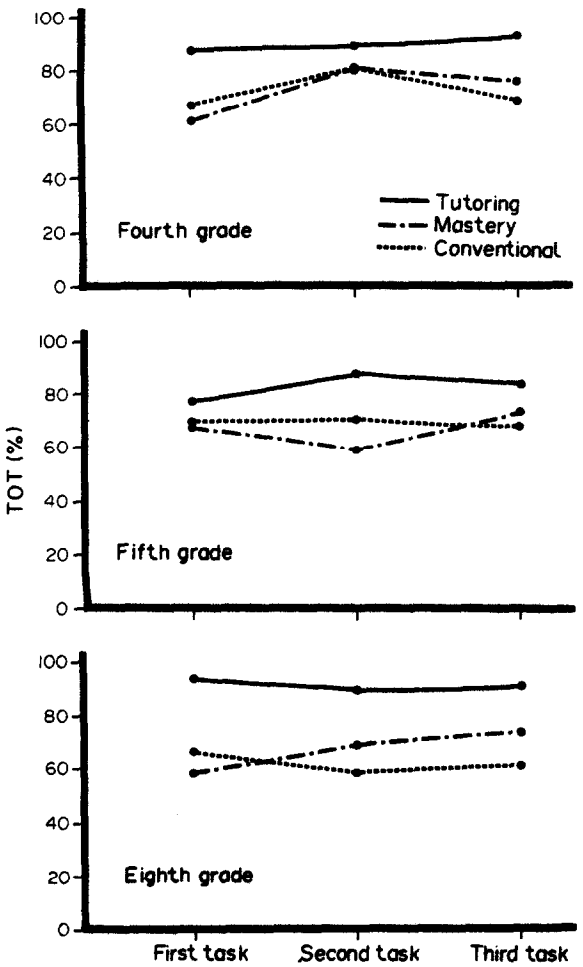

Fig. 4.5. Changes in Student Reports of Time-On-Task Over a Series of Learning Tasks

Summary

The effects of quality of instruction are significant and immediate in the study. The highest levels and smallest variations in time-on-task were found for students who received tutoring, a maximal quality of instruction. The lowest levels and largest variations were found for conventional groups, after the first learning task. Once mastery students begin receiving feedback/correctives, they attain levels and variations in time-on-task which indicate more effective use of learning time than is found in conventional conditions.

Students under the three quality of instruction conditions were initially similar in prior achievement and, with one exception, in aptitude (refer to Table 4.1), but they became very different in the extent of their active engagement in learning during the brief, three-week period of the study. Levels of time-on-task were high throughout for students who received tutoring. Students in tutoring received initial instruction which was adapted to individual needs and feedback/correctives which provided minor adjustments to assure that students attained prerequisite learnings and increased confidence in their ability to learn successfully. The initial instruction students in mastery and conventional conditions received was similar, and the level of engagement in learning for students in these conditions was similar on the first task. However, by the end of the series of tasks, mastery students had higher levels of time-on-task and were more alike in their involvement in learning. Students under conventional conditions were not assisted with individual learning problems, and their levels of task involvement either remained relatively low or decreased further over the series of tasks.

EFFECTS OF ACHIEVEMENT AND PERCEPTION OF ACHIEVEMENT ON ATTITUDE AND INTEREST TOWARD LEARNING

The final problem examined by the study involves the development of subject-specific affect (i.e., attitude and interest) toward learning. Two questions regarding the development of subject-specific affect were posed: Are the interests and attitudes which students develop toward learning a reflection of their achievement and of the way they *perceive* themselves as learners? Can attitudes and interests toward a school subject be altered by more effective instructional conditions?

Correlations between subject-specific affect and achievement generally range from .20 to .40 (Bloom, 1976). Although the literature provides conflicting assertions about the direction of causality between affect and achievement (see Chapter 2), Bloom's summary of fundings from mastery learning studies indicates that correlations between interest in learning a subject at the *beginning* of a series of learning tasks and summative achievement are very weak, a median of .06. In comparison, correlations between achievement at the end of a learning task and interest for the subsequent task reach a median of .30. Also, the interest at the completion of the series of tasks and summative achievement typically reach a correlation of about .30. These comparisons strongly suggest that achievement influences affect, while affect has only a weak effect on subsequent achievement.

The model discussed in Chapter 3 posits students' perceptions of their achievement as an important variable in the relation which develops between affect and achievement. Attitude and interest in learning may in part develop from the objective evidence students receive about the level of success they have attained in learning. However, it is believed that attitude and interest also evolve from the extent to which students *perceive* of their learning as adequate. Bloom (1971) has proposed a causal relation between students' perceptions of the adequacy of their learning of a specific task and the affect they develop toward the task. He also argues that the perceptions are derived from comparisons students make between their own achievment and the achievement of others in their immediate

learning environment. Theoretically, students who are successful with the content and skills of a learning task and who perceive themselves as successful should develop positive attitudes and interest toward the task. Attitude and interest among students who achieve little success with the task and do not perceive their learning as adequate should be relatively low.

Mastery learning studies indicate that when students receive a quality of instruction enabling the majority of students to succeed in learning they develop more positive affect toward learning than is found for the majority of students receiving conventional instruction. In the study here, the highest levels of positive affect toward learning were expected for students in tutoring conditions. *Affect toward learning* refers to whether students think it is important to learn the subjects taught during the study, whether they enjoy learning the subjects and whether or not they want to continue with the learning.

