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INTERACTIVE EFFECTS OF STUDENT SOCIAL LEARNING ORIENTATION AND INSTRUCTIONAL MODE--INDEPENDENT AND SMALL GROUP--ON ACHIEVEMENT IN A HIGH SCHOOL GRAPHIC ARTS PROGRAM

The Ohio State University

Ph.D. 1982

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INTERACTIVE EFFECTS OF STUDENT SOCIAL LEARNING ORIENTATION AND INSTRUCTIONAL MODE—INDEPENDENT AND SMALL GROUP—ON ACHIEVEMENT IN A HIGH SCHOOL GRAPHIC ARTS PROGRAM

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

David M. Wagner, B.S., M.A.

* * * * *

The Ohio State University

1982

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Adviser
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In Memory of Norman J. Wagner

The author wishes to dedicate this dissertation to his father, Norman J. Wagner. My father held education in very high esteem and would be quite proud of me for this significant academic accomplishment.
ACKNOWLEDGMENTS

In many respects, the acknowledgment page is the most difficult portion of this work to write. The writer wishes to acknowledge his indebtedness to the many persons who have assisted in making this study possible. I shall list and express my thanks to those who have helped and supported me during this challenging and rewarding period of my life.

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Finally, no words of thanks or appreciation will ever be sufficient for the love, understanding and the many hours of help and encouragement that my wife, Molly, unselfishly provided during this trying period.
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CHAPTER I

INTRODUCTION

A central and persisting problem of our schools is the necessity to design and provide educational environments that adapt to individual diversity. Commitment to the realization of individual potential and equality of opportunity demand that the process of education provide individual differences along the various dimensions in which they are manifested. For example, differences in needs, interests, abilities, talents, and styles of learning should be considered.

The fundamental educational task is to design settings for education that are flexible and adaptive enough to handle differences which derive from an individual's own uniqueness among other human beings (Glaser, 1977). The notion of designing instructional programs to fit individual learners is beginning to replace the older notion of fitting learners to a standard program. Under this new orientation, it is not the student who fails but the instructional program. The design, implementation, and evaluation of instructional programs, which are compatible with individual learner variables, should be the responsibility of the educational community (Fantini, 1980).

Many educators that support individualized methodology agree that the best or ideal learning situation is one that takes the
greatest advantage of the student's particular strengths and minimizes the effects of his or her weaknesses (Reid, Palmer, Whitlock & Jones, 1973). The contemporary concept of individualization promises to move learners beyond equality of opportunity and toward equality of outcomes. However, this ideal is founded upon the premise that individual differences are accounted for in the instructional program. This assumption is dangerous in that differences among learners are complex and extremely diverse in nature. In ideal educational environments, a wide range and variety of instructional methods and opportunities for success should be provided. The alternate means of learning would be adaptive to and in some organized way matched to knowledge about individuals.

In summary, there seems to be a popular misconception relative to individualized instruction. That is, because instruction is individualized each student will equally benefit from that instruction. This misconception is supported by the lack of evidence relative to the adaptiveness of individualized programs to individual differences or characteristics. Bloom (1974) emphasizes this approach when he states that "much research is needed to determine how individual differences in learners can relate to variations in the quality of instruction" (p. 8).

In education, several major patterns of adapting to individual differences can be identified if one examines past and present educational practices. The pattern that was the focus of this study was that of adapting to individual differences by varying instructional
treatments. Briefly, this pattern involves providing detailed diagnosis of the student's learning habits, attitudes, skills, and learning styles. On the basis of this analysis of the student's characteristics, a prescription is made for a course of instruction specifically designed for that student. These diagnostic/prescriptive procedures should be sensitive in detecting how students learn and how they best function within an instructional environment.

Statement of the Problem

The problem of this study was to determine the effectiveness of specific diagnostic/prescriptive procedures used in an instructional program and how these procedures interact with selected student characteristics and instructional treatments in terms of achievement. Specifically, this experimental study attempts to provide empirical evidence as to whether there are differences in achievement when students with specific social learning orientations (independent or small group) are placed in specific instructional treatments (independent or small group settings). An analysis of individual learning orientation and how this orientation affects individual achievement when individuals are assigned to independent or small group instructional modes were the focus of this study.

A Statement of Problem Background

The instructional process is very complex and can be delineated using a model for classroom teaching. Dunkin and Biddle (1974)
presented a model that described the process of teaching and learning. This model included four main classes of learning variables: (1) presage (teacher related variables), (2) context (pupil and school related variables), (3) process (classroom activity variables), and (4) product (teaching outcome variables). The problem, as stated earlier, was concerned with the effect or influence of context variables (selected pupil characteristics) on the product or outcome variables within an individualized instructional environment or process variables.

Contextual variables in an instructional situation are abundant. These learner variables would include characteristics such as: aptitude, attitudes, personality traits, sex, age, intelligence, race, and prior achievement. These characteristics are complex and quite diverse with very little in common except that the school, teacher, and/or the instructional designer have very little control over them. In regard to the role that student characteristics and aptitude have with learning, Cronbach (1967) states that "personal characteristics are complex and account for an individual's end state after a particular educational treatment" (p. 23). Cronbach goes on to say that an "aptitude includes whatever promotes the pupil's survival in a particular educational environment, and may have as much to do with styles of thought and personality variables as with abilities" (p. 24).

Glaser (1977) examines older and newer psychological notions and their implications for the design of educational environments adaptive to individual differences.
The prevalent educational conception of individual differences has been derived from the discipline of psychometrics and standardized testing; this work has emphasized the measurement of individual differences as entities predictive of success in school. Individual differences in abilities and aptitudes as they related to education are now being conceived in terms of cognitive processes that can be utilized and developed to facilitate learning and performance. With this shift has come a change in the attitude toward aptitude. Competent performance is not something only to be predicted; the emphasis now is on how the processes that contribute to it can be influenced. What is being studied is how the individual might be educated to improve his or her cognitive skills to make the attainment of competent performance easier and more effective. (p. 48)

Rita and Kenneth Dunn have done considerable research in the area of understanding learning styles and the need for individual diagnosis and prescription procedures. They suggest that individual differences among students and the possible variations in learning styles are infinite. Some students learn better by listening to the teacher, some by discussion, others by working on their own or in small groups. Learning style, therefore, describes a student in terms of those educational conditions under which he is most likely to learn. To say that a student differs in learning style means that certain educational approaches are more effective than others for him or her.

Learning styles emerge from inborn, natural inclinations which include preferred ways of learning and descriptions of personality characteristics that relate to learning. For example, the need for structure or flexibility; preference for working in large groups, small groups, or individually.
The Dunns investigated educational, industrial, and psychological research concerned with how children and adults learn, and isolated eighteen elements that comprise learning style. When classified, those characteristics indicate that learners are affected by their: (a) immediate environment; (b) own emotionality; (c) sociological preferences; and (d) physical needs. The Dunns advocate creating an environment and choosing a style that best matches each child's preferred way of learning (Dunn & Dunn, 1978).

The learning variable or student characteristic that this study was concerned with was that of social learning orientation of the learner. In this study, social learning orientation was considered an aptitude. By definition, the term "aptitude" refers to any individual difference variable which functions selectively with respect to learning, that is, which appears to facilitate learning in some students and some instructional treatments while limiting or interfering with learning in other students and other instructional treatments (Snow & Salomon, 1968). Learner differences in terms of social learning orientation and how the learner uses instructional material may account for various degrees of success or achievement. Students learn in a variety of sociological patterns that include working alone, with one or two friends, with a small group, or as part of a team. It is important to identify how each student learns and to then assign to that individual the correct grouping and/or methods of instruction.
The effectiveness of group processes in facilitating learning has received attention from several educational psychologists. Piaget viewed social interaction as one of the major forces in cognitive development. Peer interaction can be of great value for several reasons. Students are apt to attach significance to activities deemed important or interesting to their peers. In addition, peers can serve as models or instructors for new skills. Peers are likely to be near the same cognitive level as the learner, thus their explanations may be more effective than those of the teacher (Webb, 1980).

Bloom, Hastings, and Madaus (1971) suggest that group processes provide occasions for the more able students to strengthen their own learning while they help other students grasp an idea through alternative explanations and applications. The use of these group processes or peer teaching to effect achievement is not a new strategy within education. Gartner, Kohler, and Riessmen (1971) explain that a major benefit of peer tutoring is the gain by students providing the tutoring. In preparing to teach, tutors engage in review of the material and perceive it in new ways as they think through how the skill or concept will be presented.

The Dunns in their discussion of the importance of small group techniques state that many students respond best to a learning situation that involves from two to five of their peers. Some students may need the interaction of friends to stimulate them to learn; others are motivated by a team effort. Many relax when a
group, rather than each individual, is responsible for a task or a project. Small-group interactions also permit students to solve problems in cooperation with other students so that they need not fear failure or embarrassment. Even if errors are made, sharing the responsibility with a group of peers sharply reduces the tension. For these reasons, many students' learning styles are best served if they are often permitted to work in groups (Dunn & Dunn, 1978).

Conversely, the unique characteristics of individual students may nullify strategies which have been proved effective with small groups. The teacher should, therefore, always be alert to the possible effects a new instructional approach may have on individual students. A strategy such as small group study, for example, may work out well with one student but be completely unmanageable with another (Finch, 1974).

Returning to Dunkin and Biddle's model for classroom teaching, the next class of variables of interest in this study were process variables. Process variables are concerned with the actual activities within a classroom that promote learning. These variables include all observable behaviors of teachers and pupils. The concept of individualization of instruction has become one of the central tenets of the educational process and is acclaimed as a desirable educational strategy to be employed in the classroom. Industrial arts historically has been the principal area of the school curriculum in which individualized instruction has been emphasized. In the early 1900's the manual training and manual arts activities were largely
done on an individual or small group basis. As industrial arts developed, it continued to retain and improve its individualized instruction. The programs of the future continue to build on this function with new methods of individualized instruction. One of the individualizing methods receiving a great deal of attention in industrial arts education is the learning activity package (Rosser, 1975).

Learning activity packages are designed and developed to facilitate student learning. An issue of *Educational Technology* (September, 1972) was devoted to the discussion of learning packages. One consistent point made by the authors in that journal was that packages are developed to facilitate the attainment of the objectives for specified populations. There are obviously degrees to which instructional materials and activities can be individualized and/or packaged. "Variability among students in learning skills, conceptual-affected development, verbal development, motor skill development, and level of responsibility can be taken into account in the learning packages" (Kapfer & Kapfer, 1973, p. 3).

Product variables are concerned with the outcomes of the instructional process. These variables include those changes that have come about in pupils as a result of their involvement in classroom activities with teachers, instructional materials, and other pupils. Four years ago the researcher began using learning activity packages as a form of individualizing instruction in his beginning high school graphic arts courses. During the first two years of
individualizing instruction, this researcher observed some variance in student achievement using this form of instruction. Some students used the packages on an independent basis while others worked with the packages in small groups. The researcher realized that not all students would profit from this haphazard and unsystematic approach but there was no empirical evidence that supported any aptitude-treatment interaction. There was no assurance that the individual student was using the instructional material in a way that was most beneficial in terms of achievement. Based upon this observation it can be postulated that the use of learning activity packages in different social groupings may account for variance in achievement. It can also be postulated that some learners may achieve better with independent instruction while others achieve better in a small group setting.

Research in instruction was needed in order to establish whether or not interactions exist between various treatment variables and student characteristics. Bloom et al. (1971) emphasized that it should be possible to match instructional techniques and materials with individual student characteristics so that the achievement of all students seeking a given objective of instruction will be greater than would have been realized had a single method been employed.

Researchers in the field of instruction are becoming more amenable to the idea of aptitude-treatment interactions (ATI) as opposed to the search for the one "best" method or instructional treatment. The primary function of ATI research is to improve
instruction. ATI research differs from that of traditional research on instruction in that it admits to the existence of individual differences and takes them into consideration. ATI work is based on the assumption that different instructional procedures interacting with learner aptitudes will lead to the same learning outcomes (Salomon, 1972).

**Purposes of the Study**

The major purpose of this study was to provide empirical evidence as to whether an interaction exists between instructional treatment (independent and small group) and the student attributes of social learning orientation (independent and group). Interaction between treatment and attribute is said to exist when instructional treatment effects are specific to one level of attribute and are not generalizable across both levels of the attribute variable.

The research questions were stated as follows:

1. Does one level of treatment (independent or group) result in higher levels of achievement regardless of learning orientation?

2. Is there an interaction between instructional treatments and learner attributes?

3. Does learning orientation represent a valid learning variable in an individualized instructional program?
Specifically, the purposes of the study were to: (1) investigate the effectiveness of instructional grouping (independent and small group) in a graphic arts program which employs learning activity packages as the dominant mode of instruction; (b) investigate the interaction between student instructional grouping, learning orientation, and student achievement (aptitude-treatment); and (c) present a diagnostic/prescriptive assessment procedure that could be replicated in similar instructional situations to determine whether instructional groupings have an effect on achievement and whether learner social learning orientation and instructional grouping have an effect on achievement.

Definitions of Terms

The following terms are defined as they were used in this study (Page & Thomas, 1977):

**Achievement:** Performance in school or college in a standardized series of educational tests. The term is used more generally to describe performance in the subjects of the curriculum.

**Aptitude:** Innate or acquired skill or ability which is assumed to underlie, and is conducive to, an individual's capacity to learn and attain a level of achievement in a specific field. Aptitude is normally inferred from testing or observation of attained behavior and attitude.

**Aptitude-treatment Interaction** or trait-treatment interaction: Interaction between the personality traits and aptitudes
of the learner and the various forms of instruction and learning methods available.

Learning: Used in educational psychology to refer to a relatively permanent change in behavior that is the result of past experience, either produced incidentally or through institutional learning through teaching.

Learning Activity Package (LAP): Package of resource materials --often including tapes, slides and printed materials-- designed to meet the needs of students in a particular instructional sequence. It may be tailored to the needs of individual students, as in individually prescribed instruction.

