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Investigation of students' study habits under traditional and phase achievement systems of instruction in a college biology course

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**INVESTIGATION OF STUDENTS' STUDY HABITS UNDER TRADITIONAL
AND PHASE ACHIEVEMENT SYSTEMS OF INSTRUCTION IN A COLLEGE
BIOLOGY COURSE**

Iowa State University

PH.D. 1981

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Investigation of students' study habits under
traditional and phase achievement systems
of instruction in a college biology course

by

Abdullatif Jassim Al-Hashash

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
Requirements for the Degree of
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CHAPTER I. INTRODUCTION

Traditional methods of teaching have been almost the only instructional technique utilized in education up to the start of this century. Early in this century, however, efforts and trials have emerged with the concern for developing more effective methods of teaching. The first, as far as instructional technique is concerned, were developed by Fredric Buck in 1912 (Sherman, 1974).

Since then not very many additional efforts and studies have been done until the sixth decade of this century, when the number of students enrolled in schools and universities increased significantly so that the large enrollments resulted in heterogeneous problems that involved teachers and students as well. Heterogeneity comes from a mixture of major and nonmajor students who elect to study the same course although differing in levels of ability and background. Dolphin (1980) stated that this kind of problem has developed into a willingness to design and experiment with instructional technologies that focus on the individual within a large lecture context.

As a result of extensive research during the past 30 years on the most effective method of teaching, some new instructional technologies have been developed and adopted,

after proving that they would be at least as effective as the traditional approach if not better. The most common of these instructional technologies is the concept of individualized instruction.

Kulik and Kulik (1975) stated that it is possible that individual study had "greater influence than classroom instruction on student achievement in college courses." The individualized instruction is, in fact, adapted to the background and the ability of the individual himself. Gangé (1970) indicates also that an important part of the learning process is contributed by the individual learner and his own past experience.

In the 1960s, three different instructional technologies as approaches to individualized instruction were developed at the college level. Postlethwait's Audio-Tutorial approach at Purdue University in 1961; Keller's Personalized System of Instruction (PSI) at the University of Brasilia in 1964 (also known as the Keller plan); and Bloom's Master Learning at the University of Chicago in 1968 (Kulik, 1976; Block, 1974).

The personalized and Audio-Tutorial (A-T) systems of instruction have been adopted in many colleges and universities around the world with variations. Some individuals would argue that the A-T approach to instruction should be considered a major approach to mastery learning,

but this does not seem so far from Block's point of view (1974) when he stated:

Postlethwait's approach was originally designed to provide the student with a maximum opportunity to learn for mastery rather than to demand that each student actually use this opportunity fully.

Research about the effectiveness of these instructional technologies have often been reviewed. Several different measures have been used to evaluate these approaches. Such measures are student achievement at the end of courses, achievement at the end of units using quizzes, repetitions of these quizzes, retention, transfer of knowledge, longitudinal effects and time needed to complete the course requirements. Some of the studies reviewed, in general, indicate that these instructional technologies are superior to the traditional methods. They, at the very least, indicate that there is no significant difference between traditional methods and any of these newer approaches, with the exception of a limited number of studies which revealed negative results concerning the instructional technologies (Robin, 1976; Fisher, Guenther and MacWhinney, 1976; Kulik et al., 1979; Block, 1974; Tylor, 1976; Mintzes, 1975; Bloom, 1974; Keller, 1968; and others).

The PSI or Keller results indicated that students who were taught by the PSI approach achieved a significantly

higher level than did those who were taught by the traditional methods. Moreover, PSI was considered superior not only to the traditional method, but also to the Postlethwait's A-T and Bloom's strategies (Kulik et al., 1979). Early research also indicated that the PSI students had needed more time and effort to complete the course requirements, while more recent research reported different results. Kulik and Jaksa (1977) and Kulik and Kulik (1975) indicated that the average study time to complete the course requirements of students in PSI was nearly equal to the average of study time required for students under the traditional methods.

Other studies that have reviewed Audio-Tutorial, as another approach to instructional technology, indicated some mixed results. Grobe and Allen (1973) reported that there was no significant difference between A-T students and traditional students in terms of students' achievement while Mintzes (1975) concluded that the students in A-T achieved significantly higher scores than those in the traditional methods.

Bloom's mastery theory is designed primarily for use with group-based instruction (Bloom, 1974). Studies that reviewed Bloom's theory indicated that this approach is considered superior to the traditional method of teaching with regard to student achievement, retention, and

transfer of knowledge (Bloom, 1974; Block, 1974; Smith, 1976).