In the study, subject-specific affect and perceptions of achievement were measured during the same instructional period, on the day preceding the administration of a formative test. Affect was operationalized as students' responses to items taken from an instrument which included both positive and negative statements about the subject they were studying. Perception of achievement, which refers to the subjective judgments made by students about the level of learning they attain, was operationalized as students' responses to items taken from an instrument which required students to indicate how well they thought they were learning, to compare their work with the work of their classmates, and to project how their learning was viewed by others. Because of the brevity of the study, the focus in analyzing the data is primarily on data collected during the first and final week.

INITIAL AND FINAL MEASURES OF ACHIEVEMENT, PERCEPTION OF ACHIEVEMENT AND AFFECT TOWARD LEARNING

The initial measure of affect was administered before students had received objective evidence of their achievement. As Table 4.6 reports, the correlations between initial affect and achievement on the first learning task are extremely weak at each grade level. The median correlation is only -.02. However, by the time students responded to the final measure of attitude and interest, they had received information about their level of achievement from the results of formative tests administerd at the completion of the first and second learning tasks. The median correlation between affect at the end of the series of learning tasks and summative achievement is .19. The greatest change occurs in the eighth grade, where the correlation between summative achievement and affect at the end of the series of tasks is .30, considerably stronger than the correlation of .03 found between achievement and affect for the first task.

The initial measure of perceptions of achievement was administered concurrently with the measure of affect. During the first task, the median correlation is .27. However, the median correlation increases to .55 when both perception and affect are measured at the end of the series of learning tasks. The students' initial perceptions of achievement were formed in the absence of any objective evidence of the adequacy of their learning. During

TABLE 4.6. Relations Between Attitude and Interest, Perception of Achievement, and Achievement During The First Learning Task and at The End of a Series of Learning Tasks

Grade Level Groups	Relations During First Task				Relations at End of Series of Tasks			
	Achievement and Affect	Achievement and Perception of Achievement	Perception of Achievement and Affect	Multiple R Affect: Perception of Achievement and Achievement	Summative Achievement and Affect	Summative Achievement and Perception of Achievement	Perception of Achievement and Affect	Multiple R Affect: Perception of Achievement and Summative Achievement
Fourth (N=70)	-.02	.27	.35	.37	.19	.28	.55	.55
Fifth (N=82)	-.07	.28	.26	.30	.07	.22	.25	.25
Eigtht (N=82)	.03	.32	.27	.28	.30	.60	.64	.65
Median	.02	.28	.27	.30	.19	.28	.55	.55

Correlations for the first task are based on measures administered at the end of the first task. Correlations for the end of the series of tasks are based on measures of affect and perception of achievement at the end of the tasks and summative achievement.

the period intervening between their initial reports of perceptions of achievement and their final reports, the students received test results which would be expected to modify the original judgments they had formed about their success in learning. As they received more information about how well they were learning, their perceptions of achievement became more closely related to the kinds of attitude and interest they developed toward the learning.

Support for hypothesizing that affect for learning evolves from achievement and perceptions of achievement is provided by the multiple correlations for the fourth and eighth grades. In the fourth grade, achievement and perception of achievement account for only 14% of the variability in effect during the first task but for 31% of the variability in affect during the final task. The changes which occur in the eighth grade are even more striking. In the eighth grade, achievement and perception of achievement account for only 8% of the variability in affect on the first task but for 42% of the variability in affect on the final task. In the fifth grade, there is little change in the relations between variables over the series of learning tasks.

Effects of Achievement on Perception of Achievement. Theoretically, achievement should influence the students' perceptions of achievement and this should be reflected in increasingly strong correlations between the two variables over a series of learning tasks. The findings of the eighth grade study provide the kind of results which were expected. The correlation for achievement and perception of achievement on the first task is .32, but the correlation is .60 for summative achievement and perception of achievement at the end of the series of tasks. However, in the fourth and fifth grades, the relations between achievement and perception of achievement remained fairly stable over the series of tasks, with achievement accounting for an average of no more than 8 to 6% of the variation in perception of achievement. It is possible that had the study continued for longer than three week the effects of achievement on perception of achievement for fourth and fifth grade students would have been more pronounced.

Predicting Affect for Learning. In this study, the correlations between student perception of achievement and affect toward learning were stronger than the relations between their achievement and the affect they reported. An average of about 26% of the variation in students' affect at the end of the series of learning tasks can be accounted for by their perceptions of their achievement, alone. In comparison, summative achievement accounts for only about 4% of the variation in final affect. The results as summarized on Table 4.6 strongly suggest that once the students' perceptions of their own achievement are known, knowledge of the achievement they actually attained makes little additional contribution to predicting the affect they will profess for learning.

DEVELOPMENT OF AFFECT AMONG STUDENTS IN DIFFERENT QUALITY OF INSTRUCTION CONDITIONS

In introducing the study, a question was raised about whether affect for learning could be altered by more effective instructional conditions. If the quality of instruction students receive alters the achievement they attain, it should follow that the highest levels of perception of achievement and positive affect would be found under conditions which enable almost all students to attain high levels of learning.