Individualization: General term for designing or adapting teaching methods and materials for the individual student. Individualized instruction that is tailored to the needs of individual students and situations, is characterized by such features as clear objectives or outcome specification, detailed repertoire assessment of the student, learner-selected objectives involving the student, active responding or frequent monitoring of student responses, contingency contracting or contingency management, immediate and frequent feedback, use of successive approximations, self-paced learning, mastery learning, use of proctors, multi-media programs, and computer-assisted instruction.
Implications and Significance of the Study

Results of this study should have a significant impact on educational practices in terms of diagnostic/prescriptive procedures used in the classroom. An adaptive mode of education assumes that the educational environment can provide for a wide range and variety of instructional methods and opportunities for success. Alternate means of learning are matched to students on the basis of knowledge about each individual's talents, preferences, and aptitudes. An individual's abilities and learning styles are assessed and educational paths are selected or assigned. The match between individual performance and the educational environment are the defining characteristics of an adaptive mode of instruction. The success of this adaptive interaction is determined by the extent to which the student does indeed experience some kind of match between his/her specific abilities and the activities in which the student engages (Glaser, 1977).

Research relative to the technicalities of designing and implementing flexible educational environments is the responsibility of the education community. As John Dewey said in his book Experience and Education (1938/1979):

The trouble with traditional education was not that educators took upon themselves the responsibility for providing an environment. The trouble was that they did not consider the other factor in creating an experience; namely, the powers and purposes of those taught. It was assumed that a certain set of conditions was intrinsically desirable, apart from its ability to evoke a certain quality of response in individuals. This lack of mutual adaptation made
the process of teaching and learning accidental. Those to whom the provided conditions were suitable managed to learn. Others got on as best they could. (p. 45)

A major objective of this study was to provide supportive evidence or lack of evidence of an interaction between student social learning orientations, instructional grouping or treatment and achievement. Measuring effectiveness of learning activity packages in terms of their best or optimum use in an instructional situation, given the student's individual characteristics, is an important and necessary element of program design and implementation.

This study will contribute to the body of knowledge because information concerning the best or optimum use of instructional materials would be beneficial to teachers, curriculum developers, and the learner. In addition, this study will contribute to the limited amount of research in this area. Aptitude-treatment interaction research also has the potential to contribute to the body of knowledge, by gradually constructing a matrix of learning situations and learners' characteristics, which may then facilitate the development of instructional theory (Salomon, 1972). For example, that students with small group learning orientation achieve higher scores while assigned to small groups and achieve lower scores while assigned to work on an independent basis, then it could be postulated that student social learning orientation and instructional grouping is a significant factor that should be considered during program design and implementation. Educators should have special
interest in this study due to the ramifications relative to diagnostic/prescriptive procedures. This study could be replicated in other learning environments, using a similar design and appropriate instruments, for the purpose of evaluating the effectiveness of instructional programs in terms of the best or optimum learner grouping in an instructional situation. Given this information, instructional grouping could be prescribed to individual learners to fit their particular needs and learning abilities.

This study was also important in terms of action research which calls for an immediate solution to a classroom problem. It was necessary to establish whether learning activity packages, which were used by the researcher (instructor), work better in a small group or independent mode and whether there was a significant interaction between student social/psychological variables, instructional grouping, and achievement. This study could then lead to program changes which would enable the instructional process to be more beneficial to students enrolled in beginning graphic arts classes.
CHAPTER II

REVIEW OF RELATED LITERATURE

The basic problem addressed by this study concerns the theory of aptitude-treatment interactions and the effects of these interactions on adaptive arrangements in an educational situation. During the review of literature, the researcher found several different types of studies which were relevant to the problem. Much research has been conducted which compares two or three different methodologies, such as traditional methods vs individual instruction. Newsom, Eischens, Roger, and Looft (1972) reported on a study which dealt with the lack of attention to individual differences. This study postulates the problem that individual differences among learners are extremely complex and diverse in nature and should be identified in order to maximize the educational process. A review of related studies focuses on the following areas: the effects of personality factors on achievement, the antecedents of selected aptitudes, relationship of ability to achievement, review of comparison studies (small group vs independent instruction), and research related to aptitude-treatment interactions. The review of literature also attempts to identify valid instruments for measuring student aptitude characteristics which are of concern in this study.
A Study of Personality and Achievement

There has been considerable correlational research relative to personality characteristics. Haskell (1969) used the ten specific personality traits from the Guilford-Zimmerman Temperment Survey (GZTS) to investigate the relationship of personality variables and academic performance using vocational high school students. This study indicated that students who were agreeable, emotionally stable, serious-minded, and persistent did significantly better than other students ($\mu = .05$). In this study Haskell made adjustments for the effects of general mental ability by covarying achievement test scores with ability scores.

A study (Kirkpatrick, 1974) using intact groups of college students in a beginning course of electrical engineering examined how selected personality traits of students related to achievement using an individual paced instruction (IPI) system. The Edwards Personal Preference Schedule (EPPS) was used to measure fifteen personality traits of students and the Eysenck Personality Inventory was used to measure introversion-extraversion tendencies. Results of this study indicated that order, abasement, change, endurance, and introversion are significant predictors of academic achievement.

In a similar study (Jelden, 1971) investigated the effectiveness of predicting success and/or failure in an individualized multimedia industrial arts college course in electronics. Student psychological variables were measured using scores on the General Aptitude Test Battery (GATB) and the Edwards Personal Preference Schedule (EPPS).
Each variable of both measures (total 24) was correlated with the student's term achievement or course grade. A correlation coefficient using Pearson product-moment correlation was calculated for each variable. A step-wise multiple regression was run in order to reduce the number of variables. Results found that the top five factors measured by the GATB and EPPS are capable of predicting term achievement at the .95 confidence level. The best predictors in order were: general intelligence (.38), abasement (-.21), autonomy (-.19), affiliation (-.17) and intraception (.10). A level of significance of .05 was used for these correlations.

Reid et al. (1973) found that personality variables related to performance in computer-assisted instruction for college level algebra students. Four scales of the California Psychological Inventory (CPI) were used to measure student personality variables, namely, achievement via independence, dominance, flexibility, and sociability. Results indicated that there was a significant positive correlation between sociability and performance (.39, \( p = .001 \)). The researchers pointed out that students worked in pairs during instruction and posttesting. A parallel study was cited which found that when subjects work alone there is no relationship between sociability and performance. Achievement via independence, flexibility, and dominance did correlate, but not significantly, with performance.

Doty and Doty (1964) reported on a study \( (N = 100) \) which investigated the effectiveness of programmed instruction in relation to five student characteristics: GPA, creativity, achievement need,
sociability, and attitude. Achievement need and sociability are of interest in this review. Achievement motivation was measured by the Edward's Personal Preference Schedule and was found not to be significantly related to achievement but was significantly related to GPA. Achievement on programmed instruction was found to be significantly related to GPA and to social need. The sociability variable was measured using the Gilford-Zimmerman Temperament Survey. Results using a Pearson product-moment correlation produced an $r$ of $-.35$ ($p = .01$) between need and achievement. This correlation was determined modest but a reliable relationship because the effects of heterogeneity with respect to GPA were removed by using a partial correlation coefficient. The results of this study support the hypothesis that effectiveness of programmed instruction varies as a function of student personality variables, primarily sociability.

In another predictive study, results suggested that sociability was correlated with achievement. Lewis (1975) in a study of 406 high school biology students, attempted to discriminate and identify students who "did well" in an individualized program of instruction. Lewis found a significant discriminant function between achievement levels and the following personality factors: shy vs adventurous, disregards rules vs conscientious, and sociably group-dependent vs self-sufficient.

Brooks (1976) investigated one aspect of personality and achievement relationship. This study was concerned with the student's cognitive style (field-dependence - independence) as a classificatory
variable for assigning students to different instructional treatments. Specifically, this study sought to determine if there was a relationship between an individual's cognitive style and his mastery of the content of a self-administered unit of instruction. Brooks, in this study, concluded that a student's cognitive style contributes significantly to performance on a self-administered unit of instruction. It was further concluded that a student's cognitive style, which reflects not only his manner of perceiving and analyzing visual stimuli, as well as the nature of his personality and the mode of his intellectual functioning, should be given consideration when assigning students to learning environments.

Personality Antecedents

In the review of literature, relative to personality variables, the researcher found considerable agreement concerning the personality factor, sociability, as it relates to achievement. Since the focus of this study concerns the investigation of aptitude-treatment interactions with emphasis on sociological learning orientation as the primary aptitude, the antecedents of this aptitude should be reviewed. Individuals have preferred ways of organizing and processing information and these experiences have come to be called cognitive styles. These cognitive styles influence almost all human activities that implicate cognition, including social and interpersonal functioning.

An example might help clarify the nature of these stylistic dimensions and their pervasive involvement in learning, thinking, and
social interaction. One of the most widely studied of these styles, field-independence versus field dependence, refers to a consistent mode of approaching the environment in analytical, as opposed to global, terms. The field-independent person tends to articulate figures as discrete from their backgrounds and to easily differentiate objects from embedding contexts, whereas the field dependent person tends to experience events globally in an undifferentiated fashion (Messick, 1976).

The concept of cognitive style does not imply that there are two types of people—field dependent or field-independent. But there is now evidence that this style extends into psychological domains beyond cognition. Persons who tend to be field dependent also differ from relatively field independent persons in important personal characteristics. For example, several studies have explored the relation of cognitive style to social interaction, and it is of value to cite some of the results. Field-dependent persons are especially prone to be guided by the positions attributed to an authority figure or peer group (Messick, 1976).

Messick (1976) cites research that supports the notion that cognitive style refers to personal as well as cognitive characteristics, and both must be considered in making predictions and interpreting findings on how cognitive style figures in various aspects of the educational process. Messick states that "because these styles show themselves in perception, where they are readily accessible to observation and assessment by controlled laboratory techniques, they offer
an objective route to the study of individual differences in personal functioning" (pp. 44-45).

The determinants of cognitive style are important in terms of discovering how these individual differences arise. Messick (1976) cites research which examines the effects of child rearing and socialization in the development of this cognitive style.

Studies of the family experiences of children who turn out to be relatively field dependent or field independent have indeed demonstrated that the kind of relations the growing child has with his mother is very influential in determining his cognitive style. . . . The characteristics of child rearing that seems most closely associated with the development of a more field independent style of functioning, for example, is the early development of autonomous functioning. In a further effort to identify the socialization experiences contributing to the development of a more field dependent or field independent style, cross-cultural studies have been undertaken. . . . The evidence accumulated from these many cross-cultural studies demonstrates impressively that development of a more field dependent or more field independent cognitive style is indeed related to socialization. (pp. 45-46)

Messick (1976) cites research that supports the notion that cognitive styles are quite stable. The question remains as to whether this stability necessarily implies fixity or whether cognitive styles are modifiable through education or training. Several researchers studied the same group of persons over an age range of ten to twenty-four years and found that an individual's relative standing on field-dependence versus field-independence within the group was highly stable. At the same time, the group as a whole displayed a progressive increase in extent of field-independence up to age seventeen, with little further change up to age twenty-four.
A Study of General Mental Ability on Achievement

There would be little argument with the notion that the student's basic ability to learn would be related to achievement. In the review of literature, the researcher found several studies of interest. These studies revealed a relationship between GPA and/or ability and achievement. Doty and Doty (1964), cited previously, found that achievement was significantly related to GPA. Jelden (1971), cited previously, found that the top predictor of success was general intelligence (.38). Smith (1972) investigated the effects of learning activity packages on thirty college students in a beginning graphic arts class. He found that the student's GPA is an effective measure of a student's ability to accept a learning activity package system of instruction. A correlation between term achievement scores and GPA's produced an $r$ of .405 which is significant when examined at the .05 level. Worley (1975) reported on a study which tested one hundred five junior college students to determine who benefits from individual instruction. Worley, using a Pearson product moment correlation analysis, concluded that a correlation existed between GPA's and posttest scores of fifty college students in the individual instruction treatment group.

A recent study (Sayer, 1979) identified selected characteristics of high school students which could be used as predictors of success in an automotive mechanics course. The variables selected were intelligence, age, mathematics achievement, attendance, and grade point average. Multiple regression analysis was used to analyze the
relationships of the predictor variables and the criterion variable. Results indicated that GPA and intelligence were found to be significant predictors of student success.

A previously cited experimental study (Haskell, 1969) used scores of students' general mental ability as the covariate to adjust posttest scores. Another study (Jellema, 1976) found a positive correlation between reading comprehension level and achieved scores when using learning materials that are in a reading format, even though the materials were written at the sixth grade equivalent reading level. These findings suggest that the student's general mental ability should be taken into consideration in any interactive, experimental study concerning student achievement.

Bloom (1974) disagrees with this notion when he states that when students are normally distributed with respect to aptitude, but receive quality individualized instruction, the majority of students may be expected to achieve mastery of the subject. Bloom cites the relationship between aptitude and achievement should approach zero when students receive instruction that is appropriate to their characteristics and needs.

A Review of Comparative Studies

In the review of comparison studies, where method A is compared with method B, for the most part, no significant difference between methods was found. An exception concerned the effects of instructional objectives on achievement of field-dependent and field-independent college biology students (Mackie, 1978). The
field-dependent and field-independent dimensions of the students' cognitive styles were identified by administration of The Hidden Figure Test. Eight intact classes were randomly assigned to control and treatment groups. A posttest only control group design was used in this study.

Mackie, in comparing the achievement of students of different cognitive styles on application-level questions, found a difference in favor of field-independent students which was statistically significant at the .05 level in the control group. Mackie also found that on the questions reflecting analysis-level thinking, the test scores of field-dependent students in the treatment group were higher than the scores of field-independent students in the treatment group. Field-independent students had the higher scores on all other levels. The conclusions of this study were that field-dependent students in the experimental group when contrasted with field-dependent students in the control group achieve higher test scores.

In the review of literature, the researcher found much agreement that the main effects between two methods of instruction show little or no significant differences. Three such studies will be reviewed in terms of their effects on achievement when instructional grouping is varied and learning style of individual students is not considered. Miller (1971) conducted a study in an effort to ascertain the relative effectiveness of selected approaches to the teaching of technical related information. The study sought to test the theory that students who study in small groups will learn more
technical related information than students who study individually. Therefore, the purpose of this study was to compare experimentally the relative effectiveness of three classroom organizational schemes whereby students were exposed to technical related information in industrial arts. The three organizational schemes were: (a) individual achievement in a small group setting with no teacher interaction in the small group, (b) group achievement in a small group setting with no teacher interaction in the small group, and (c) individual achievement in an entire class with no teacher interaction with the class. The sample for this study consisted of forty-eight ninth grade boys enrolled in three industrial arts classes.

The analysis of the scores from the cognitive tests failed to reveal any significant differences. An attitude measure found a relatively high percent of students responding in favor of the small groups. It appeared that students who work in small groups can be expected to: (1) increase their level of enjoyment, (2) consider learning to be easier, (3) experience a reduction in frustration, and (4) find learning more challenging, than when individual study is used.