Block (1974) reported that Bloom's mastery learning strategy is predicated upon the assumption that up to 95 per cent of the students can learn much of what they are taught at the same high level typically reached by only the best students.

The newest approach to individualized instruction is the Phase Achievement System (PAS) which was developed by Dolphin and his colleagues at Iowa State University in 1973. This system is predicated on providing for individual differences within large enrollment classes.

Research on this approach indicated that the PAS has overcome the problem of large enrollment classes, and provides for better achievement for female students, especially the highly anxious students. It also proved beneficial for students who have weak background or ability (Dolphin, 1980; Dolphin et al., 1973; Latta et al., 1978; Najmaie, 1979; Stinard, 1980; Mohammed, 1980). Different measures and procedures were incorporated to evaluate this system, such as: student achievement, frequency of use of video tapes, immediate and longitudinal effects, and a measure called Attribute by Treatment Interaction (ATI).

Another approach to instructional technology is the Visualized Base Instruction (VBI). This approach consists of several parts: instructional television, still projection, motion pictures, and video tape recorders. Although the literature was reviewed regarding this approach, the primary review centered on instructional television and video tape because these represent part of the focus of this study.

Early in 1966, Chu and Sherman reported from a review of four hundred comparisons between televised instruction and traditional instruction (TRAD), that televised instruction was a bit less favorable (Kulik, 1976). Other studies, which evaluated televised instruction as an independent approach, reported that there was no significant difference between the televised and the traditional instruction (Kulik and Kulik, 1975; Dubin and Hedley, 1969; Kulik and Jaksa, 1977). But the results may not be the same when the television is combined with other learning resources. Ohliger (1970) indicated that instructional television is seldom effective alone. Its optimum value is achieved only when used with other learning resources and experiences (Mohammed, 1980).

In general, the VBI approach has been very helpful and beneficial to the other approaches such as A-T, PSI and the PAS. Furthermore, the video taped lecture is

considered an essential part of the PAS components. The video tape and the other approaches are discussed more fully in Chapter II.

Background

Researchers have long been concerned with student achievement. During the past 10 years, there has been an increasing emphasis in instructional research on the techniques used by students in their effort to learn from written materials such as text books and lecture notes. Although students put a great deal of effort and faith into such study techniques, there has not been a great deal of systematic research on students' study activities.

For example, several studies (Howe, 1970; Idstein and Jenkins, 1972; Noall, 1962; Stordahl and Christensen, 1965; DiVesta and Gary, 1972; Annis and Davis, 1978) compared the effects of study techniques such as reading only, reading and underlining, reading and note-taking and/or some other similar combinations. Results from these studies and others reveal some inconsistencies. One possible reason for these inconsistent results is that students have been arbitrarily assigned to study conditions without any concern for the student's preferred method of study (Annis and Davis, 1978). Therefore, Cronbach's (1957) call for less separation between differential and

experimental research has finally had an impact on the human learning and memory areas. This impact is evidenced in part by the search for interactions between classical personality and memory measures (Eysenck, 1977). It is also evidenced by attempts to develop measures of learning and memory activities based, in part, on learning and memory research (Hunt et al., 1973; Sternberg, 1979; Carroll and Maxwell, 1979).

Nevertheless a self-report instrument has been developed by Brown and Holtzman in 1953. This instrument is called the Survey of Study Habits and Attitude (SSHA), which was originally designed to provide a single score that assessed the effectiveness in the academic settings (Brown and Holtzman, 1953). The developers (1967) improved this instrument's usefulness in clinical settings by revising the items of SSHA and grouping them into seven different categories represented in seven different scale scores as follows:

The four basic scores are Delay Avoidance (DA), Work Method (WM), Teacher Approved (TA) and Educational Acceptance (EA). These scores are then combined to yield two second order scores; Study Habit (SH = DA + WM) and Study Attitude (SA = TA + EA). And finally the two second order scales are combined to yield an overall

score for Study Orientation ($SO = SH + SA$)

(as cited in Bray, Maxwell and Schmeck, 1980).

Though Brown and Holtzman (1967) indicated that there is evidence that the overall SO scores are a valid predictor of grade point average, the literature contains little evidence concerning the independence, internal consistency or discriminant validity of the individual scores. Goldfred and D'Zurilla (1973) reported that SO scores were more highly related to peer rating of study effectiveness than to peer ratings of interpersonal effectiveness. They also reported that, SH scores were more highly related to peer ratings of study effectiveness than were the SA scores.