As reported in discussing the results pertaining to the first question addressed by the study, the highest levels of summative achievement were attained by students who received tutoring and the next highest by students in mastery conditions (refer to Table 4.3). The mean levels of perception of achievement for students in the three different learning conditions during the initial task, before students had taken the first formative test, and at the end of the series of learning tasks are reported on Table 4.7. The initial perceptions of achievement are very high for all groups, with the lowest level of 77% found in the eighth grade conventional instruction group. The final measure of perception of achievement was administered after students had taken tests over the first and second learning tasks, and as Table 4.7 indicates, the highest levels of perception of achievement at the conclusion of the series of tasks are found in tutoring groups, an average of about 81%. The next highest levels are found under mastery conditions, an average of about 74% and the lowest in conventional conditions, where the average is about 63%. The pattern which emerges for perception of achievement under different learning conditions (see Fig. 4.6) essentially replicates the pattern reported earlier for achievement under different learning conditions (refer back to Fig. 4.2).

If the quality of instruction students receive alters their achievement and perception of achievement, it should also be capable of altering the affect students develop toward learning. Differences should be found in the mean levels of positive affect reported by students who learn under different quality of instruction conditions.

Effects of Quality of Instruction of Affect

The highest levels of positive attitude and interest toward the subjects taught during the study occurred for students receiving tutoring (see Table 4.7 and Fig. 4.6). In each study, the level of affect reported in tutoring conditions increased on the final measure while the variance decreased. Students who received tutoring reported the highest levels of attitude and interest at the end of the series of learning tasks, and they became more alike in the kind of affect they developed toward learning. Table 4.7 provides means and standard deviations for affect at the beginning of the series of learning tasks and at the end. As indicated on Table 4.7, students in tutoring reported significantly higher levels of attitude and interest than did students in conventional conditions.

The results of the eighth grade study provide the strongest support for asserting that quality of instruction is *capable* of altering the affect

TABLE 4.7. Comparison of Affect and of Perception of Achievement at The Beginning and at The End of a Series of Related Learning Tasks

Groups		Initial Perception of Achievement	Final Perception of Achievement	Initial Affect	Final Affect
Fourth Grade					
Tutoring	x	90.00*	81.50**	76.67	82.50*
(N=20)	s	13.20	14.61	23.30	14.85**
Mastery	x	82.69	71.92	73.08	67.79
(N=26)	s	20.33	17.89	29.47	30.04
Conventional	x	81.25	65.83	75.69	68.75
(N=24)	s	18.43	20.41	26.91	31.06
Fifth Grade					
Tutoring	x	96.88**	81.50*	65.83	81.25**
(N=20)	s	7.98**	17.85	33.54	21.27*
Mastery	x	86.06	78.08	57.05	57.21
(N=26)	s	17.08	17.21	35.02	32.82
Conventional	x	85.71	71.79	61.90	59.82
(N=28)	s	19.46	18.87	31.38	31.06
Eighth Grade					
Tutoring	x	94.64***	80.48***	65.87***	80.95***
(N=21)	s	9.33	12.03	34.35	24.88
Mastery	x	89.29**	69.64**	44.64	51.79
(N=28)	s	12.60**	22.36	35.44	38.75
Conventional	x	76.52	52.12	32.83	40.53
(N=33)	s	21.82	24.59	29.01	28.99

Levels of significance are indicated between tutoring and conventional and between mastery and conventional. A one-tailed test was used to determine differences in means, and an F ratio was computed to determine differences in variance.

*p< .05
**p< .01
***p< .001

students develop toward learning. In this study, students in both tutoring and mastery conditions reported more positive affect than did either the conventional group as a whole or the highest-achieving 20% of the conventional students. Fig. 4.7 illustrates the changes in affect which occurred both within and between different quality of instruction conditions from the initial to the final reports made by the students.

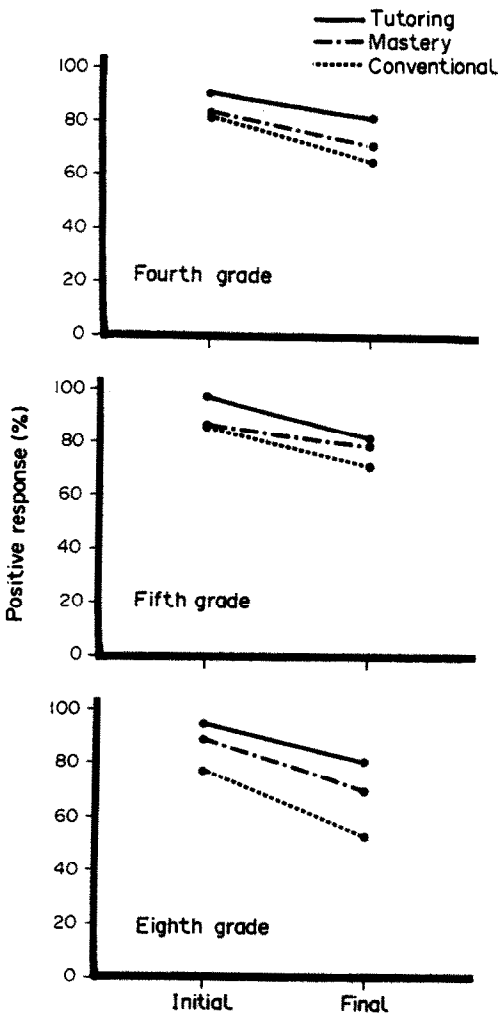

Fig. 4.6. Changes in Perception of Achievement Over a Series of Related Learning Tasks

In the fourth and fifth grade studies, mastery students did not report the levels of positive affect which were expected. In these grades, levels and variation are very similar for mastery and conventional groups (see Table 4.7). It is possible that requiring the fourth and fifth grade mastery students to maintain a criterion of 80% correct placed too much pressure on them. This may explain why they responded with less positive reports of affect than are normally found for mastery students. Block's (1970) work in establishing optimal criterion levels for maintaining positive affect used junior high school students.