Koble (1963) conducted a study which compared, in terms of achievement, group-oriented versus individual-oriented learning experiences in industrial arts. Koble's sample consisted of one-hundred-fifty seventh grade graphic arts students which were divided into ten intact classrooms. A Content Information Test and a Perceptual Motor Skill (PMS) Performance Test were constructed and used to measure the dependent variable.
The data indicate no significant difference in the results of group-oriented learning experiences and individual-oriented learning experiences in the amount of content information learned or in the degree of perceptual motor skill developed. In this study, group-oriented learning experiences and individual-oriented learning experiences were used with equal effectiveness in the graphic arts area of industrial arts in grade seven in terms of teaching content information and perceptual motor skill.

In a similar study, Rosenbloom (1977) examined the comparative effects of peer tutoring strategies, individual study, and teacher instruction, on the reading achievement of secondary school students within the setting of their self-contained English classes. Subjects (N = 93) were randomly assigned to one of four treatments and required to complete a fifteen-lesson reading improvement program. The peer tutoring group was divided into two groups—one receiving Learning Reinforcement theory training and the other without this training.

Following an analyses of covariance, no significant differences were found for reading achievement in treatment groups. Results of this study did not support previous research regarding the effectiveness of peer tutoring, there were indications that this strategy would be more acceptable to secondary school students if pairing relationships were not imposed. The effectiveness of a tutor training program based on learning reinforcement theory was not substantiated.

Devin-Sheehan, Feldman, and Allen (1976) presented a review of available published research on tutoring. They found that tutoring
programs were reported to be valuable for both tutors and tutees, but the evidence supporting generalizations about tutoring was often inconclusive. In a recent study, Novak (1980) examined the effects of peer teaching and independent study on vocabulary word learning of sixth-grade students. Findings of this study corroborates most peer teaching research that indicates peer teaching is at least as effective in producing learning gains as independent study. Novak recommends further research on variables (social-emotional characteristics) that may contribute to peer teaching effectiveness.

The central notion of research on individualized instruction is to determine the most effective instructional strategy to achieve a given set of objectives for an individual student. Comparative studies, which are designed to explore the differences in effectiveness between instructional method A and instructional method B for a particular group of students given a common set of instructional objectives, usually result in no significant differences between instructional methods. Bloom et al. (1971) state that when a researcher merely compares one instructional method with another he may be unable to demonstrate any differences in learner's achievement until he takes into consideration certain student characteristics. More appropriate questions in the field of research on individualizing instruction are those which relate to the degree of effectiveness of selected instructional strategies with selected kinds of students. What instructional strategies are most effective for a learner with given characteristics, as compared with a learner with another set of characteristics (Impellitteri & Finch, 1971)?
Investigation of Aptitude-Treatment Interaction

For many years educational research seemed to be predicated on the notion that there was a single best instructional method that could be used for every student. Current methodology is now recognizing that different instructional treatments may be optimal for maximizing the performance of students with different characteristics or aptitudes. Research concerned with adapting instructional treatments to individual differences among students' aptitudes has been termed aptitude-treatment interaction, abbreviated ATI. Cronbach and Snow (1969) defined the term aptitude as "any characteristic of the individual that increases (or impairs) his probability of success in a given treatment", and treatment as "variations in the pace or style of instruction" (p. 7). Berliner and Cahen (1973) prefer the term trait-treatment interaction rather than aptitude-treatment interaction. They believe that "trait" is less restrictive than other terms and includes characteristics such as personality, attitude, and interest variables.

Methodologically, the aptitude-treatment interaction (ATI) paradigm was the product of Cronbach's (1957) call for the unification of the correlational and experimental approaches to the study of behavior. Cronbach stressed the importance of bringing together the correlational approach, concerned with individual differences, and the experimental approach, concerned with a search for the best treatment. ATI research is of relatively recent origin. It is somewhat difficult to summarize the various findings since the studies are rather diverse
and since many of the early hypotheses on the type of aptitudes that many investigators thought would enter into ATI's in a rather straightforward manner proved to be either too simple in their conception or inappropriate in nature. Nevertheless, it is clear that ATI's exist, and several excellent reviews (Cronbach & Snow, 1977; Berliner & Cahen, 1973; Snow, 1976; Snow, Federico & Montague, 1980) of the current state-of-the-art have appeared in the last several years (Shuell, 1979). During the review of literature, several studies were found that made use of the aptitude-treatment interaction model for investigating variables pertinent to this study.

Psychological processes of the learner and the learning environment have received considerable emphasis from the educational research community (Cronbach & Snow, 1977; Snow, 1976; Glaser, 1974; Bracht, 1970; Fagan, 1979; Shuell, 1979). In a previously cited study (Haskell, 1969), the effects of personality characteristics upon learning by various modes of instruction were investigated. A treatment by levels (of personality) analysis of covariance design was used with achievement test scores serving as the criterion. No significant differences were found in the mean achievement of groups who received the various treatments. However, there were significant interactions between instructional methods and levels of subjects categorized as low, medium, and high on the general activity and friendliness personality variables. This finding suggests that the effectiveness of the method of instruction utilized will vary as a function of certain student personality characteristics. Haskell found that programmed instruction
appeared to hold promise for students who were agreeable and easy to get along with (high friendliness), while those who were more likely to be characterized as aggressive (low friendliness) appeared to perform better under conventional instruction.

Results of another previously cited study (Kirkpatrick, 1974) indicated a strong trend (not statistically significant) pointing toward the IPI method of instruction as being best suited for mastering content for those students with introversion tendencies. The trend further indicated that students with extraversion tendencies would generally achieve better via conventional methods of instruction.

A recent study (Baldwin, 1977) dealt specifically with the ATI model when the interaction of field-dependence and field-independence with the method of instruction in mathematics was investigated. This study, which used fifteen liberal arts mathematics classes at Nassau Community College, hypothesized that field-dependent subjects, preferring interaction with people, would achieve more in mathematics if permitted to study in homogeneous groups of field-dependents or in heterogeneous groups of two field-dependents and two field-independents. Secondly, the field-independent subjects would perform equally well in individual study, homogeneous group study, or heterogeneous group study.

The investigator used the Group Embedded Figures Test (GEFT) to establish two groups of individuals—field-dependent and field-independent. These students were then assigned to one of three methods
of instruction—homogeneous group study, heterogeneous group study and individual study. To account for any previous learning, a co-variate test was administered.

Using an analysis of covariance the first hypothesis that field-dependent students would achieve more in a group study than individual study was not substantiated. A reason for this might have been the result of too little time permitted to develop the proper group relations. The second hypothesis was substantiated and thus evidence was given to support the hypothesis that field-independent students would achieve equally well regardless of the method of instruction in mathematics. The overall statistical results did not provide evidence in support of the aptitude-treatment interaction model.

Statistical non-significance in ATI research studies, as reported in the Baldwin (1977) study, may be attributed partly to the inclusion of a general ability variable in the design of the study. An exemplary study (McLeod & Adams, 1979) in mathematics supports this suggestion. This study tested the hypothesis that the cognitive style of field-independence would interact with treatments that differed in the use of small groups as opposed to individual instruction. Students (N = 111) were assessed on field-independence (Hidden Figures Test) and general ability (SAT scores) and randomly assigned to treatments for a week of math instruction. Achievement was measured by an immediate posttest and a delayed retention test, and student ratings were also obtained.
Results of this study found a significant ($p < .05$) interaction with measures of field-independence when achievement was the dependent variable. However, when SAT scores were included in the regression along with measurements of field-independence, all interactions disappeared. As a result, it seems reasonable to conclude that the interactions that occurred were unstable and probably not due to field-independence. Findings suggest that interactions should be attributed to general ability and viewed with some caution. The difficulty of distinguishing between field-independence and general ability has been noted by several authors (Cronbach & Snow, 1977; Watkin, 1969).

Another interaction study (Root, 1978) attempted to determine whether student characteristics interact with instructional methods to affect learning outcomes. The instructional methods were "conventional" instruction (lecture with lab) and mastery learning (individualized self-paced instruction involving multi-media modules). The learner characteristics were achievement orientation, locus of control, and prior achievement.

Fifty-nine students from an Oregon State University Fisheries and Wildlife class were chosen as the experimental subjects for the study. They were randomly assigned to the conventional instruction treatment or the mastery learning treatment. The duration of the experimental treatment period was two and one-half weeks. The students were pretested on the achievement via conformance ($Ac$) and achievement via independence ($Ai$) scales of the California Psychological Inventory and the Internal-External Locus of Control scale.
An ATI analysis revealed a significant effect involving Ac and the achievement posttest. The interactions were disordinal; students who scored high on the Ac scale were found to do better if assigned to conventional instruction than if assigned to mastery learning; students who scored low on this scale did better if assigned to mastery learning than if assigned to conventional instruction. The researcher's review of literature found that the Ac, Ai, locus of control, and prior achievement all have been shown in prior research to interact with instructional variations to affect achievement. In this study, however, only Ac was involved in a significant ATI effect. This may be because the study used a class that was taken as an elective by many of the students and knowledge of the content assessed by the achievement test was primarily of facts, terminology, and classifications. The ATI effects were sufficiently large to warrant further consideration in the design of college-level instruction.

Domino (1971) conducted an interesting study which investigated the interactive effects of achievement orientation and teaching style on academic achievement. In this experiment, Domino identified fifty students with achievement via independence (Ai) and fifty students with achievement via conformance (Ac). The California Psychological Inventory (CPI) was used to classify and block students relative to social orientation. Twenty-five students from each block were assigned to one of two treatments--independent teaching style and conformity teaching style. Following a factorial analysis, Domino found significant interaction--students characterized as
"achieving via conformity" (high Ac, low Ai) do best when courses require conformity, while "independent achievers" (high Ai, Low Ac) do best in courses arranged to encourage independence.

Domino reported that these significant interactions have implications for educational practice. His findings suggest that homogeneous grouping of students on the basis of their achievement orientation is a desirable practice, since it maximizes both their factual learning and their reported satisfaction. In this study, Domino also employed a double-blind assignment procedure which prevented the instructor from knowing achievement orientations of the students in the study.

Domino's (1971) findings were substantiated in a recent study (Peterson, 1977). This study explored the effects of student personality and teacher behavior on student achievement and attitude. Subjects for this study (N = 103) were ninth graders in a high school social science course. Specifically, this study investigated interactions between student personality and teaching approach using aptitude and treatment variables similar to those used in the Domino (1971) study. In summary, the results lend strong support to Domino's (1971) notion that independent students achieve more with a teaching approach that permits independence, and conforming students achieve more with an approach that requires conformance.

There has been considerable research, as reported by (Renzulli & Smith, 1978) concerning matching students to learning environments.
They state that "in order for maximum efficiency to occur in the learning process it is important to have some degree of congruence or matching between teaching strategies and student learning style" (p. 5). Their findings suggest that an effort to match teaching strategy to the student's learning style preference may be beneficial. The results of one study (Jellema, 1976) suggest this notion of matching may not be true in some situations.

Jellema proposed in his study that the educational process could be more efficacious if the instruction and learning materials were developed in harmony with the way in which students prefer to learn. This study was designed to measure the learning styles of the students, and to provide experimental research evidence of the effectiveness of matching the learning style of the student with an instructional mode. This experimental study used a group of secondary school students enrolled in an area vocational school (N = 100). The preferred learning styles of the students were measured using the Learning Activities Survey. This instrument measures learning styles on two continua, concrete/symbolic and structured/unstructured. The two selected instructional modes were direct-detailed and directed-discovery.

Results of this study suggest that: (1) it is possible to assess the learning styles of secondary school students and (2) the experimental matching of learning style with instructional mode yielded inconclusive results. In response to this finding, Jellema suggested that a longer term study should be conducted before accepting
or rejecting the need to consider student learning style as a factor in the development of curriculum.

Summary of the Literature

The primary focus of this literature review was in the area of aptitude-treatment interaction (ATI). An interaction between treatment and/or attribute is said to exist when instructional treatment effects are specific to one level of attribute and are not generalizable across both or all levels of the attribute variable. A major concern in ATI studies is the selection of learner attribute variables which may interact with the treatment variable. The review of literature surveyed several learner personality characteristics which have an effect on achievement and are of interest in this study. Based upon this review, the following personality characteristics or learner attributes appear to be positively correlated in respect to achievement: (1) independence, (2) conformance, (3) flexibility, and (4) sociability. The review suggested that a student's social learning orientation is an important learning characteristic or attribute that should be matched to teaching strategy for maximum learning (Reid et al., 1973; Doty & Doty, 1964; Brooks, 1976; Domino, 1971; Kirkpatrick, 1974).

The literature review surveyed a variety of instruments to measure student learning characteristics. As stated by Cronbach, Glaser and others, classification is very important in any ATI study. The review suggests that the CPI (California Psychological Inventory) is a valid and reliable instrument for measuring learner characteristics (Reid et al., 1973; Domino, 1971; Root, 1978; Peterson, 1977).
The literature review also suggests that the student's mental ability variables should be isolated or controlled. Studies, previously cited, (Doty & Doty, 1964) used students' GPA which was defined as academic ability to adjust student achievement scores in terms of their academic ability. Doty's study did show a significant correlation (.46) between achievement and the student's GPA. The (Haskell, 1969) study, previously cited, also adjusts for student ability by grouping students into three ability groupings. Jellema (1976) found a positive correlation between reading comprehension level and achieved scores when using learning materials that require reading. In the review a study was also cited (McLeod & Adams, 1979) which found that when general ability was included in the regression, all interactions disappeared.

Delaney and Maxwell (1980) in a survey of ATI literature examined the appropriateness of using covariates in designs which simultaneously investigate the effects of learner attributes and experimentally assigned treatments. In this design the ATI for a particular learner attribute such as social learning orientation is of primary interest. Delaney and Maxwell's concern was with the issue of using some other aptitude variable such as mental ability as a covariate to improve the precision of the ATI analysis. Their findings suggest that the use of analysis of covariance (ANCOVA) provides a needed means to achieve more powerful designs for assessing ATI's.
There appears to be no question that aptitude-treatment interactions exist in educational settings. Cronbach, Snow, and others have pointed out many problems in ATI research. Empirical evidence supporting ATI's is tenuous. Bracht (1969) in a comprehensive literature review searched for an explanation for the insufficiency of ATI findings showing disordinal interaction between alternative treatments and personological variables. Bracht's survey of 62 research articles revealed only four with results meeting his criteria for disordinal interaction. Bracht's disordinality interaction criterion has been criticized as overly stringent by Cronbach and Snow (1977).