Research on SSHA has been reviewed. Studies by Briggs et al. (1971), Brown (1965), and Brown et al. (1971) have shown that when instruction or counseling on study habits was provided, students reported higher measures on study habit inventories, and obtained higher scores on academic courses. Instruction and counseling about study skills can assist students to learn effective study techniques and to develop positive attitudes toward learning (Briggs, Tosi and Morley, 1971; Brown, 1965; Brown, Wehe, Zunker and Haslam, 1971; Zunker and Brown, 1966; Haslam and Brown, 1968).

The researchers mentioned above used different approaches in teaching study skills. Haslam and Brown

(1968) presented study skills instruction to large classes. Others like Brown (1965), Brown et al. (1971), and Zunker and Brown (1966) applied the student-to-student approach. They contend that the student-to-student counseling approach is the most effective method of teaching study skills.

The study of Haslam and Brown (1968) examined the effectiveness of instruction on study habits for high school sophomores by comparing subjects who received instruction on study habits with those who did not. Results indicated that grades for academic courses were significantly higher for the experimental group than for the control group. This indicates that knowledge of how to study effectively may be crucial for the high school students. However, is the situation of equal importance to the college students, i.e., would the college students need to be taught how to study?

Gadzella, Goldston and Zimmerman (1978) investigated whether college students who were academically successful when exposed to effective study skills would differ significantly from students who were not exposed to these skills in their perceptions of study habits and academic achievement. The results indicated that when academically successful students are provided insight into some of the effective study techniques, they report progressively

higher scores on study habit inventories as the semester progresses. Students who are not exposed to effective study techniques revealed lower scores, showing that they were either discouraged and/or were not sure of their study habits. But no significant difference between the two groups in terms of their academic achievement was reported.

The researchers pointed out that perhaps the subjects in the experimental group were unable to apply the materials they learned to make a difference before the semester ended. They also concluded that providing students who are generally academically successful with a guide on how to study more effectively and stressing the content by administering quizzes and providing for opportunity for class discussions changes students' perceptions of their own study habits.

The literature reviewed indicates that students could be advised to follow certain procedures with regard to study method through some basic study skills courses. Since students of the present study were not provided with study technique instructions or study skills courses, then the investigation of the student study techniques will depend upon how students chose their own techniques (or patterns) individually without pre-advice. From here on, study techniques will be called study patterns.

The study patterns, which represent the concern of this study, consist of four main variables: lecture notes, text reading assignments, study guides, and video-taped lectures, and/or any combinations of these variables.

Unfortunately the literature that has been reviewed with regard to these patterns indicated very little about the combinations of these patterns. Most of these studies investigated the effect of each variable independently, or at the most a second degree combination of some of these variables; for example, the effect of lecture notes, video taped lectures, study guide and/or lecture note/study guide, on the student achievement.

Note taking can aid or hinder the memory for classroom lecture information. DiVesta and Gary (1972) reported that note taking can facilitate learning by providing two major functions:

- (a) an encoding function in which verbal information is transferred into a more meaningful form, and
- (b) an external storage function where notes are used for later review.

Miller (1956) observed that the process by which people translate information into their "own words" plays an important role in perception and learning. But a question

arises. Would all or most of the students be able to take proper notes while they are listening?

Because notes are typically taken while listening to lectures, this activity may interfere with a student's ability (Petters, 1972; Aiken et al., 1975). The external storage function of notes was of more benefit for immediate recall than was the encoding function (Fisher and Harris, 1973). They also found that the students who took no notes during a lecture but reviewed a lecture summary, recalled more information on an immediate recall test than did students who took notes while listening and then mentally reviewed before testing.

Studies like McClendon (1958), Eisner and Rhode (1959), Petters (1972), provided no support for the advantages of note taking. Petters (1972) found that students who took notes on an 8-11 minute speech rate showed significantly poorer recall than those who did not take notes.

The second study pattern is the study guide which is typically a list of questions that students may answer as they read their assignments. The rationale for the use of study guides is that they eliminate students' guess work by identifying the important concepts in the reading material by focusing study effort on specified content

(Lloyd and Eastman, 1977). Crawford in 1928 described the study guide saying:

It is said that all thinking begins with a doubt, perplexity or problem. Questioning is the teacher's easiest method of arousing such a mental state in the student. A few well-selected questions might well replace the usual assignment, "Take the next ten pages," and would afford the necessary stimulus to real study which page assignments usually fail to provide. Asking a student a few questions will often start him on his problem much more effectively than telling him the answers or teaching him how to solve them; moreover, it discourages mental laziness in him.