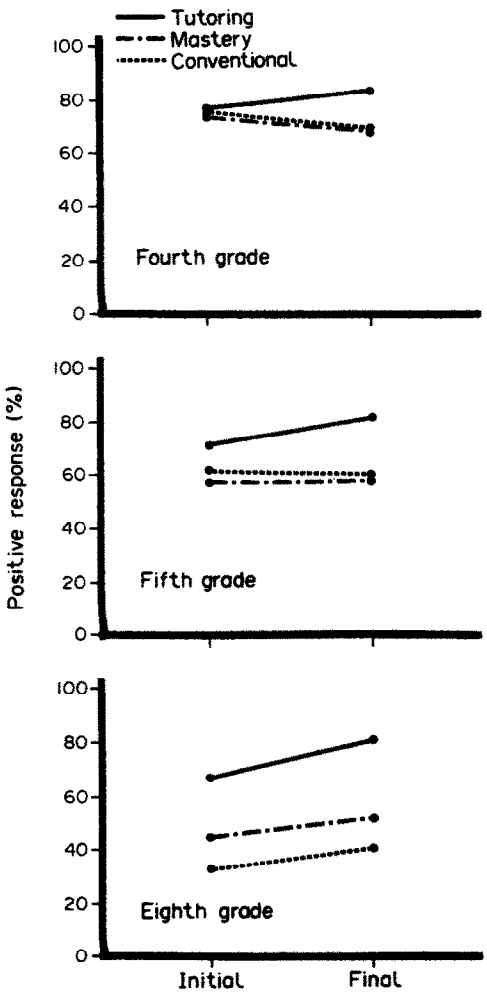

Fig. 4.7. Changes in Affect under Different Quality of Instruction Conditions

Summary

The results of the studies indicate that the affect students develop toward learning emanates from their achievement and their perception of the adequacy of the achievement. The relation between affect and perception of achievement is particularly strong. The results for all tutoring groups and for the eighth grade mastery group also suggest that when the quality of instruction students receive alters their level of achievement, this in turn alters the affect they develop toward learning.

CHAPTER 5

IMPLICATIONS FOR SCHOOLS AND FOR FUTURE RESEARCH

The research findings which have been reported here challenge several widely held assumptions about human potential for learning and about the extent that factors within the domain of schools are capable of influencing the learning processes and learning outcomes of students. In discussing the implications which can be drawn from the study, the issue of human potential for school learning is addressed first. A discussion of the implications for schools and for teacher preparation follows, with suggestions for the kind of research which continues to be needed.

HUMAN POTENTIAL FOR LEARNING

Most of what we know or assume we know about human capacity for school learning is based on studies of learning processes and learning outcomes when students receive conventional, group-based instruction. The results of such studies are quite consistent; a few students learn very well, and a few fail to learn, with most students ranging somewhere between the two extreme levels of learning. Instead of viewing the results as indicating that the learning environments provided by conventional instruction are not particularly favorable for most students or as indicating what can be expected when instruction is not responsive to the learning needs of most students, the patterns of learning and achievement which emerged under conventional instruction conditions formed the basis for a number of untested assumptions about human potential for learning. One of the more widely accepted of these is that a few students are innately more capable of learning what the schools teach than are the majority of the school-age population. This assumption leads to another, which has had a large impact on the way we view and respond to individual students, and that is, the assumption that the distribution of achievement presently found in schools is a natural and inevitable result of individual differences in such factors as home background, socio-economic status, and the cognitive and affective characteristics of the individual learner. In both assumptions, the individual's success in school is predetermined by some variable outside the classroom.

Efforts toward providing universal education give these assumptions a special significance. Unquestioned, they threaten to turn this most democratic of ambitions back on itself. If studies of learning outcomes under conventional instruction conditions continually suggest a scale of abilities and advantages that schools cannot alter, education will eventually become its own worst enemy, arguing through its own statistics for the very limitations and inequalities it had once proposed to eliminate.

The results of the study reported here challenge the assumptions about human potential for learning and the inevitability of finding large variations in the learning outcomes individuals attain in the schools. The patterns of learning and achievement which emerged under the three different quality of instruction conditions provide strong, consistent evidence that the learning outcomes students attain are a function of the quality of the instruction they receive. In the tutoring condition, where the instruction was most adaptive to individual learning needs, almost every student proved to have a very high capacity for learning, as reflected by their achievement. When even one aspect of the quality of instruction was enhanced, which is what occurred in the mastery learning condition through the feedback and corrective strategies, there was an immediate increase in the students' capacities for learning. It was only in the conventional instruction condition that students appeared to have great differences in their capacities for learning, with few students able to attain the highest levels of learning. The implication of these findings is that the inequalities we observe in the learning outcomes students obtain are neither natural nor inevitable; they are, instead, the consequences of providing students with instruction which is not adaptive to the learning needs of individuals.