In a follow-up study, Delaney and Maxwell (1980) using the same studies as Bracht, revealed that more than three-fourths (48 of 62) of Bracht's reviewed studies did not use ANCOVA in a test of ATI. Delaney and Maxwell's findings, previously cited, suggest that ATI studies are made more powerful by inclusion of a covariate.

The review of literature did suggest several problems with treatment variables. For example, in the Baldwin study the lack of significant results may have been that too little time was permitted to develop proper group relations. The Jellema study suggests that a longer term of study be conducted. In analyzing treatments in ATI research, Fagan (1979) stated that a persistent problem in ATI
research has been the need for a better conceptualization of instructional treatments. Fagan emphasized the importance of considering the psychological processes called upon by the instructional treatment and the generalizability of the treatment. The same argument is used by Snow (1978) when he summarizes the problem when he states that "the ultimate goal is demonstration that aptitude measures connect to instructional treatment variations in understandable and predictable ways." Snow goes on to say that this "proof will be in real-school, long duration, instructional studies" (p. 261). These problems, both theoretical and methodological, need to be resolved before ATI research can provide meaningful results which have promise of practical applications.

This review represents, for the most part, research done on the college level. The high school population is very much different from that of colleges. High school students are less mature, grouping is relatively more heterogeneous, and the students may be less highly motivated (Porter, 1964). In addition, the researcher found only a few studies in the area of industrial arts education which employed the ATI approach. This review indicates that there is a manifested gap of ATI research in industrial arts education.

The review of related research indicates that additional investigation is required to determine what interactions exist between aptitude (social learning orientation) - treatment (instructional grouping) and achievement. The results of this review suggest that these personality variables and treatments provide fruitful constructs for ATI research.
The review of aptitude-treatment interactions supports the statement made by Cronbach and Snow (1977) when they state that "well substantiated findings regarding ATI are scarce. Few investigations have been replicated. "Many reports (of both positive and negative results) must be discounted because of poor procedures" (p. 6). The review of literature supports the importance of learning orientation and instructional grouping as valid aptitudes and treatments, but with sometimes conflicting results. Cronbach and Snow go on to state that "learner x treatment interaction is an essentially new scientific problem, and reaching consolidated understanding in such matters often requires decades" (p. 494).

**Statement of Hypotheses**

This study attempted to provide data used to test these four null-hypotheses:

\[ H_0^1 \] There is no significant differences in the mean achievement between students who achieve instruction via small groups and those who receive instruction via independence.

\[ H_0^2 \] There is no significant difference in the mean achievement between students that have a small group learning orientation receiving instruction via independence than similar students receiving instruction via small group instruction.
There is no significant difference in the mean achievement between students that have an independent learning orientation receiving instruction via independence than similar students receiving instruction via small group instruction.

There is no significant interaction between students receiving instruction via independence or small group and their learning orientation.
The Setting

The subjects for this study came from the general student population at Westerville South High School, Westerville, Ohio. The population for this study was defined as all students enrolled in the beginning graphic arts course during the first semester 1981. Westerville is a suburban community of approximately 55,000 people in central Ohio. This small community would most likely be classified in the middle socio-economic level and its racial makeup is nearly exclusively white. The general student population at Westerville South High is approximately 2,000 students, in grades 9-12, ages 14-18.

Learning Materials and Instructional Environment

The beginning graphic arts course at Westerville South High uses instructor-developed learning activity packages as the dominant mode of instruction. The purpose of the learning activity package is to: (1) provide guided hands-on experiences, (2) provide for individual needs and differences, and (3) make maximum use of time, materials and facilities.

The system of graphic arts instruction is divided into two major elements, the Unit Learning Packet (see Appendix A) and the
Laboratory Learning Package (see Appendix B). The Unit Learning Packet (ULP) guides the learner through a series of academically oriented experiences to include: (1) unit objectives, (2) text readings, (3) programmed instruction, (4) audio/visual materials, and (5) student evaluation. The Laboratory Learning Package (LLP) guides the learner through a progression of laboratory activities, which includes: (1) introduction, (2) work station description, (3) objectives, (4) reference sources, (5) lab review questions, (6) laboratory requirements, and (7) student evaluation.

The instructional content for the beginning graphic arts course is divided into seven units of study, each having its own ULP and LLP. Each unit of study is based upon a major component of the graphic arts industry; they are: Artwork, Image Assembly, Photo Conversion, Image Carrier, Image Transfer, Finishing, and Screen Printing. Students in each beginning graphic arts class study and work either independently or in small groups of three to four students per group. Each student is assigned to a different unit of study or work station and is free to select and rotate to another unit of study, following completion of the ULP's and LLP's minimum requirements. Each unit of study is designed to be independent, with no particular sequence.

**Research Instruments and Data Collection**

The collection of data necessary to test the hypotheses for this problem were derived from three instruments: (1) California Short Form Test of Academic Aptitude Level 5 (SFTAA); (2) Sections
of the Ohio Vocational Education Achievement Lithographic Printing Test; and (3) California Psychological Inventory. The review of literature indicated that a student's mental ability should be controlled. The researcher selected the SFTAA to measure subject academic ability. Scores from this measure were used to remove the effect of the controlled variable (mental ability) from the relationship between the independent and dependent variables.

The Short Form Test of Academic Aptitude includes verbal and non-verbal concepts in comprehending relationships among ideas presented in various forms. Scores on the language and non-language sections are derived from items presented as two different types of stimuli. The language section is composed of items which are primarily verbal in nature, while the non-language items are essentially non-verbal, i.e. pictorial and numerical. The abilities measured by the language section are generally regarded as more closely related to academic school-oriented tasks than are those measured by the non-language section.

For purposes of this study, the researcher used both sections of the aptitude measure to equate subjects in terms of academic ability. Instructional stimuli received in the beginning graphic arts course include not only language stimuli, i.e. ULP's, textbooks and LLP's but also considerable non-language stimuli in the form of manipulative hands-on learning experiences. In this respect, the researcher used the composite raw scores from the language and non-language sections of the aptitude measure. The SFTAA was
used to statistically eliminate pretreatment biases among groups on mental ability (see Appendix C for subject test data). The test publisher cites a reliability coefficient (KR-20) of .93 for the SFTAA (Sullivan, Clark, & Tiegs, 1974, p. 49).

To measure student achievement or learner outcomes, the researcher selected the Ohio Vocational Education Achievement Lithographic Printing Test. This standardized test consists of 318 multiple choice items, with four possible responses, where one choice is correct and the other three are distractors. The test covers nine components of the graphic arts: (1) Layout and Design, (2) Composing, (3) Paste-ups, (4) Proofing, (5) Camera and Film Processing, (6) Stripping, (7) Platemaking, (8) Offset Presses, and (9) Finishing Operations. For this test, the publisher states it has a reliability coefficient (K-20) of .911 (Shoemaker, 1978, p. 15).

Due to validity problems of the vocational printing test encountered during the pilot test, the researcher used a revised version of the achievement test. The revised test has content validity for a beginning industrial arts course in graphic arts. Original test items which had no relevance to course content were deleted. The revised test consists of 98 multiple choice items, selected from the 318 item achievement test. The revised test also includes a section on screen printing. The revised printing test had a reliability coefficient (KR-20) of .853. (See Appendix D for sample test copy and Appendix E for subject test data.)
The review of literature suggested that student variables of sociability, conformance, and independence vary with respect to student achievement. In addition to these variables the researcher, based upon professional experience, believes that self-control should be added to the list of measured variables. The California Psychological Inventory (CPI) was selected due to the high association between selected social variables and the scales included in this inventory. Student social/psychological variables were measured using four scales from the CPI, namely, achievement via independence (Ai), achievement via conformance (Ac), sociability (Sy), and self-control (Sc). The test publisher cites the following test-retest (N = 101 male high school students) coefficients of reliability (Ai) .63, (Ac) .60, (Sy) .68, and (Sc) .75 (Gough, 1975). The entire inventory was administered, but only the selected scales were considered in the framework of this study. The following scales are defined as they are used in this study (Gough, 1975):

**Achievement via conformance.** To identify those factors of interest and motivation which facilitate achievement in any setting where conformance is a positive behavior. **HIGH SCORERS:** capable, cooperative, organized, responsible, stable, and sincere; persistent and industrious; valuing intellectual activity and achievement. **LOW SCORERS:** coarse, stubborn, awkward, insecure, and opinionated; easily disorganized under stress or pressures to conform; pessimistic about their occupational futures.

**Self-control.** To assess the degree and adequacy of self-regulation and self-control and freedom from impulsivity and self-centeredness. **HIGH SCORERS:** calm, patient, practical, self-approving, thoughtful and deliberate; strict and thorough in their own work and in their expectations for others; honest and conscientious. **LOW SCORERS:** impulsive, shrewd, excitable, irritable, self-centered, and uninhibited; aggressive and assertive; overemphasizing personal pleasure and self-gain.
Achievement via independence. To identify those factors of interest and motivation which facilitate achievement in any setting where autonomy and independence are positive behaviors. HIGH SCORERS: mature, forceful, dominant, demanding and foresighted; independent and self-reliant; having superior intellectual ability and judgement. LOW SCORERS: inhibited, anxious, cautious, dissatisfied, dull; submissive and compliant before authority; lacking in self-insight and self-understanding.

Sociability. To identify persons of outgoing, sociable, participative temperament. HIGH SCORERS: confident, enterprising, ingenious, and outgoing; competitive and forward; original and fluent in thought. LOW SCORERS: awkward, conventional, quiet, submissive; detached and passive in attitude; suggestible and overly influenced by others' reactions and opinions. (pp. 10-11)

Subject Assignment to Blocks Procedure

The researcher selected a procedure intended to place individuals validly into learning orientation groups or blocks. Recognizing the necessity of interactions between the CPI scales, Gough (1975) recommends a multiple scale analysis. The researcher used the composite scores of the achievement via independence (Ai) and sociability (Sy) and the composite scores of the achievement via conformance (Ac) and self-control (Sc) to establish two sets of scores for student classification. The intercorrelations between these multiple-scale analyses are .46 (Ai and Sy) and .60 (Ac and Sc) (Gough, 1975). The researcher believes that overlapping similar adjectives results in a more valid placement of an individual. In this respect, Gough (1975) states that "when the behaviors suggested by two or more scores seem to be similar, they may well
reinforce each other" (p. 12). Also this procedure should increase the reliability of the measure by increasing the item pool (Ai/Sy scales - 68 items, Ac/Sc scales - 87 items for a total of 155 items).

Following administration of the inventory, each subject's raw score for each scale was converted to a standard score. The first step of the blocking procedure consisted of rank ordering the composite Ai and Sy scores. Using the established cut-off limits as the upper 45% of the scores (30 subjects) and the lower 45% of the scores (30 subjects) on the Ai/Sy scales, two extreme groups were established. High scores on the Ai/Sy scales indicated an independent learning orientation while low scores indicated a group or team learning orientation.

A second step of the blocking procedure was used to eliminate subjects with conflicting Ai/Sy and Ac/Sc scores. All subjects scoring in the lower 45% on the Ai/Sy scales and having a Ac/Sc score of a -1SD or below the Ac/Sc mean were excluded. Scoring in the lower 45% on the Ai/Sy scales indicated a group learning orientation, while scoring a -1SD or below the Ac/Sc mean indicated that the subject had an independent learning orientation. Likewise, all subjects were eliminated who scored in the upper 45% of the Ai/Sy scales and who had an Ac/Sc score of +1SD or above the Ac/Sc mean. Scoring in the top 45% on the Ai/Sy scales indicated an independent learning orientation, while scoring +1SD or more above the Ac/Sc mean indicated that the subject had a group learning orientation. (See Appendix F for subject data.)
As a result of these blocking procedures, twenty-four students were classified as having an independent learning orientation and twenty-four students were classified as having a group or team learning orientation. All subjects who were eliminated either in the first round or second round were assigned to work independently, thus preventing their bi-orientational influences on the actual participants in the study.

Additional data, such as sex, age, grade level, attendance, attitude survey, work stations completed, GPA and graphic arts grade were collected. These data, not being part of the actual study data, may be used by the researcher at a later date for correlation or other types of analyses. A subject data card was used by the researcher to collect and organize data (see Appendix G).

**Summary of Research Variables**

The review of literature suggested several independent variables of principal interest in this study. The variable of student mental ability was identified as a possible extraneous variable. The researcher exercised statistical control (ANCOVA) over this independent variable by incorporating its effect into the basic design of the study as a covariate. The academic aptitude measure (SFTAA) was used to describe this variable quantitatively.

The second independent variable of this study was assigned as to students' sociological learning orientation. The review of literature identified this variable as being significantly correlated with the
dependent variable. This concomitant variable was used to exploit learning orientation information about the subjects. The CPI was used to measure the students' learning orientation and provide the basis for the blocking variable.

The third independent variable was the treatment and was manipulated by the researcher as to instructional setting or mode--independent or small group. Subjects in each assigned block (independent and group orientation) were randomly assigned to one of the two instructional modes.

The dependent variable was student achievement on a multiple-choice test, given as a posttest following treatment.

**Research Design**

This study was designed as an experimental study to investigate the aptitude-treatment interactions as specified in the stated hypotheses. Specifically, a 2 x 2 factorial design was selected to test whether the effects of instructional treatment are generalizable across both levels of learning orientation or whether the effects are specific to specific levels of learning orientation.

**Analysis Procedures**

1. Collection of interval data in the form of raw scores from the ability measure (pretest) and from the achievement measure (posttest).
2. The unit of analysis was the individual subject. Within-group independence of response will be achieved by (a) randomly assigning students to treatment groups and (b) exposing students individually to their assigned treatment conditions.

3. An analysis of covariance (ANCOVA) was used to statistically equate the groups on the control variable, mental ability.

4. The SPSS computer program designed for the ANCOVA was used to analyze the empirical data.

5. Statistical assessment of treatment effects and their interactions with the orientation variable was examined at the .05 level of significance.

Research Procedures

The following steps were followed in conducting this study:

Step 1. Subject Selection. The population for this experimental study included all 1981 first semester graphic arts students at Westerville South High School (N = 66). On the first day of classes, student demographic information was collected and the CPI was administered. In order to help prevent treatment bias, only the student numbers, not names, were recorded on the inventory response sheets. Following the two step blocking procedure, described previously, the researcher classified forty-eight subjects to one of two levels of the blocking variable. The blocking variable has been defined as social learning orientation (independent or small group learning
orientation). The sample size for this study was determined by the testing procedures that were established to classify subjects into either independent or small group learning orientations.