This indicates the importance of study guides to the traditional methods. Yet recent studies indicated that study guides are considered an integral part in most individualized instruction courses (Born, Gledhill, and Davis, 1972; Hursh, Sheldon, Sherman, Minkin and Wolf, 1975; Keller, 1968; Lloyd and Knutzen, 1969; Lloyd, McMullen, Fox, Rinke, and Duncan, 1974).

Evidence indicated that students' achievement improved when study guides were used (Whitehurst, 1972; Dolphin, 1980; Mohammed, 1980). Moreover, Volo et al. (1976) reported that students appear to prefer study guides when given a choice of having or not having them.

The third pattern is the video cassette-tape or the video-lecture. Video tape is one of several components

of the visual-based instruction method. It has been developed to provide lectures for those students who missed or have been unable to attend the classroom lectures, and to make lectures available for the students upon their demand. Also the video tape could be used as a supplement or alternative to the classroom lecture according to the individual student's opinion. On the other hand, video tapes have also been used as a means for feedback.

In general, a number of studies and research have been done with regard to the effectiveness of video tapes on students' achievement and attitude (Fisher, 1974; Fisher, Guenther and MacWhinney, 1976; Dolphin, 1980; Mohammed, 1980; Dubin and Taveggia, 1968; Fulton, 1969). Dolphin, for example, pointed out that the video-taped lectures support both traditional methods and the Phase Achievement System of student instruction. He also reported that when students were divided into two high and low groups of ability and background, and analysis of variance was used, all groups seemed to profit from viewing the video tapes.

The fourth study pattern is the text book. It was known a long time ago, that text books are the greatest single source of information open to the majority of students in schools and universities. Unfortunately,

the literature indicated very little about the effectiveness of the textbook on student achievement.

Mohammed (1980) reported that the text book's main effect was not significant except that it has a negative effect on student achievement, especially for high ability students, although the negative effect changed when the low ability students used the textbook with the study guide.

Stinard (1980) indicated that in the average phase achievement system, students reported reading significantly more of the text assignments (20% difference) than the traditional students. But no significant difference in terms of student achievement was reported.

Much of the foregoing research reported the use and the effect of student study patterns (habits) on student achievement. The combinations and comparisons of these patterns in both traditional and phase achievement systems were almost totally ignored. Therefore, the major thrust of this study is to find out more information about the effect of, and the relationship between, these patterns, and whether it is important to advise students on how to study.

Statement of the Problem

The Phase Achievement System (PAS), a method of teaching Biology, was begun by Dr. W. Dolphin and colleagues as an experimental method in 1972 at Iowa State University. Three Biology courses, Biology 101 (Principles of Biology I), Biology 103 (Principles of Biology II), and Zoology 155 (Basic Human Physiology and Anatomy) have used this system.

In 1974, Dolphin taught two sections of Biology 101 using the PAS in one section and a traditional method in the other. When outcomes of the two methods were compared, the results indicated that the PAS was highly beneficial learning experience for highly test-anxious female students.

In 1976, a project was developed and funded by a grant from the National Science Foundation to apply the PAS mastery learning model to the three lectures courses, and to create video cassette instructional materials at varying concept levels in an attempt to provide for individual differences in testing and instruction. Since then, various studies of the project have been reported. Latta et al. (1978) reported on an individual differences model applied to instruction and evaluation of large college classes. Stinard (1980) evaluated the PAS and traditional instruction in a university anatomy and

physiology course using comparative and attribute-by-treatment interaction designs. Najmaie (1979) did research on the longitudinal effects of PAS instructional method in an introductory university course.

Purposes of the Study

The present study is considered as an extension of the previous mentioned studies and intends to focus on investigating and then comparing the amount of time and effort students reported spending on the course in and outside of the classroom in both Traditional and Phase Achievement sections in Biology 101 of Fall 1978. This investigation is directed by the following purposes:

1. To investigate the students' study effort on their achievement with regard to answering these questions:
 - a. How do the study patterns relate to each other?
 - b. What is the relationship between the use of study patterns and student ability?
 - c. What is the relationship between the use of study patterns and student background?
 - d. What is the best combination of these patterns (helped most) for what type of students?
2. To compare students in the Phase Achievement section with students in the Traditional section with regard to the previously tested questions

e. To determine in which section students used more time to learn using the study patterns. Consideration of the following figure may help clarify these purposes-