A great deal of educational thought and planning in the past has been based on the *presumption of a scale of academic potentials* among learners. This scale of potentials has been invoked over several decades of educational research as an explanation of the inequality in learning outcomes found among students and as an explanation of the strong relations found between student characteristics, such as aptitude and prior achievement, and the subsequent achievement they attained. Aptitude and prior achievement suggest purely academic capabilities, but a large number of studies have shown them to be closely related to economic and social factors. As schools have become increasingly involved with students from more varied populations, the range of prior characteristics has become more extreme. Students whose backgrounds and personal characteristics show few of the traits associated with school success seem consigned to failure or marginal achievement, according to much of the research of the past two decades.

If academic potential is largely predetermined by the personal characteristics of the student, enhancements in the quality of instruction given to students would be expected to produce at best only moderate improvements in learning, and strong relations would be expected to remain between the prior characteristics and achievement. However, the results of the study reported here suggest that strong relations between individual characteristics and achievement are largely an unacknowledged by-product of the quality of the instruction we traditionally provide in schools. In the tutoring and mastery learning conditions, the relations are weak, and very little of the variation in achievement for the learning units can be explained by

differences in either prior achievement or aptitude. This is very different from the findings for students in conventional conditions, where the relations between each of the two prior characteristics and subsequent achievement continue to be strong.

One of the major implications which can be drawn from the study is that the extent to which aptitude or prior achievement will influence the achievement students attain is largely determined by a variable which lies within the domain of schools and educators. The quality of instruction available in the school mediates the relationship which evolves between students' prior characteristics and their subsequent learning and achievement.

The results of the study support the theoretical position, argued by Bloom (1976; 1978), that the differences we observe in students' learning and school achievement are *manmade* and *accidental*. This position holds that when learning conditions are favorable for the individual what can be learned by other persons can also be learned by the individual. Bloom qualifies the applicability of the theory by noting that about 5% of the population may prove exceptions either because they learn in extremely capable ways or because they have extreme physical or emotional problems which limit learning. Theoretically 95% of the student population should attain the highest levels of learning when the instructional environment approximates a maximal learning condition.

The theoretical limits proposed by Bloom are very similar to the research findings for students who received tutoring in this study. Individuals possess far greater potential than the majority of them are able to realize because of decisions which have been made about what shall constitute standard school practice.

IMPLICATIONS FOR SCHOOLS

One of the strong implications which emerges from this research is that students, regardless of their prior history as learners, will respond with high levels of task involvement when the instruction they receive enables them to gain the knowledge and skills needed to comprehend and succeed with the learning task. Research has, in general, shown a strong relationship between time-on-task and achievement, and it is often assumed that there is a simple causal link between the two. In the school setting this implied causality confirms a convenient moralism-hard work and diligence bring success; laziness and intractability produce failure. However familiar, these conclusions are problematic. They readily rationalize educational failure with a culturally certified homily.

The findings of the study suggest a different way of thinking about the large variation in task behaviors which are observed in classrooms. While not denying the influence of time-on-task on achievement, the model which underlies this study proposes that time-on-task is causally related to quality of instruction. Student inattentiveness and off-task behaviors may well be signals that the quality of instruction they are receiving is not meeting the learning needs of individuals. Participation or attention in

class sessions may not be an option for the individual who does not understand the directions or explanations being offered by the teacher and does not have access to an alternative instruction which would be more appropriate to the individual's need. It may be that the only option for these individuals lies in what kind of off-task behaviors to engage in during the class, whether to quietly daydream or to noisily disrupt the work of classmates. The results of the study indicate that students who are given the instruction they need for comprehending and succeeding with the task become more actively engaged in learning and more alike in their level of task involvement than do students who receive a group-based instruction which has no systematic approach for assisting individuals learn well.

The perceptions students develop about themselves as learners are influenced by the achievement they actually obtain and by the conditions under which they learn. In this study, the relations between learning condition and the way students came to view their own academic ability was especially strong. When students in the tutoring and mastery learning groups were assisted in correcting misunderstandings about the elements of a task or errors in their initial learning and were given objective evidence that they had indeed learned well, they responded with highly positive views of their own capabilities. The objective evidence of successful learning came from their performance on the alternative formative test administered after corrective instruction was completed. The traditional practice in schools, which was followed for the conventional condition of the study, is to provide students with evidence of the extent of their present level of learning, without attempting to use the information as a guide for improving the learning. While a few students succeed under this system and receive confirmation of their ability to learn, the majority are receiving consistent evidence that they are not as capable as the few.

Belief in one's own ability to learn has consequences not only for future attempts at learning, but also for continued mental health. While more global views of self worth doubtlessly involve experiences beyond the schools, the suggestion here is that the student's perception of ability to learn within a specific subject area can be enhanced.

As the study indicates, positive changes in the way students view their own capacities can occur in a very brief period of time, if the instruction enables them to learn well and provides an opportunity for them to receive some kind of objective evidence that they are meeting a high standard for learning. The possibility exists that schools could have a very dramatic and positive effect on the way students view themselves and their futures by changing the conditions which inhibit learning.

When the quality of instruction enables students to successfully achieve, they become confident of their abilities, and the data strongly suggest that, in turn, influences the kinds of attitudes and interests they develop toward what is being learned. Although outside influences in the society and the home help shape the attitudes and interests of individuals, the school itself, through the learning conditions it provides, may well prove to be the major influence on how students feel about what they are learning and whether they want to learn more. The findings of this study indicate such a direction of causality.