**Step 2. Treatment Assignment.** A double-blind assignment procedure was used to randomly assign subjects to one of the two treatment groups. The researcher prepared a list (student numbers only) of twenty-four subjects classified as having an independent orientation and a list of twenty-four subjects classified as having a small group learning orientation. The researcher's advisor then randomly assigned twelve students classified as being independent to the independent instructional treatment and twelve students similarly classified to the small group instructional treatment. The same procedures were employed to assign students with a small group learning orientation to the two instructional modes or treatments. By using a double-blind procedure, the researcher (instructor) did not have knowledge as to which students with specific learning orientations were assigned to which treatment group. The researcher (instructor) did know which students were to receive which treatment.

A computer-generated random assignment roster was used to form subgroups (Taylor, 1978). Four sub-groups of twelve subjects each were established using the above techniques. In order to investigate the aptitude-treatment interactions as specified in the hypotheses, the researcher used a $2 \times 2$ factorial design. An overview description of the experimental conditions is presented in Figure 1.
### SOCIAL LEARNING ORIENTATION (ASSIGNED)

<table>
<thead>
<tr>
<th>INSTRUCTIONAL MODE (Manipulated)</th>
<th>Independent</th>
<th>Small Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student learning orientation</td>
<td>Students with independent learning orientation who use materials independently.</td>
<td>Students with group learning orientation who use materials independently.</td>
</tr>
<tr>
<td>Group</td>
<td>Students with independent learning orientation who use materials in a small group.</td>
<td>Students with group learning orientation who use materials in a small group.</td>
</tr>
</tbody>
</table>

**Figure 1. Experimental Conditions**

**Step 3. Pretest.** A pretest in the form of an aptitude test (SFTAA) was administered to all participants on the second day of classes. Scores from the pretest were used to adjust posttest (achievement) scores for any initial differences (pretreatment) in aptitude between sub-groups.

**Step 4. Treatment.** The review of literature suggested that treatments in ATI research be carefully arranged. Fagan (1979) advocated a conceptualization of treatments in ATI research in which the psychological processes of the learner are taken into account in designing treatments. Two treatments, functionally different, were designed: (1) independent instruction, and (2) small group instruction.

Students assigned to the instruction via independent treatment studied, worked and learned in an independent environment. Each student in this group was required to individually work with the instructional materials. Each individual student completed all required academic and lab assignments on an independent basis with no
direct or classroom assistance from other class members. Students in this group were instructed to communicate with the teacher when assistance was needed.

Students assigned to the instruction via small groups used the same instructional materials as the independent group but did so in a group or social setting. Small groups of three or four students were assigned to work stations or units of study and worked and used the instructional materials using a "team" approach. Peer teaching was emphasized in this group. Students were encouraged to seek help from other students in their group while working in lab, studying the text, and while completing learning activity packages. A team approach was also used by students in this treatment group, when preparing for written and manipulative tests over unit material.

The same instructional materials were used by both treatment groups. The teacher, learner objectives, classroom, and laboratory facility were the same for both treatment groups. The instructional methodology centered around learning activity packages and was the same for both treatment groups. Each package was designed to be used by students independent of the instructor. Presage (teacher) variables and process (instructional) variables remained constant for each participant during the study. The only variation of process variables was the treatment where one group of students used the materials independently while the other group used the same materials but in small groups. Each graphic arts student or small group had limited control over learning strategy, content, objectives, and
rate. Limited control means that the individual student or small group may select the sequence of units studied, the completion of optional objectives and content within each activity package, and the rate or time that is spent on each activity package. All treatment groups were exposed to the instructional materials for the same length of time, eighteen weeks. There was no homework requirement for either treatment group. All students were exposed to treatment only during regularly scheduled classroom periods.

Step 5. Posttest. The achievement or learning outcome of all groups was measured using the revised Lithographic Printing Test. The achievement test was administered five school days before the end of the semester. Administration of the test was the same for all subjects.

Pilot Study

The research methods and procedures for this study were a result of an extensive pilot study conducted by the researcher during the 1980/1981 school year. During the pilot study, the entire research procedure was carried out. The preliminary trial resulted in: (1) revising data collection methods, (2) revision of scoring techniques for the CPI, (3) complete revision of the achievement measure, (4) practice administrating the ability measure, (5) preliminary testing and revising of the hypotheses, (6) a thorough check of the planned statistical and analytical procedures, and (7) monitoring treatment procedures to reduce procedural slippage. The researcher believes this preliminary trial of research measures and techniques helped to
permit generation of more accurate answers to the research questions proposed in this study.

**Basic Assumptions of the Study**

The researcher made the following assumptions:

1. That the beginning graphic arts students received no prior instruction in the area of graphic arts or printing. Student achievement was attributed to the instructional-treatments during the course of the study.

2. That all students participating in the study responded with honest and true responses on the California Psychological Inventory.

3. That the aptitude variable of mental ability accurately measured pretreatment biases among groups and was independent of the treatments.

4. That observations within the treatment-by-blocks design were normally and independently distributed within blocks in the population, and that the variance of observations within population blocks was the same over both learning orientation blocks. As described previously, the subjects within blocks were randomly assigned to the two levels of the treatment variable. Random assignment, together with the assumption that both treatments had a constant effect on observations within respective treatment groups, allows the assumption that observations were normally and independently distributed
within population cells, and the variation of observations within cells were homogeneous (Kennedy, 1978).

5. That due to the replicative nature of this study, it is assumed that significant interactions between variables could be generalized to other school populations.

**Delimitations and Limitations of the Study**

This study was delimited in the following respects:

1. Modes of subject treatment were delimited to independent and small group instructional treatment modes. Due to the two treatment design, subjects assigned to the independent treatment groups did not work toward achieving one of the generally accepted objectives of industrial arts education that of developing desirable social relationships and positive attitudes of cooperation when working and learning with others. The departure from this objective was justified in terms of design efficiency and did not bias the results in that attainment of this objective was not measured on the achievement test.

2. Subject attribute blocking variables were delimited to (1) independent and (2) group learning orientations.

3. Measurement of term achievement was delimited to student cognitive knowledge as measured by an objective test. Motor skill and manipulative ability were not measured or considered in this study.
4. Measurement of subject pretreatment biases was delimited to scores obtained from the Short Form Test of Academic Aptitudes.

5. The length of the study was limited to one semester (eighteen weeks).

6. Subject selection was limited to the beginning graphic arts classes at Westerville South High School, first semester, 1981/1982.

This study was limited to the following respect:

1. The generalizability of results are limited to future beginning graphic arts classes at Westerville South High School, given the facility, instructional techniques, instructor and other variables remain constant.
CHAPTER IV

RESULTS

This chapter presents the findings resulting from an analysis of investigative data. Included in this chapter are descriptive tables, figures, graphs, and brief narratives summarizing the results of group test data, analysis of covariance, and the post hoc analysis. Contained in this chapter are all necessary data for reporting study findings; individual subject data may be found in Appendixes C and E. Chapter IV is organized into the following sections: (1) analysis of data, (2) review of variables and data collection instruments, (3) restatement of the null hypotheses, (4) discussion of descriptive data, (5) statement of findings, (6) discussion of null hypotheses, and (7) chapter summary.

Analysis of Data

The data from this investigation were analyzed at The Ohio State University Instructional Resource Computer Center. The Statistical Package for the Social Sciences (Nie, Hull, Jenkins, Steinbrenner, & Brent, 1975) computer program was utilized in the analysis. The alpha level .05 was chosen as an appropriate level of statistical significance for an inquiry of this nature. The unit of analysis was the individual subject.
Review of Variables and Instruments

The independent variable of subject mental ability was used as a covariate to statistically eliminate pretreatment biases among treatment groups. The Short Form Test of Academic Aptitude quantitatively measured this variable. The reliability coefficient (KR-20) of .93 was cited for this measure (see Appendix C for subject data).

The second independent variable was assigned as to subjects' social learning orientation. Subjects were blocked (independent or group learning orientation) according to their scores on the California Psychological Inventory. (See Appendix F for Subject Blocking data and Procedures.)

The third independent variable was the treatment and was manipulated by the researcher as to instructional setting (independent or small group). Subjects in each assigned block (independent and group orientation) were randomly assigned to one of the two instructional modes.

The dependent variable was student achievement as measured by a 98 item multiple-choice test. The test was administered as a posttest following treatment (see Appendix D). The reliability coefficient (KR-20) of .853 was cited for this measure (see Appendix E for subject data). The achievement measure was machine scored by the Office of Evaluation at The Ohio State University.

Restatement of the Null Hypotheses

Below are statements of the null hypotheses for this study:
**H0₁** There is no significant difference in the mean achievement between students who achieve instruction via small groups and those who receive instruction via independence.

**H0₂** There is no significant difference in the mean achievement between students that have a small group learning orientation receiving instruction via independence than similar students receiving instruction via small group instruction.

**H0₃** There is no significant difference in the mean achievement between students that have an independent learning orientation receiving instruction via independence than similar students receiving instruction via small group instruction.

**H0₄** There is no significant interaction between students receiving instruction via independence or small group and their learning orientation.

**Discussion of Descriptive Data**

The reporting of study results includes several tables of descriptive statistics. Tables 1, 2, and 3 present group means and standard deviations for the covariate measure, unadjusted achievement scores, and adjusted achievement scores respectively. Treatment groups are distinguished by the following descriptions: Group 1 is identified as those students having an independent learning orientation and who received instruction in an independent setting. Group 2
is identified as those students having an independent learning orientation and who received instruction in a group setting. Group 3 is identified as those students having a group learning orientation and who received instruction in an independent setting. Group 4 is identified as those students having a group learning orientation and who received instruction in a group setting (see Figure 2).

<table>
<thead>
<tr>
<th>LEARNING ORIENTATION (ASSIGNED)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INSTRUCTIONAL MODE (Manipulated)</strong></td>
</tr>
<tr>
<td><strong>GROUP</strong></td>
</tr>
<tr>
<td>Independent</td>
</tr>
<tr>
<td>(Group 1)</td>
</tr>
<tr>
<td>Small Group</td>
</tr>
<tr>
<td>(Group 2)</td>
</tr>
</tbody>
</table>

Figure 2

Treatment Group Layout
### Table 1

Means and Standard Deviations of Academic Aptitude Scores by Learning Orientation and Treatment

<table>
<thead>
<tr>
<th>Learning Orientation</th>
<th>Treatment Variable</th>
<th>Independent Means</th>
<th>SDs</th>
<th>Group Means</th>
<th>SDs</th>
<th>Overall Means</th>
<th>SDs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N = 12</td>
<td></td>
<td>N = 12</td>
<td></td>
<td>N = 24</td>
<td></td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td>60.83</td>
<td>10.48</td>
<td>58.42</td>
<td>9.43</td>
<td>59.63</td>
<td>9.83</td>
</tr>
<tr>
<td>Group</td>
<td></td>
<td>50.75</td>
<td>11.16</td>
<td>54.58</td>
<td>8.99</td>
<td>52.67</td>
<td>10.1C</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>55.79</td>
<td>11.77</td>
<td>56.50</td>
<td>9.22</td>
<td>56.15</td>
<td>10.4</td>
</tr>
</tbody>
</table>

### Table 2

Unadjusted Means and Standard Deviations of Achievement Scores by Learning Orientation and Treatment

<table>
<thead>
<tr>
<th>Learning Orientation</th>
<th>Treatment Variable</th>
<th>Independent Means</th>
<th>SDs</th>
<th>Group Means</th>
<th>SDs</th>
<th>Overall Means</th>
<th>SDs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N = 12</td>
<td></td>
<td>N = 12</td>
<td></td>
<td>N = 24</td>
<td></td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td>67.56</td>
<td>11.20</td>
<td>60.17</td>
<td>8.31</td>
<td>63.83</td>
<td>10.34</td>
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<tr>
<td>Group</td>
<td></td>
<td>51.00</td>
<td>12.71</td>
<td>62.50</td>
<td>6.45</td>
<td>56.75</td>
<td>11.47</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>59.25</td>
<td>14.43</td>
<td>61.33</td>
<td>7.37</td>
<td>60.29</td>
<td>11.38</td>
</tr>
</tbody>
</table>

(N = 12) (N = 12) (N = 24) (N = 24) (N = 48) (N = 48)
Table 3

Adjusted Means of Achievement Scores by Learning Orientation and Treatment

<table>
<thead>
<tr>
<th>Learning Orientation</th>
<th>Treatment Variable</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Independent Means</td>
<td>Group Means</td>
</tr>
<tr>
<td>Independent</td>
<td>65.51 (N = 12)</td>
<td>59.20 (N = 12)</td>
</tr>
<tr>
<td>Group</td>
<td>53.29 (N = 12)</td>
<td>63.16 (N = 12)</td>
</tr>
<tr>
<td>Overall</td>
<td>59.40 (N = 24)</td>
<td>61.18 (N = 24)</td>
</tr>
</tbody>
</table>

Statement of Findings

This research study employed a 2 x 2 factorial treatment-by-blocks design to investigate the aptitude-treatment interactions between selected subject characteristics and instructional treatments. An analysis of covariance, using academic aptitude as the covariate, was performed to determine whether there was a significant difference between adjusted group means (see Table 4). Subjects were first blocked as to social learning orientation (independent or group) variable (A), and then randomly assigned to one of two instructional settings (independent or group) variable (B). The dependent variable was subject term achievement.
Table 4
Analysis of Covariance of Posttest Scores by Learning Orientation and Treatment

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariate (Apt)</td>
<td>1</td>
<td>930.400</td>
<td>930.400</td>
<td>9.915*</td>
</tr>
<tr>
<td>Orientation (A)</td>
<td>1</td>
<td>232.564</td>
<td>232.564</td>
<td>2.478</td>
</tr>
<tr>
<td>Treatment (B)</td>
<td>1</td>
<td>40.490</td>
<td>40.490</td>
<td>0.431</td>
</tr>
<tr>
<td>Orientation x Treatment (AB)</td>
<td>1</td>
<td>855.584</td>
<td>855.584</td>
<td>9.117*</td>
</tr>
<tr>
<td>Residual</td>
<td>43</td>
<td>4035.165</td>
<td>93.841</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>6091.875</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .05

As indicated in Table 4, there were significant differences evident in the analysis in terms of interaction. For the dependent variable, achievement, the analysis produced a significant interaction between learning orientation and instructional treatment (AB), $F(1,43) = 9.117, p < .05$. The analysis also indicated that the main effects due to learning orientation (A) and instructional treatment (B) were not significant, $F(1,43) = 2.478, p > .05$ and $F(1,43) = 0.431, p > .05$, respectively.