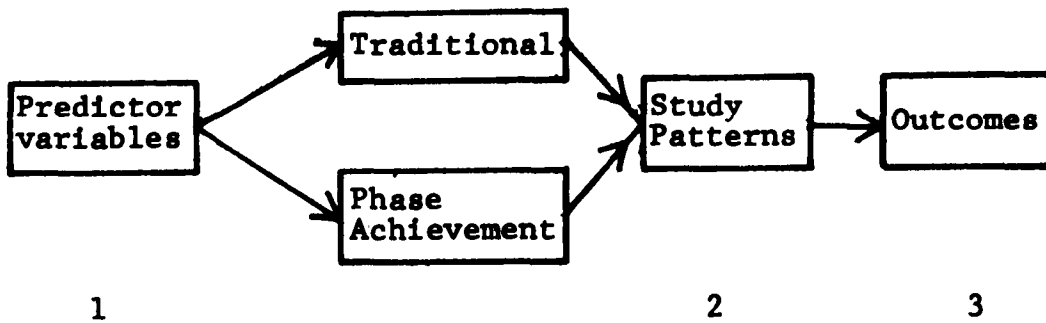


Figure 1. A model for representing the purposes

In Figure 1, the predictor variables (#1) are the measure of a student's ability and background. These will be presented as Minnesota Scholastic Aptitude Test (MSAT) scores and credits in high school science, a composite score of high school physics, chemistry and biology (H-science). The study patterns variables (#2) are

lecture notes, textbook, study guide and videotape use. The outcomes, or the dependent variable (#3), are a measure of the student attainment of course goals (FINAL EXAM).

Definitions

Cause project

A Comprehensive Assistance to Undergraduate Science Education (CAUSE) project was developed in 1976-1979, and funded by a grant from the National Science Foundation. The project was a comprehensive attempt to improve instruction in three freshman biology courses which annually enroll over 5,500 students in large lecture section classes at Iowa State University.

In the 1976-1979 CAUSE announcement brochure, the primary goals of the CAUSE program were as follows:

- A. Strengthen the undergraduate science education components of the nation's two- and four-year colleges and universities.
- B. Improve the quality of science at undergraduate level.
- C. Enhance the capability of institutions for self-assessment, management, and evaluation of their science program (Dolphin, 1980).

Phase Achievement System (PAS)

The Phase Achievement System as identified by Latta, Dolphin and Grabe (1978) is:

An instructional system designed around large enrollment lecture sections, an audio-tape library and assigned reading in a text. Multiple choice examinations compiled in a modular format corresponding to the eight units, are offered periodically outside of scheduled class time. The primary difference between the PAS and the Traditional approach is that students may take the examination modules in any order or grouping at five different times during the enrollment period. Any module may be retaken at any of the regularly scheduled testing times. Examinations are scored by units, and grades are based on a criterion-referenced policy requiring students to achieve a minimum score on each unit and to pass a minimum number of units before receiving a course grade. The system is presently being modified to include a video tape library over the content of each unit to be available to each student upon demand.

Traditional instruction (TRAD)

Traditional instruction consists of large group lectures held several times a week with or without discussion sections. Students compete with each other for the highest grades, and the main purpose is to normatively assign grades. Exams are administered two to four times per term on an established schedule without provisions to retake a test to correct deficiencies. All students progress through the material at the same pace which is set by the instructor (Stinard, 1980).

Students' study patterns

Students' study patterns, as defined here, consist of four main sources of information available for students at the college level. They are: the textbook, the learning questions (or study guide), video cassette tapes, and their own notes from classroom lectures and/or video-taped lectures.

Nature of the Study

The present study is investigatory. It is designed to investigate the effects of students' study methods on their achievement, and to find out which type of students, using certain study patterns, benefits more from which method of instruction (Traditional Method or Phase Achievement System).

It is hoped that this study will help to answer questions such as: Is students' achievement affected by the use of a certain type of study pattern? Is there a difference in student achievement using certain combinations of these patterns? And overall, is it worth making a recommendation or giving advice to the students on how to study?

Special attention is placed on the use of the video tape where it is considered an essential component of PAS and used by the Traditional courses as well. A

review of related literature is presented in Chapter II. Techniques used in this study are discussed in Chapter III. Chapter IV will present the findings and Chapter V will give the researcher's discussion and conclusions.