IMPLICATIONS FOR TEACHER EDUCATION

The results of the study also have implications for the preparation of preservice teachers and the inservice training of teachers who are already working in schools. The study indicates that it is possible for previously inexperienced teachers to learn approaches for enhancing each component of the quality of instruction for an individual student, and Nordin's (1979) study indicates that experienced teachers can become skillful in enhancing cues or the extent of participation in learning of their students in group-based instruction. In both studies, the new teaching behaviors were acquired by the teachers in a very brief period of time. While additional research is needed to identify which aspects of an effective tutorial can be incorporated into group-based instruction, it appears likely that once identified they can be learned well and used effectively by almost all teachers. Helping teachers learn how to adapt the qualities of instruction to the needs of individuals within their classes should prove one of the most effective and cost-efficient means of improving student learning.

The *yardstick* provided here is primarily a research measure, but it has implications for teacher training, as well. Since a maximal quality of instruction has been shown to raise learning to very high levels for nearly all students, it provides a much needed basis for the argument that changes in instruction can produce positive effects on student learning. It could not be argued that with present resources, classroom teachers should approach the results reported here, but there is clearly cause for optimism.

In training teachers, the argument for individual, interpersonal instruction has been made on largely moral grounds. Personal is better than impersonal; individual is better than collective. There is support here for the informal, personal behaviors we generally associate with good teaching. Classroom teaching behaviors that replicate aspects of an excellent tutorial, however briefly, have now been given a theoretical and experimental context by these results. The teacher who moves among student - observing, questioning, responding, encouraging - is clearly engaged in activities similar to those of our tutors. If this is not a panacea, it offers a direction for development rooted in our best sense of teaching as an intrapersonal activity.

IMPLICATIONS FOR RESEARCH

Because the three quality of instruction conditions employed in the study consistently produced three distinctively different levels of achievement, the study supports the view that quality of instruction is a continuum ranging from minimal to maximal. The clear implication is that other enhancements of the quality of the instruction are likely to produce positive results. The findings of mastery learning studies are sufficiently compatible with each other to provide a fairly clear understanding of the limits to which learning can be increased when instruction is enhanced after the initial teaching has occurred. Research is now needed which focuses on identifying the particular aspects of tutoring than can be incorporated into the initial instruction students receive under group-based conditions. The results of the study reported here can serve as a *yardstick* for measuring the effectiveness of future attempts to enhance the quality of instruction.

The effects of quality of instruction on cognitive and affective learning and on learning processes, such as engagement in learning, were immediate and measurable in a brief period of time. Under the maximal learning condition, the effects were evident on the first learning task. The findings indicate that it is no longer necessary to wait for a semester or a year before determining whether or not a new procedure for enhancing instruction has been effective. According to the results of this study, the trend should appear early, and the effects should be measurably week by week.

The study also suggests several other areas of needed research. Although findings of this study clearly indicate that previous assumptions about human potential for school learning must be reassessed, additional research will be needed to determine if these results hold for other kinds of school learning and other groups of students. It is especially important to determine if these results hold for students who come from backgrounds at the extreme edges of the economy.

Future research needs to be directed toward identifying the ways that the initial instruction given under group-based conditions can be adapted to the individual so that students can become active participants in learning from the onset of instruction. Research is also needed to determine if the high levels of task involvement found for students in the maximal learning condition would be sustained over a longer period of time than the period during which this study was conducted.

Additional research is needed to establish the linkage between achievement and perception of achievement and the affect students develop toward learning. However, a clear direction for further research has been provided here.

Most previous research has concentrated on factors outside the classroom in an attempt to explain the variations in learning which occur within the classroom. The information generated by the research is valuable and it contributes to our general knowledge, but it is largely concerned with variables over which schools and teachers have no influence. It does not provide a direction or course of action which can be pursued by teachers in an effort to improve student learning. The study which has been detailed here focused on the effects of the quality of instruction, a variable within the control of schools and educators. Quality of instruction has been shown to be an alterable variable, which exerts a pervasive influence on learning outcomes and learning processes. Differences in the learning and achievement students attain can no longer be justified as an inevitability of differences in their cognitive and affective characteristics. The concept of students as possessing greater or lesser degrees of academic potential becomes meaningless, in view of the findings reported here. However, in order for students to begin realizing their full potential as learners, the means must be found for adapting instruction to the needs of individuals *early* in group-based learning conditions.

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APPENDIX A

SUPPLEMENTARY TABLES

TABLE A.1. Reliability of Formative and Summative Tests

Group	FT 1A	FT 2A	FT 3A	Summative
Fourth Grade	.6149	.7586	.1153	.7184
Fifth Grade	.6836	.6474	.1514	.6595
Eighth Grade	.6673	.5420	.5452	.7230

Kuder-Richardson formula number 21 was used to determine test reliability. Means and standard deviations for the conventional instruction groups in each grade level were used in the calculations.