The graph in Figure 3 indicates that the nature of the interaction between learning orientation and treatment (AB) was disordinal. This type of interaction negates serious interest in the main effects of the instructional treatment (B) or learning orientation.
variables (A). In order to determine exactly where the significant differences were among the four learning orientation and treatment adjusted cell means, it was necessary to follow-up with an appropriate post hoc comparison test. Tukey's honest significant difference (HSD) test for equal n pairwise comparison was used for the post hoc procedure.

\[ I = \text{Independent Learning Orientation} \]
\[ G = \text{Group Learning Orientation} \]

Tukey's HSD test, which obtains the minimal difference needed between means for significance at a desired overall alpha level, was performed using adjusted group means (see Table 3). Adjusted group
means were derived mathematically by the formula stated in Figure 4
where \( \bar{X}^{*.j} \) was the adjusted achievement cell mean (Table 3), \( \bar{X}.j \) was
the unadjusted achievement cell mean (Table 2), \( \hat{\beta} \) \( p \) was the covariate
raw regression coefficient of 0.425, and \( \bar{C}.j \) and \( \bar{C}.. \) are aptitude
cell means the the aptitudde overall mean respectively (see Table 1).

\[
\bar{X}^{*.j} = \bar{X}.j - \hat{\beta} \ p \ (\bar{C}.j - \bar{C}..)
\]

Figure 4
Computation of Adjusted
Means (Kennedy, 1978)

In order to control additional sampling error associated with
adjusted group means, the researcher used the formula depicted in
Figure 5 to compute Tukey's HSD minimal difference.

\[
\hat{\Psi} \ (hsd) = q \ (a) \ \sqrt{\frac{MS(S/A) \ [1 + \frac{SS(A)^*}{(a-1) \ SS(S/A)^*}]}{n}}
\]

Figure 5
Tukey's HSD with
Adjusted Means Equation
(Kennedy, 1978)

A one-way analysis of variance (ANOVA) was performed on the
covariable academic aptitude to derive the necessary sums of squares
and the error sums of squares associated with the covariate (see Table
5). The resulting F ratio of this analysis was not significant, \( F \)
(3,44) = 2.32, \( p > .05 \).
Table 5

One Way Analysis of Variance of Pretest Academic Aptitude Scores by Treatment Groups

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>704.229</td>
<td>234.743</td>
<td>2.32</td>
</tr>
<tr>
<td>Error</td>
<td>44</td>
<td>4445.750</td>
<td>101.039</td>
<td></td>
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<tr>
<td>Total</td>
<td>47</td>
<td>5149.979</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

p > .05

In testing for Tukey's minimal difference criterion, the only significant difference observed was the pairwise comparison between Group 1 and Group 3 (see Figure 2). Using adjusted group means (Table 3) in the equation cited in Figure 5 with df = 43, a = 4, n = 12, the critical value for significance was 10.87 at the alpha level of .05. Results of this analysis can be stated as follows: (1) given an independent instructional setting, independent learning oriented subjects did significantly better than group learning orientated subjects; and (2) all other pairwise comparisons were not significant at the alpha level of .05.

Discussion of Null Hypotheses

This section presents the results of the data analysis associated with testing each of the hypotheses. As indicated earlier, an ANCOVA procedure was used in the analysis. The first null
hypothesis (Ho₁) was not rejected. There were no significant treatment differences in the mean achievement between students who received independent instruction and those who received small group instruction, \( F(1,43) = .431, p > .05 \) (see Table 4).

The second null hypothesis (Ho₂) was not rejected. For students who had a group learning orientation, there were no significant differences in the mean achievement between those students who received independent instruction and those who received group instruction, \( F(1,43) = 2.478, p > .05 \) (see Table 4).

The third null hypothesis (Ho₃) was also not rejected. Similarly, for students who had an independent learning orientation, there were no significant differences in the mean achievement between those who received independent instruction and those who received group instruction, \( F(1,43) = 2.478, p > .05 \) (see Table 4).

The fourth null hypothesis was rejected since a significant interaction between student's learning orientation and instructional treatment was demonstrated \( F(1,43) = 9.117, p < .05 \) (see Table 4). An alternative hypothesis was accepted in that a significant disordinal interaction was found between the treatment variable and the attribute variable (see Figure 3). Results indicated that in the independent instructional setting, independent learning oriented subjects did significantly better than group oriented subjects.

**Summary**

To summarize the results of the present study, significant interactions between a student's learning orientation and instructional treatments were substantiated. This finding, therefore,
indicates that specific instructional treatments are specific to one level of student attribute and are not generalizable across both levels of the attribute variable. Main effects of learning orientation and treatments were not substantiated in these findings.

In addition, a post hoc analysis showed that given an independent instructional setting, independent learning oriented subjects did significantly better than group learning oriented subjects, while all other pairwise comparisons were not significant.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This chapter consists of the summary, conclusions, and recommendations. The summary restates the problem; describes the experimental design, variables, and instruments; and reviews the research procedures to include subject selection and treatments. The findings are reviewed and the conclusions based upon the findings are established. Recommendations are made for future research and practical implications of the study are discussed.

Restatement of the Problem

The problem of this study was to determine the effectiveness of specific diagnostic/prescriptive procedures as used in a graphic arts instructional program and investigate how these procedures interacted with selected student traits and instructional treatments in terms of achievement. Specifically, this study attempted to provide empirical evidence as to whether there are differences in achievement when students with specific learning orientation (independent or small group) are placed in specific instructional treatments (independent or small group settings). An analysis of an individual's learning orientation and how this orientation affected individual achievement
when individuals were assigned to independent or group instructional treatments was the focus of this aptitude-treatment interaction (ATI) study.

Experimental Design

A 2 x 2 factorial treatment-by-blocks design was used to investigate the aptitude-treatment interactions between selected student characteristics and instructional treatments. An analysis of covariance was performed to determine whether there was a significant difference between adjusted group means in term achievement. The independent variable of mental ability was used as the covariate and was measured by the Short Form Test of Academic Aptitude. The blocking variable for this study was the student's learning orientation (independent or group) and was measured by the California Psychological Inventory. The treatment variable was manipulated by the researcher as to instructional setting (independent or small group). The dependent variable was student achievement as measured by an objective graphic arts test.

Review of Research Procedures

Subjects were selected from the 1981 first semester graphic arts student population at Westerville South High School (N = 66). A two step blocking procedure was used to select and assign subjects to one of two levels of the blocking variable, learning orientation. As a result of these blocking procedures, twenty-four subjects were classified as having an independent learning orientation and
twenty-four subjects were classified as having a group learning orientation. The sample size \( N = 48 \) was determined by the established blocking procedures.

Treatment groups were established by randomly assigning an equal number of subjects from each assigned block to one of two treatments, independent or small group. Four sub-groups \( N = 12 \) were established using this procedure. Group 1 included those students having independent learning orientation and who received instruction in an independent setting. Group 2 included those students having an independent learning orientation who received instruction in a group setting. Group 3 included those students having a group learning orientation who received instruction in an independent setting. Group 4 included those students having a group learning orientation who received instruction in a group setting. All treatment groups were exposed to the same instructional materials, shared the same learning objectives and were exposed to treatments for the same length of time.

Prior to treatment, a pretest in the form of an aptitude test (SFTAA) was administered to all participants. These scores were used as the covariate to adjust achievement scores for any pretreatment differences in aptitude between sub-groups.

Following treatment, the achievement of the four sub-groups was measured using the revised Lithographic Printing Test. Administration of the achievement test was the same for all groups.
Findings

In this study a 2 x 2 factorial treatment-by-blocks design was used to investigate the aptitude-treatment interactions between subject learning orientation variable (A) and instructional treatment variable (B). An analysis of covariance, using academic aptitude as the covariate, was performed to determine whether there was a significant difference between adjusted means. The alpha level of .05 was used for statistical significance. The results are summarized as follows:

1. The main effects due to learning orientation, Variable A, and instructional treatments, Variable B, were not significant.

2. A significant interaction between learning orientation (A) and instructional treatments (B) was found. The nature of this interaction was disordinal, which also negates serious interest in the main effects of the blocking or treatment variables.

3. The post hoc analysis indicated that the only significant difference was between the adjusted means of Group 1 and Group 3. Interpretation of this finding suggests that given an independent instructional setting, independent learning orientated subjects did significantly better than group learning oriented subjects.
Conclusions

The major concern of this study was with the hypothesized interaction between student learning orientation and instructional treatment. The research questions examined in this study were as follows:

1. Does one level of treatment (independent or group) result in higher levels of achievement regardless of learning orientation?
2. Is there an interaction between instructional treatments and learner attributes?
3. Does learning orientation represent a valid learning variable in an individualized instructional program?

Specifically, the purposes of the study were to: (1) investigate the effectiveness of instructional grouping (independent and small group) in a graphic arts program which employs learning activity packages as the dominant mode of instruction; (b) investigate the interaction between student instructional grouping, learning orientation, and student achievement (aptitude-treatment); and (c) present a diagnostic/prescriptive assessment procedure that could be replicated in similar instructional situations to determine whether instructional groupings have an effect on achievement and whether learner social learning orientation and instructional grouping have an effect on achievement.

In response to the above research questions, the following conclusions are derived from the reported findings:
1. The instructional setting (independent or small group) did not produce different levels of achievement. Both methods of instruction were equally effective in terms of achievement when student learning orientations were not considered. This conclusion is consistent with results reported by Miller (1971) in which he compared small group instruction and individual study. Miller reported no significant differences between these approaches in teaching technical related information to industrial arts students. Similar results were reported by Koble (1963) when he compared group-oriented versus individual-oriented learning experiences in the graphic arts area of industrial arts education. This conclusion was also corroborated by Haskell (1969) when he found no significant differences in achievement between groups who received the various treatments. The findings of the present study, in addition to several research findings discussed in the review of the literature, suggest that the effectiveness of the method of instruction utilized will vary as a function of certain student personality characteristics.

2. The results of the present study clearly indicate a definite interaction between student learning orientation and instructional setting or treatment. In response to this finding, it can be concluded that specific instructional treatments are specific to one level of student attribute and are not generalizable across both levels of
the attribute variable. This conclusion is consistent with results reported by Domino (1971). Domino found significant interaction between student achievement orientation and teaching style. This conclusion was also corroborated by Haskell (1969) when he found significant interaction between instructional methods and levels of subject personality traits. The results in the present study, in corroboratation with replicative ATI research, provides strong evidence in support of the aptitude-treatment interaction paradigm. In this respect, it can be concluded that horizontal generalization is possible to other schools or communities which are found to match the present study on relevant variables. It can also be concluded that the interaction found in the present study may partly be attributed to the vigorous attention to the blocking technique used in this study.

3. A student's learning orientation is a valid learning variable and an effective diagnostic tool in an individualized instructional program. Conclusions stemming from the reported significant interaction and post hoc analysis suggest that students with a specific learning orientation have higher achievement when placed in an instructional setting consistent with their learning orientation. This conclusion was corroborated by Renzulli and Smith (1978) in a study which found that for maximum
learning efficiency, some degree of congruence or matching between student learning style and teaching strategy is necessary.

**Recommendations**

The obtained significant interactions cited in this study have several implications for educational practices. The following recommendations are made regarding the use of the information provided by the present study:

**Recommendations for Practitioners**

1. Learning orientation represents an important learning characteristic that should be considered when prescribing instructional strategy or treatments.

2. Educators need to be cognizant of students' different learning orientations and use this knowledge in planning and assigning methods of instruction. Findings indicated that independent learning oriented students did significantly better than group oriented students when assigned to an independent instructional setting. Although not significant, group oriented students did better in a group setting than they did in an independent instructional setting.

3. Homogeneous grouping of students on the basis of their social learning orientation is a desirable educational
practice, even through this grouping technique may deny independent and group learning orientated students the valuable experience of working together in a heterogeneous environment. As reported in the present study, interaction of social learning orientation with instructional mode represents an important dimension in education which should not be neglected by educators.

Recommendations for Researchers

1. Further aptitude-treatment interaction research should be conducted where treatments are designed to be substantially different in the function they serve. For example, different instructional packets or procedures could be designed where one packet or procedure promotes group interaction and group learning processes while the other packet or procedure promotes individual effort. The present study used the same instructional packets for both treatment groups.

2. Recommend that future ATI researchers give vigorous attention to blocking or classification techniques used in determining levels of aptitude.

3. Recommend the administration of a posttreatment questionnaire designed to measure subject congruence with assigned treatment. Data derived from a "cavalier" questionnaire administered at the end of treatment, in the present study, suggested that treatment congruence was
reinforced but was influenced by subject pretreatment orientation. Although not significant, mean agreement scores of Group 2 and Group 3 indicated that treatment effect was pulled toward the subject's learning orientation as determined by the California Psychological Inventory (CPI). Results of this causal pilot study suggest that knowledge acquisition should be monitored periodically during an ATI study. Researchers should also collect unobtrusive evidence to augment questionnaires for the purpose of validating assigned student treatments.

4. Further replicative research efforts are needed in similar learning environments to clarify, support or dispute the reported findings described in this study.

5. Further ATI research should be conducted in order to construct a matrix of learning situations and learners' characteristics which may then facilitate the further development of instructional theory with regard to individualizing instruction.
Appendix A

Unit Learning Packet (ULP)
Introduction

Welcome to your new component of graphic communications. In this unit of instruction you will learn the basic methods of converting camera-ready images to film negatives or positives. This unit contains many new and different concepts, which most likely will be new to you. For this reason it is important that you be acquainted with the basic concepts relative to this unit of instruction. The objective of this packet is to guide you through a series of learning experiences, which will provide the knowledges necessary for successful completion of this unit of study.

Helpful Hints

A. Read and review the unit objectives to see what you will be learning.

B. Read your text slowly and study the illustrations.

C. Each sub-unit has a programmed instruction section for learner reinforcement. Each section must be completed before continuing to the next topic.

D. View the audio/visual material relative to your unit of instruction.

E. Ask questions about anything that you do not understand.

F. Remember that it is your responsibility to achieve basic understanding of this unit. A pre-test will follow this packet, which will measure your understanding of this unit. A score of 60% is required before lab work may begin.
G. Keep your text in your notebook for reference. Following laboratory work, it is recommended that you retake the test (Post - Test) for a higher score.
Independent Instruction

Write your answer in the space provided in this packet. Check off each task when accomplished.

( ) 1. Read pages 3-7. Do sub-unit #1. Review Questions, page 8 and 9, 7 answers.


6. Self-evaluation of completed packet. See instructor for the key and grade your own answers. If a response is incorrect, return to the page having the same illustration and review the narrative, then correct your answer.

7. View the audio/visual material relative to this unit of instruction.

8. Read and review the new graphic communication terms at the end of your text.

9. The Photo Conversion Test has 30 multiple choice questions, 18 of which must be correctly answered in order to begin laboratory work. Below are four sample questions.
1. The basic purpose of photo-conversion is the preparation of a film negative or _______.
   a. photo-mask  
   b. exposure guide  
   c. paper plate  
   d. photo print  

2. A camera lens gathers and __________ light to form an image.
   a. focuses  
   b. collects  
   c. filters  
   d. diffuses  

3. If the film emulsion will accommodate some variations in exposure, the emulsion is said to have exposure _________.
   a. latitude  
   b. index  
   c. equivalent  
   d. factors  

4. The latent image becomes visible on the film emulsion by the action of the:
   a. stop bath  
   b. developer  
   c. fixer  
   d. Photo-flo  

( ) 10. Turn-in this completed packet and secure a pre-test question and answer sheet from the instructor. **Good Luck**
## Evaluation

<table>
<thead>
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<th>Description</th>
<th>Possible Points</th>
<th>Student Evaluation</th>
<th>Instructor Evaluation</th>
</tr>
</thead>
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<td>Unit Learning Packet</td>
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<td></td>
</tr>
<tr>
<td>Pre-Test</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total Points</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Student's Name ____________________________

Date ____________________________

Period ____________________________
Appendix B

Laboratory Learning Package (LLP)
Introduction

Congratulations, you have a passing grade on your pre-test, thus enabling you to start working in your assigned work station. It is now time to apply what you have learned—the real test. Laboratory work in the Graphic Arts Lab is very important, requiring accurate procedures, quality craftsmanship, and safe handling of all materials and equipment. As a laboratory guide, this LLP has been prepared for you. Every Graphic Arts I student is required to follow this LLP, performing each task in the prescribed order. Read all directions and requirements carefully and refer to your text and other reference materials as needed.

Note that this LLP is divided into three levels: "A" Beginners, "B" Intermediate, and "C" Advanced. Successful completion of Level "A" is required before rotation to a new work station. Level "B" is recommended to the student who wishes to learn more about Photo Conversion. Level "C" is optional with instructor's permission.

Work Station Description

During the time that you are assigned to the Photo Conversion work station, you will:
1. Photo convert all projects (student and class).
2. Cooperate with others and function as a team.
3. Handle all equipment and material in a safe manner.
4. Produce consistent quality work and sign your initials to all of your work.
5. Clean-up and maintain the work area at all times.

Objectives

As a result of this Laboratory Learning Package the student will be able to: (A - Required, B/C Optional)

Levels

A 1. Identify and locate the following process camera parts: copy board, lights, lensboard, ground glass, bellows, film back, copy and lensboard controls, focus controls, vacuum motor, master switch and frame.
A 2. Prepare processing chemicals and state darkroom safety procedures.
A 3. Describe and demonstrate correct darkroom and film handling procedures.
A 4. Define the elements of exposure and development control.
A 5. Demonstrate the correct operation of the process camera and film developing procedures.
A 6. Produce three line negatives: (1) 100%, (2) Reduction and, (3) Enlargement.
A 7. Demonstrate an attitude of cooperation, while working with others.
A 8. Inspect three line negatives and evaluate each using the elements of quality control.
Levels

A  9.  Maintain a camera log of each exposure, development and their results.

B  10. Produce acceptable line negatives from problem copy, using filters and/or special darkroom techniques.

B  11. Produce a halftone negative.


B  13. Produce a film positive from a film negative using contact procedures.

B  14. Develop continuous tone roll film, 120 or 35 mm.

B  15. Using an enlarger, produce two projection prints.

C  16. Photographically drop red from line copy using panchromatic film.

C  17. Produce special effect negatives or stats including: screens, posterizations, duotones, spreads and chokes, and outline halftones.

References Sources

The following materials can be used to help you complete this laboratory assignment. Before you begin this assignment, gather together the references listed below. Refer to these references during your assignment and if you have any questions, see your instructor.

Level

A  Photo Conversion Text
A  Anatomy of the NuArc Camera
A  Wall Chart on Mixing Chemicals
A  Wall Chart on Shooting a Line Negative
B  Cameraman's Gray Scale Information Sheet
B/C Kodak's Filter Selector
B  Kodak Contacting Procedures (Q-4)
B  Kodak PMT Materials (Q-201)
Laboratory Review Questions

All questions must be answered by each student prior to starting Photo Conversion Lab assignments.

1. Locate the following process camera parts: copyboard, lights, lensboard, ground glass, film back, copy and lens controls, focus controls, vacuum motor and frame.
2. Name, in correct order, the six processing steps for developing a line negative.

3. List seven elements of line negative quality control.

4. State the safety precautions, which should be followed when:
   a. operating the process camera
   b. mixing darkroom chemicals
   c. processing film

5. Describe basic darkroom procedures and film handling techniques.
6. Define the following terms:
   a. safe light
   b. orthochromatic
   c. line copy and halftone copy
   d. emulsion (how can you tell which side is which?)
   e. agitation
   f. constant aperture system
   g. filters and filter factor

7. Exposure and development controls are very important in producing a quality line negatives. Camera lights are adjusted to a ____________, the copyboard glass must be ____________, the aperture is set at ____________, the timer is set for a ____________ exposure, and the negative is developed to step ____________ on the gray scale.

8. Describe the methods you will use to maintain exposure and development control.
9. Explain why we have wet and dry areas within the darkroom.

10. When using the constant aperture system for exposure control and given a basic exposure time of ____________ seconds, a filter factor of __________, and a photo reduction of __________%, what would be the resulting camera exposure.

SHOW WORK, CIRCLE ANSWER.

Laboratory Requirements

The student is requested to refer to their text, reference material and demonstration notes during completion of the below lab requirements. If at any time there is a question about a certain procedure or operation - Ask The Instructor. DO NOT Proceed past an instructor check point.

<table>
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<th>Possible Points</th>
<th>Level A</th>
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<tbody>
<tr>
<td>_______________</td>
<td>( ) Instructor Check</td>
</tr>
<tr>
<td>10</td>
<td>( ) Prepare processing chemicals and set-up the darkroom for operation</td>
</tr>
<tr>
<td>10</td>
<td>( ) Set-up process camera to reproduce copy at 100% size</td>
</tr>
<tr>
<td>_______________</td>
<td>( ) Instructor Check</td>
</tr>
<tr>
<td>20</td>
<td>( ) Shot and process negative, record data in your log book</td>
</tr>
<tr>
<td></td>
<td>( ) Self-evaluation of negative properly exposed and developed line negatives should show:</td>
</tr>
<tr>
<td>Possible Points</td>
<td>Level A</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>30</td>
<td>Produce at least three line negatives, (100% Reduction and Enlargement), as daily lab work requires. Record each negative made in your log book.</td>
</tr>
<tr>
<td>10</td>
<td>Self-evaluation of each negative produced using the 7 point quality control table</td>
</tr>
<tr>
<td>10</td>
<td>Training or coaching of a new photo conversion student. Name of student trained</td>
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<tr>
<td>30</td>
<td>In instructor Check</td>
</tr>
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</table>

30 ( ) At this time you may rotate to a new work station provided that the following conditions are met:

1. The Photo Conversion LLP, Level A is completed.
3. Trained replacement to fill your position in the Photo Conversion work station.
4. Post-Test retaken for higher grade (optional).
5. Turn-in this LLP and samples of your work to the instructor for evaluation.

<table>
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<tr>
<th>Possible Points</th>
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</tr>
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<tbody>
<tr>
<td>20</td>
<td>( ) Production darkroom work (minimum 5 production negatives)</td>
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<tr>
<td>20</td>
<td>( ) Line negative(s) from problem copy, using filters and other special darkroom techniques</td>
</tr>
<tr>
<td>20</td>
<td>( ) Produce a halftone negative from continuous tone copy</td>
</tr>
<tr>
<td>10</td>
<td>( ) Produce a film positive using contact procedures</td>
</tr>
<tr>
<td>10</td>
<td>( ) Reproduce line art with the PMT process</td>
</tr>
<tr>
<td>10</td>
<td>( ) Roll film processing (minimum 2 rolls)</td>
</tr>
<tr>
<td>10</td>
<td>( ) Projection printing (minimum 2 prints)</td>
</tr>
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</table>

**Level C**

| open            | ( ) Special effects - Explain ____________________________ |
|                 |                                                            |
| open            | ( ) Use of Panchromatic film                               |
| open            | ( ) Experimentation with new materials or processes        |
**Evaluation**

Your laboratory work in Graphic Arts will constitute the major portion of your grade. Check the objectives for this LLP and see if you have achieved each criteria.

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<th>Description</th>
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* Partial credit will be given for each Level B and C criteria achieved.

Student's Name
_____________________________________________________________________

Date
_____________________________________________________________________

Period
_____________________________________________________________________
Appendix C

Short Form Test of Academic Aptitude

Subject Test Data
### Short Form Test of Academic Aptitude
Raw Score Test Data Used as the Covariate in the Analysis of Covariance

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Appendix D

Revised Lithographic Printing Achievement Test
FINAL EXAMINATION
GRAPHIC ARTS I

DIRECTIONS:

1. This exam contains 98 multiple choice test items. Each question counts approximately 2.5 points for a total of 250 points.

2. Each of the following statements or questions is followed by a set of four words or phrases. Read all choices and select the one which answers the question or phrase correctly.

3. Fill out the student information on the Scan-Tron answer sheet. Below Date and Hour record the code numbers of each workstation completed.

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<tr>
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<tr>
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<td>3</td>
<td>Photo-Conversion</td>
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<td>5</td>
<td>Image Transfer</td>
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<td>6</td>
<td>Finishing</td>
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<tr>
<td>7</td>
<td>Screen Printing</td>
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4. Use a #2 pencil to record your response. Make no marks on the test booklet.

5. Time limit - 55 minutes.

6. The student may use the following equipment during the test: proportion wheel, calculator, line gauge, filter chart, lead/line chart and scrap paper for your calculations.

7. Do not spend too much time on questions which appear difficult. Go on with the rest of the test, and if time is available later, return to the unanswered questions. Check your work after completing the test. Attempt to answer EACH question.

8. No talking, if you have a question raise your hand and the instructor will assist you.

9. Wait for instruction to open your test booklet.

10. When completed, remain seated and raise your hand. No talking.
SECTION 1 - Artwork

1. The clip-art provided is 3" x 5-1/2", which must fit into a 2-1/4 x 4-1/8" space. The copy should be scaled to the following percentage?
   a. 40% reduction
   b. 75% reduction
   c. 75% enlargement
   d. 135% enlargement

2. When estimating display type length for copyfitting, you should count characters and spaces in the
   a. longest line.
   b. shortest line.
   c. average line.
   d. count and measure type characters only.

3. The space to be occupied by a photograph should be indicated on the layout by
   a. the actual photograph.
   b. a black keyline of the reproduction size.
   c. full description.
   d. dimensions only.

4. A comprehensive layout shows
   a. the exact position of photos other than art.
   b. the exact position of all type except margins.
   c. the exact position and size of all elements.
   d. type specifications only.

5. Extending the image area past the finish size of the paper is called
   a. cut-off.
   b. bleed.
   c. flush.
   d. run-off.

6. When all elements in a layout are symmetrical, the layout is in
   a. occult balance.
   b. poor balance.
   c. informal balance.
   d. formal balance.
7. The layout that contains all the information necessary to complete the printing job is called a
   a. bill of materials.
   b. paste-up.
   c. comprehensive layout.
   d. mechanical layout.

8. Which of the following is the correct sequence for developing the series of layouts
   a. thumbnail, comprehensive, rough layout.
   b. rough layout, thumbnail sketch, comprehensive.
   c. thumbnail sketch, rough layout, comprehensive.
   d. thumbnail sketch, rough layout, finished artwork.

9. A printed piece of work involving many pages, requires a
   a. rough layout.
   b. dummy.
   c. thumbnail sketch.
   d. copy proof.

10. The purpose of cropping is to
    a. fasten copy to the paste-up.
    b. enlarge or reduce a photograph.
    c. improve photographic composition.
    d. outline halftones.

11. A piece of artwork measuring 3 inches wide by 4 inches deep is to be reduced to a width of 1-7/8 inch. What will be the new depth?
    a. 1 inch
    b. 1-3/4 inches
    c. 2-1/2 inches
    d. 3 inches

12. The optical center of a page may be located by a top/bottom ratio of
    a. 3:5.
    b. 1:2.
    c. 5:3.
    d. 3:1.
13. If the width of a halftone is 2-1/4", and height is 3-5/8", a 150% enlargement would find a new width of

a. 3-3/8".
b. 3-5/8".
c. 4-1/2".
d. 5-3/4".

14. Select the proper dummy for an eight page booklet 5-1/2 x 8-1/2 consisting of one signature.

a. 

```
1 2
3 4
```

b. 

```
1 2
3 4
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c. 

```
1 2
3 4
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d. 

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1 2
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3 4
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SECTION 2 - Image Assembly

15. An example of line camera copy is
   a. an original photograph.
   b. a wash rendering.
   c. a pencil drawing.
   d. type composition.

16. How many lines of 10 point type, 2 point leaded will go into a space 4 inches deep?
   a. 26
   b. 24
   c. 21
   d. 12

17. Typewriters which vary the space allowed for each letter according to the width of the letter have
   a. flexible spacing.
   b. justified spacing.
   c. adjustable spacing.
   d. proportional spacing.

18. When specifying body type, one should include all but one of the following specifications.
   a. Lines per pica and length
   b. Type style and point size
   c. Line spacing/leading
   d. Line width and column length

19. Images for photo-reproduction must be clean, clear and sharp. The most preferred images for reproduction are
   a. hot metal repros.
   b. strike-on.
   c. photographic.
   d. transfer type.

20. The primary duty of a proofreader is to
   a. correct the type.
   b. read the proofs and mark all corrections.
   c. read the proofs and correct the layout.
   d. read all copy.
21. A completed paste-up with repros, clip art, type and guide marks is ready for the camera is called a
   a. thumbnail sketch.
   b. rough layout.
   c. mechanical layout.
   d. comprehensive layout.