TABLE A.2. Comparison of Observed Time-on-Task

Group		Learning Task 1	Learning Task 2	Learning Task 3
Fourth Grade				
Tutoring	$\bar{x}$	91.50	95.75	100.00
(N=20)	s	8.25	8.35	.00
Mastery	x	95.60	92.25	92.60
(N=26)	s	6.05	10.05	10.25
Conventional	x	95.00	86.35	86.75
(N=24)	s	4.85	20.75	14.45
Fifth Grade				
Tutoring	x	97.65	98.15	99.50
(N=20)	s	7.00	3.85	2.25
Mastery	x	94.75	90.45	94.25
(N=26)	s	10.85	9.60	9.10
Conventional	x	90.55	84.55	82.80
(N=28)	s	8.50	12.70	15.85
Eighth Grade				
Tutoring	x	100.00	100.00	100.00
(N=21)	s	.00	.00	.00
Mastery	x	75.95	87.95	86.10
(N=27)	s	26.40	18.80	20.00
Conventional	x	77.25	62.10	67.40
(N=33)	s	31.50	33.15	32.15

TABLE A.3. Relations Between Student Reports of Overt and Covert TOT, Achievement, and Quality of Instruction

Grade Level Groups	Relations During the First Task				Relations at End of Series of Tasks			
	Achievement and TOT	Achievement and Quality of Instruction	Quality of Instruction and TOT	Multiple R TOT: Quality of Instruction and Achievement	Summative Achievement and TOT	Summative Achievement and Quality of Instruction	Quality of Instruction and TOT	Multiple R TOT: Quality of Instruction and Summative Achievement
Fourth (N=70)	-.04	.18	.47	.47	.35	.60	.46	.47
Fifth (N=82)	.20	.43	.16	.22	.22	.69	.28	.29
Eighth (N=82)	.15	.53	.47	.47	.26	.64	.46	.46
Median	.15	.43	.47	.47	.26	.64	.46	.46

Correlations for the first task are based on measures administered at the end of the first task. Correlations for the end of the series are based on measures of overt and covert TOT during the final task and summative achievement.

TABLE A.4. Summary of Students' Perceptions of The Appropriateness of Cues and Reinforcement Under Different Quality of Instruction Conditions

Group		Cues			Reinforcement		
		Week 1	Week 2	Week 3	Week 1	Week 2	Week 3
Fourth Grade							
Tutoring	$\bar{x}$	1.80	1.53	1.73	1.38	1.30	1.33
(N=20)	s	.34	.40	.28	.53	.57	.42
Mastery	$\bar{x}$	1.65	1.59	1.46	1.27	1.25	1.26
(N=26)	s	.44	.43	.52	.60	.51	.58
Conventional	$\bar{x}$	1.44	1.28	1.22	1.19	1.04	1.24
(N=24)	s	.61	.54	.54	.44	.57	.33
Fifth Grade							
Tutoring	$\bar{x}$	1.68	1.60	1.68	1.73	1.35	1.37
(N=20)	s	.41	.44	.51	.34	.49	.47
Mastery	$\bar{x}$	1.52	1.37	1.55	1.29	1.13	1.14
(N=26)	s	.56	.47	.40	.55	.67	.55
Conventional	$\bar{x}$	1.59	1.49	1.38	1.39	1.20	1.24
(N=28)	x	.45	.52	.60	.39	.57	.57
Eighth Grade							
Tutoring	$\bar{x}$	1.95	1.76	1.86	1.83	1.26	1.63
(N=21)	s	.22	.41	.34	.29	.49	.36
Mastery	$\bar{x}$	1.63	1.29	1.68	1.18	.86	1.42
(N=28)	s	.52	.62	.56	.55	.58	.49
Conventional	$\bar{x}$	1.39	.89	1.31	1.21	.70	1.01
(N=33)	s	.57	.59	.61	.59	.61	.54

The maximum possible score is 2.

APPENDIX B

INSTRUMENTS

STUDENT PERCEPTIONS OF OVERT AND COVERT TIME-ON-TASK INSTRUMENT

The word *cartography* was substituted for *probability* on the eighth grade questionnaires. Students responded by circling *yes*, *don't know*, or *no* to each item.

Covert Time-on-Task

(1) I started to work very quickly in class today.

(2) I thought about something besides probability in class today.

(3) I listened very carefully when my teacher explained the work for today.

(4) I like to think about answers to probability problems.

(5) Sometimes by teacher thinks I am working on probability when I am really thinking about something else.

(6) Some of the work today was so boring that I thought about something else for a while.

(7) I paid attention almost the whole class today.

(8) I listened carefully to the probability questions that my teacher asked today.

Overt Time-on-Task

(1) The teacher didn't call on me at all today.

(2) I hate it when my teacher asks me a question about probability.

(3) I didn't really do all of the probability experiments today.

(4) I asked my teacher for help when I needed it.

(5) I always finish my probability work.

(6) My teacher had to remind me to pay attention in class today.

(7) I told my teacher the answer to a probability question today.

PERCEPTION OF ACHIEVEMENT INSTRUMENT

Items from this instrument were included on the questionnaires which were administered at three points during each of the three studies. The word *cartography* was substituted for *probability* on the questionnaires for the eighth grade study. Students were given the choice of responding *yes, don't know,* or *no* to items 1-11. Choices for items 12 and 13 are stated here.

Items

(1) I like to be called on in probability class.

(2) I try to do the very best work in probability that I can.

(3) My probability teacher thinks my work is very good.

(4) I am very proud of my probability work.

(5) Probability is easier for me than some of my other subjects.

(6) I feel upset in probability class.

(7) I am discouraged with my probability work.

(8) I find it hard to talk in front of my probability class.

(9) Most of the students in my class know more about probability than I do.

(10) My probability teacher makes me feel I am doing poorly.

(11) I think I am not doing very well in probability class.

(12) What kind of grades do you think you are capable of getting in probability?

the best grades average grades the poorest grades

(13) Forget for a minute how others grade your work. How good do you think your work is in probability class?

My work is excellent.
My work is average.
My work is poor.

AFFECT TOWARD LEARNING INSTRUMENTS

In these studies *affect* refers to *attitude* and *interest* toward learning the content of the studies. In the eighth grade study, the word *cartography* was substituted for *probability* on the questionnaires. Students responded *yes, don't know,* or *no*.

Attitude

(1) Probability is more difficult to understand than any other subject.

(2) I think everybody should learn probability.

(3) I cannot understand why some students think probability is fun.

(4) Probability is not really useful because it is just about ideas.

(5) Probability is more like a game than it is like school work.

(6) Probability is boring.

(7) I do not think it is important to understand probability.

Interest

(1) Probability is one of my favorite subjects.

(2) I would like to do more work with probability.

(3) I would like to show somebody else how to do probability.

(4) I think doing probability work is a waste of time.

(5) I enjoy learning about probability.

(6) I would like to invite a probability expert to speak to my class.

(7) I want to learn more about probability.

INSTRUMENT FOR MONITORING STUDENT PERCEPTION OF QUALITY OF INSTRUCTION (CUES AND REINFORCEMENT)

In addition to monitoring levels of student participation and the availability of the feedback/corrective component, the quality of instruction available under each of the different learning conditions was monitoring at three points by obtaining students' perceptions of the cues and reinforcements available under each condition. Student responded *yes, don't know,* or *no* to each item. *Cartography* was substituted for the eighth grade.

Cues

(1) My probability teacher explains things so that I know what I am expected to do.

(2) I understand the questions my probability teachers asks me.

(3) If I don't understand something about probability then my teacher explains it to me again.

(4) My teacher shows me different ways to do my probability work.

(5) I don't understand when my teacher explains probability.

(6) I usually don't understand why I am supposed to do a probability experiment.

(7) Sometimes I don't know what I am supposed to do with the things my teacher gives me in probability class.

(8) If I don't understand a probability question then my teacher explains it to me again.

Reinforcement

(1) I like to tell answers to probability questions even when I am not certain my answer is right.

(2) I would finish my probability work even if my teacher didn't care if I finished it or not.

(3) My teacher always tells me when my work is good.

(4) My friends think I know a lot about probability.

(5) The answers I thought of in probability class were usually wrong.

(6) My probability teacher doesn't always tell me if my answer is right or wrong.

(7) If I think a probability question is too hard then I stop working on it.

CODING SHEET FOR MONITORING THE QUALITY OF
INSTRUCTION PROVIDED IN TUTORIALS

Tutor _____

	Yes	Sometimes	No
(1) Arrives on time for the tutorial			
(2) Has organized materials for instruction			
(3) Provides a clear explanation of each task			
(4) Provides additional and altered cues when needed			
(5) Varies instructional materials when needed			
(6) Reinforces correct responses and appropriate behaviors			
(7) Uses a variety of verbal and nonverbal behaviors to encourage participation			

OBJECTIVES FOR A THREE WEEK UNIT ON CARTOGRAPHY
FOR STUDENTS IN EIGHTH GRADE

At the completion of the learning tasks for the cartography unit, students should have acquired the following knowledge and skills:

(1) Recognizes maps as representing a collection of highly selected information, organized and symbolized for the reader by a cartographer.

(2) Accurately locates and records the exact positions of points on the earth's surface by noting distance north or south of the equator (latitude) and east or west of the Prime Meridian (longitude).

(3) Uses latitude to determine where the sun is at zenith, and uses longitude to determine the time at any point on the earth.

(4) Compares a variety of flat maps with a globe and describes the distortions which occur when a spherical surface is represented on a flat surface.

(5) Compares a variety of map projections and describes their advantages and disadvantages with regard to size, shape, distance, and direction.

(6) Uses standardized map symbols in interpreting and constructing topographic maps.

(7) Uses and constructs map scales to determine distance between points on the earth.

(8) Reorganizes written data and represents them on maps with appropriate symbols, using correct direction and distance.

Materials used in preparing the cartography unit are discussed on p. 33. The suggested scope and sequence chart prepared by the CBS Learning Center (Princeton, New Jersey) was especially helpful in identifying appropriate objectives for the cartography unit.

OBJECTIVES FOR A THREE WEEK UNIT ON PROBABILITY FOR STUDENTS IN FOURTH AND FIFTH GRADES

At the completion of the learning tasks for the probability unit, students should have developed skill in the following:

(1) Distinguishes between certain, possible, and impossible events.

(2) Identifies the set of possible outcomes of an experiment.

(3) Identifies equally likely outcomes of an experiment.

(4) Identifies unequally likely outcomes of an experiment.

(5) Writes and interprets statements of probability in symbolic form.

(6) Collects data about the frequency of events and interprets the results.

(7) Applies basic rules of probability.

(8) Determines experimental probabilities.

(9) Determines probabilities of simple and compound events.

(10) Compares experimental probabilities with theoretical probabilities.

(11) Applies the multiplication principle to determine the number of possible outcomes of a situation.

Materials used in preparing the probability unit are discussed on p. 33. Shepler's (1969) work, *A Study of the Development of a Unit in Probability and Statistics for the Elementary School,* was especially helpful in identifying appropriate objectives for students in fourth and fifth grades.