22. A complete assortment of type in one size and face is called a
   a. group.
   b. style.
   c. family.
   d. font.

23. When type is produced that is flush on both sides of a column it is called
   a. square type.
   b. flush left.
   c. flush right.
   d. justified.

24. What is the number of lines in copyfitting a layout 12 picas by 4 inches deep and the copy is to be set in 10 point Caslon, leaded 4 points
   a. 33 lines.
   b. 20 lines.
   c. 24 lines.
   d. 14 lines.

25. The term leading refers to
   a. space between the words.
   b. space between lines.
   c. font selection.
   d. proportional spacing.

26. Which of the following tools should be used to mark non-printing guidelines on a paste-up?
   a. Dark blue pen
   b. Black ruling pen
   c. No. 4 lead pencil
   d. Light blue pencil
27. When preparing a paste-up for two 5-1/2 by 8-1/2 inch note pads, printed two-up on 8-1/2 x 11 inch stock, one should include all but one of the following:
   a. light blue corner marks.
   b. layout guidelines in light blue pencil.
   c. center and corner marks in black ink.
   d. gripper edge line.

28. Given the below specimen of set type, select the incorrect specification.

   Abrasion-resistant graphic arts contact screens have been introduced by 3M’s Photographic Products Division. According to the company, 3M Dotgard contact screens are unaffected by water, alcohol, ketones and other solvents, and have anti-static properties that minimize the attraction of dust and dirt. Fingerprints, grease and
   a. 13 pica line width.
   b. 7 lines per inch.
   c. 9 point type with 1 point lead.
   d. 8 point type set solid.

SECTION 3 - Photo-Conversion

29. The correct order of usage of chemicals in developing black and white negative film is
   a. developer, fixer, stop bath.
   b. developer, stop bath, fixer.
   c. developer, fixer, wash.
   d. developer, wash, fixer.

30. The f stop expresses
   a. focal length.
   b. exposure time.
   c. focus adjustment.
   d. aperture opening.

31. When mixing solutions of acid and water, the safe procedure is to
   a. slowly add the water to the acid.
   b. quickly add the acid to the water.
   c. slowly add the acid to the water.
   d. quickly add the water to the acid.
32. All undeveloped silver salts are dissolved and the film is cleared by the
   a. fixing solution bath.
   b. stop bath.
   c. developer.
   d. rinsing bath.

33. A sensitive guide is exposed with line copy for the primary purpose of
   a. aid in developing.
   b. sizing copy.
   c. determining exposure time.
   d. exposure control.

34. Camerapersons who use a fixed aperture for all exposures and adjust their exposure times are using the
   a. fixed aperture method.
   b. variable exposure method.
   c. constant variable system.
   d. constant aperture system.

35. On black and white line copy, the negative has clear, transparent areas where the
   a. black portions of the copy reflect no light.
   b. white portions of the copy reflect no light.
   c. black portions of the copy reflected light.
   d. white portions of the copy reflected light.

36. If the image appears too soon while developing at the proper temperature, the film has been
   a. exposed emulsion down.
   b. over exposed.
   c. under exposed.
   d. developed in exhausted developer.

37. Graphic arts film which has an orthochromatic sensitivity is insensitive to
   a. blue light.
   b. green light.
   c. yellow light.
   d. red light.
38. Constant agitation during development
   a. streaks the image.
   b. increases density and contrast.
   c. decreases density and contrast.
   d. has no effect on density or contrast.

39. Detail in the highlight areas of a halftone is preserved by
   a. the main exposure.
   b. the flash exposure.
   c. the detail exposure.
   d. a smaller aperture.

40. If you have a normal exposure of 10 seconds and an exposure factor of 3.0, your exposure, using the constant aperture system, should be
   a. 7 seconds.
   b. 13 seconds.
   c. 30 seconds.
   d. base exposure time.

41. When using the constant aperture system for exposure control and given a base exposure time of 10 seconds, a filter factor of 2.0, and an exposure reduction factor of .5 the resulting camera exposure would be
   a. 12.5 seconds.
   b. 10 seconds.
   c. 20 seconds.
   d. 5 seconds.

42. When using ortho film to photograph black copy on a yellow background, what color filter should be used to gain black and white contrast?
   a. Yellow
   b. Red
   c. Blue
   d. Pink
43. Which of the following solution should be applied to a developed plate that is to be put in storage?
   a. Desensitizer
   b. Water
   c. Plate gum
   d. Developer

44. The pre-sensitized plate is coated with ________ to make it sensitive to light.
   a. silver nitrate
   b. plate gum
   c. diazo
   d. dichromate

45. Small pinholes in a negative are usually covered with
   a. red tape.
   b. film emulsion.
   c. goldenrod.
   d. opaque.

46. Lines may be scribed on a piece of film by scribing
   a. the base side.
   b. the emulsion side.
   c. the right reading side.
   d. either side.

47. To ensure accuracy always check the stripped flat with the
   a. thumbnail sketch.
   b. press sheet.
   c. developed offset plate.
   d. comprehensive layout.

48. The wedge cut-out on a 1-up flat (sketched below) indicates the
   a. gripper edge.
   b. guide edge.
   c. cylinder mark.
   d. register guide.
49. The film is positioned on the masking sheet with the aid of
   a. the rough layout.
   b. a layout table.
   c. job ticket.
   d. reference lines.

50. Which side of a screen tint should be placed against the offset plate
   a. emulsion side.
   b. base side.
   c. shiny side.
   d. either side.

51. When cutting the openings in a flat, the paper outside the image areas should be cut no closer than
   a. 1 inch.
   b. 3/4 inch.
   c. 1/2 inch.
   d. 1/8 inch.

52. Positioning and mounting film on the masking sheet is referred to as
   a. opaquing.
   b. stripping.
   c. masking.
   d. lining up.

53. Which of the following describes the correct sequence of application for developing a plate?
   a. Desensitizer, plate gum, water, lacquer
   b. Plate gum, water, lacquer, desensitizer
   c. Desensitizer, lacquer, plate gum, water
   d. Desensitizer, lacquer, water, plate gum

54. The step and repeat process of stripping allows for the use of one negative for producing an offset plate which contains
   a. one image.
   b. more than one image.
   c. screened images.
   d. blocked out images.
55. When stripping two or more negatives together what should be avoided?
   a. Overlapping image areas
   b. Butting negatives
   c. Large windows
   d. Cutting negatives

56. The major reason for using a screen tint is to
   a. increase the amount of ink on the paper.
   b. decrease the amount of ink on the paper.
   c. screen out defects.
   d. aid in step and repeat.

SECTION 5 - Image Transfer

57. When stopping a press run, the operator should first
   a. shut off the feeder.
   b. lift dampener rollers.
   c. shut off the press.
   d. decrease impression.

58. The pH of most fountain solutions should be approximately
   a. 2.2.
   b. 3.0.
   c. 5.0.
   d. 8.5.

59. Plate gum should be removed from the plate by using
   a. hot water.
   b. fountain concentrate.
   c. cleaner conditioner.
   d. etching solution.

60. Offset lithography images are transferred with a
   a. minimum of ink.
   b. maximum of ink and minimum of water.
   c. maximum of ink and water.
   d. minimum of ink and water.
61. The rollers that contact the offset plate and cause image areas to ink, are called
   a. form rollers.
   b. ductor rollers.
   c. transfer rollers.
   d. oscillating rollers.

62. If the suction feet fail to lift the sheet of paper and pass it forward, the problem may be that
   a. too much vacuum.
   b. delivery system too tight.
   c. pile height set too low.
   d. blowers set too high.

63. Which of the following is not a possible solution to gray looking type?
   a. Increase the impression
   b. Adjust ink fountain screws
   c. Decrease the impression
   d. Decrease the amount of water

64. Which is not an offset lithographic system?
   a. Dampening
   b. Jogging
   c. Feeding
   d. Impression

65. The amount of ink transferred to the distributor rollers is controlled by the
   a. press speed.
   b. amount of ink in the fountain.
   c. roller diameter.
   d. ink fountain setting.

66. Ink transferred from a freshly-printed sheet to the back of another sheet is called
   a. setoff.
   b. tinting.
   c. back-printing.
   d. off-printing.
67. The blanket cylinder on a offset press transfer the image to the
a. plate.
b. back cylinder.
c. paper.
d. plate cylinder.

68. If you have a good image on the press blanket and the image is light on the paper you should
a. increase the impression pressure.
b. increase the blanket pressure.
c. decrease the blanket pressure.
d. decrease the impression pressure.

69. Scumming frequently occurs when there is
a. a defective plate.
b. too much water solution.
c. too much ink and not enough moisture.
d. incorrect pressure between plate and blanket.

70. Which of the following images does not read right?
a. Offset plate
b. Printed sheet
c. Impression on the back cylinder
d. Impression on the blanket

SECTION 6 - Finishing

71. A paper label that shows 17 x 22, means
a. grain short.
b. grain long.
c. oversize width.
d. 17" cut first.

72. How many sheets of 23 x 35 inch stock would be required to cut 720 sheets of 5-1/2 x 8-1/2?
a. 45
b. 48
c. 60
d. 90
73. The drawing below depicts:

![Diagram of a French fold]

a. a French fold.
b. a parallel letter fold.
c. a right angle fold.
d. an accordian fold.

74. Aligning sheets at their edges is called

a. aligning.
b. jogging.
c. fanning.
d. gathering.

75. The operation that creases paper, without cutting, so that a fold may be made easily and smoothly is

a. perforating.
b. creasing.
c. die cutting.
d. scoring.

76. What kind of cut is used to get an extra sheet from a waste tail of stock?

a. Cross cut
b. Stagger cut
c. Slip cut
d. Maximum cut

77. The direction in which the fibers are aligned in a sheet of paper determines the

a. finish.
b. coating.
c. sizing.
d. grain.

78. Which term designates the relative thickness of a sheet of paper?

a. Cover
b. Substance
c. Calender
d. Grain
79. In finishing a 36 page saddle-stitched pamphlet, which bindery operation would come last?
   a. Trimming
   b. Binding
   c. Stapling
   d. Folding

80. What is the substance weight of 1,000 sheets of 17 x 22 inch bond paper weighing 48 pounds?
   a. 20
   b. 24
   c. 28
   d. 48

81. The operation of arranging individual sheets into sequential order is called
   a. gathering.
   b. booking.
   c. sorting.
   d. collating.

82. Using the most economical cut, how many 8-1/2 x 11 inch index sheets can be cut from a 25-1/2 x 30-1/2 inch sheet?
   a. 4
   b. 6
   c. 8
   d. 12

83. The drawing below depicts a
   a. saddle stitched book.
   b. side wire stitching.
   c. post binding.
   d. side stitched book.
84. The letter M stands for
   a. 100
   b. 500
   c. 1,000
   d. 1,000,000

SECTION 7 - Screen Printing

85. A coarse screen fabric, such as ________ is recommended for printing with Plastisol inks.
   a. 18xx
   b. 12x
   c. 6xx
   d. 2x

86. Screen printing may be used to print on which of the following substrates?
   a. Textiles
   b. Printed circuits
   c. Irregularly shaped objects
   d. All of the above

87. Water base stencil is recommended for use when the design will be printed with
   a. oil base inks.
   b. latex ink.
   c. all water base inks.
   d. any type of ink.

88. Stencil blockout should be applied to the fabric
   a. before adhering.
   b. after adhering.
   c. before removing sizing.
   d. on the squeegee side.

89. The image areas that you want to screen print on the substrate must be
   a. opaque on the film positive.
   b. transparent on the film positive.
   c. blocked-out on the stencil.
   d. covered with photographic stencil material.
90. When washing-out the stencil it is very important to follow the recommended temperature of
   a. 52°.
   b. 68°.
   c. 75°.
   d. 100°.

91. For best results when printing on a smooth surface, the squeegee should be passed over the stencil _________ for each print.
   a. once
   b. twice
   c. three times
   d. four times

92. Because the stencil film is presensitized, all pre-adhering handling should be carried out in
   a. total darkness.
   b. normal room light.
   c. yellow light.
   d. red safe light.

93. To remove a photographic indirect stencil from the screen fabric, one should use
   a. stencil desensitizer.
   b. blanket wash.
   c. lacquer thinner.
   d. hot tap water.

94. In screen printing, the ink prints through
   a. the screen openings covered by the stencil.
   b. the screen openings not covered by the stencil.
   c. all the screen openings.
   d. the emulsion coating.

95. Which of the following statements best describe a properly prepared stencil?
   a. Stencil wrong reading from squeegee side
   b. Emulsion adhered to squeegee side
   c. Emulsion adhered to all non-printing areas
   d. Good emulsion coverage in all printing areas
96. As the squeegee is passed over the stencil, it should be held at approximately a _________ angle.
   a. 10 degree
   b. 20 degree
   c. 30 degree
   d. 50 degree

97. The preparation for screen printing is a rather involved process requiring several operations. Which of the following statements best describes the correct order of events?
   a. Screen make-ready, block-out, adhering
   b. Develop, adhere, wash-out stencil
   c. Expose, develop, adhere, wash-out stencil
   d. Develop, wash-out, adhere stencil

98. Registration for printing multicolor screen prints is made easier by using a
   a. transparent flap.
   b. dummy mark system.
   c. line-up table.
   d. line gauge.
Appendix E
Revised Lithographic Printing Achievement Test
Subject Test Data
### Revised Lithographic Printing
Achievement Test Subject Data

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N = 48  Mean 60.29  SD 11.38
Appendix F

California Psychological Inventory (CPI)

Subject Test Data
California Psychological Inventory (CPI)  
Test Data Used for Subject Selection  
and Blocking on Learning Orientation

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N = 66  
Mean 86.77  
SD 16.26  

* Subjects excluded from the study with an Ac/Sc score of +1SD above the mean (score of 86 or above).

** Subjects excluded from the study with Ai/Sy scores between the upper and lower cut-off limits (88-86).

*** Subjects excluded from the study with an Ac/Sc score of -1SD below the mean (score of 49 or below).
Appendix G

Subject Data Card
Subject Data Card

Student No. __________  Group __________

Name ___________________  Semester __________  Period _______

Age ______ , Sex ______  Grade level ______ , GPA ____________

CPI Scores:  

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Social Orientation:  

Independent ______  Small Group ______

Achievement Score ______

Aptitude Score ______

Attendance (days present) ______

Workstations Completed 1 2 3 4 5 6 7  Total ______

Graphic Arts Grade ______

Misc. ________________________________________________
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