CHAPTER II. LITERATURE REVIEW

This study is concerned with college students' study patterns under both traditional methods and the Phase Achievement System of instruction as a new technique of teaching. The ultimate goal is to describe the best combinations of study habits in both methods with regard to student achievement. Therefore, the review of literature will be divided into two major areas:

1. Teaching technologies' effects on students' achievement, with consideration as to how they relate to factors in the students' study patterns.
2. Students' study patterns including the important factors and their effect on student achievement.

Teaching Technologies

The term technology is really tangible and very important in most scientific fields, particularly where one can easily see the results of technological uses. Yet, the situation may not be the same in educational courses since here the use of technology is not so readily recognizable. No one, of course, can deny that technological devices in the field of education have not been available for many years. Halcyon Skinner patented what was

probably the first teaching machine more than one hundred years ago (see Kulik et al., 1979), but there is still a hesitancy in adopting or using technological devices in education. Kulik has referred to the reluctance of teachers to use such devices as due in part to uncertainty about the effects of technology on learners. Using technology in teaching has some opponents and advocates, and each group has its own claims and reasons to support or not the technological aids. The main focus of teaching technology is in the area of instructional methods, upon which hundreds of studies have been carried out. Those studies have produced varying results, depending upon the techniques and kind of evaluation utilized. Some researchers have found that instructional technology has greater effect on student achievement than does the traditional method. Some have found no differences, and others have found the opposite. Kulik pointed out that in any instructional technology research, replications are never exact, and investigators may carry out hundreds of studies in an area without establishing a definite conclusion (Kulik et al., 1979).

Instructional technology has different educational approaches, one of which is the Phase Achievement System (PAS). PAS will be discussed in more detail, for comparisons here between the PAS and Traditional. For

the sake of completeness, however, some other strategies should first be discussed briefly. These include the following:

1. Individualized instruction,
2. Audio Tutorial,
3. Mastery learning,
4. Visualized based instruction, and
5. The Phase Achievement System.

Individualized instruction

As mentioned in the first chapter, student achievement has been one of the biggest concerns among educators. A movement toward using individualized instruction emerged more than two decades ago. A well-known method of individualized instruction is the personalized system of instruction, PSI, or Keller plan, in honor of the senior of its two inventors, Fred S. Keller and J. G. Sherman. This system was first used in the department of psychology at the University of Brazilia in March, 1963. It was predicated on providing for individual differences.

Keller (1968) has summarized the characteristics of his plan as follow:

1. The student progresses on his own, which permits the student to move through the course depending upon his ability and time.
2. Before the student proceeds to the next unit he must show and demonstrate mastery of the unit.

3. Lectures are means of motivation, but not sources of critical information.
4. Teacher-student communications
5. Teaching staff includes proctors (tutors) which permits repeated testing, scoring and tutoring.

Research on evaluating the five components of Keller's plan indicates that the level of student performance in unit quizzes is a function of the level of mastery required, and the self-paced groups scored higher than did the instruction-paced groups (Kulik et al., 1979; Kulik, 1976; and Najmaie, 1979).

PSI and student achievement A great deal of research has been carried out discussing the effectiveness of PSI and comparing its outcomes with the outcomes of conventional courses. Most of these studies and the studies that this research reviewed produced impressive evidence that PSI as a total system is more effective as contrasted with the conventional method.

James Kulik (1976) reviewed 31 studies on the effectiveness of PSI concerning the end of course performance. In 30 out of 31 cases, examination performance was better in the PSI course, and in 25 of these cases the difference was great enough to be statistically valid. In one case, lecture performance was slightly better than PSI. (For

more details about the effectiveness of PSI, see Najmaie, 1979 and Kulik, 1976.)

Evaluation models in PSI Carroll's 1963 model of school learning states that any student could achieve a mastery of learning task if he was provided with enough time to learn that task. In 1963, Benjamin Bloom wrote an influential paper that elaborated on Carroll's mastery model and showed how it could be applied to college instruction (Kulik and Kulik, 1976).

In mastery learning, according to Bloom, student achievement is the constant and the time needed is the variable; therefore, individual differences in aptitude are expressed as differences in the amount of time that is needed to complete the course, but not in the differences of student achievement. Although the PSI procedures were developed independently of the mastery model, PSI methodology and mastery model seemed highly compatible to many educators (Kulik and Kulik, 1976).

Five predictions were derived from the mastery learning model by Kulik and Kulik in 1976:

1. Variation in final exam scores should be smaller in a PSI course than in a lecture course.
2. Mean final exam scores should be higher in a PSI course than in a lecture course.

3. The difference in teaching method should have the strongest effect on final exam performance of low aptitude students.
4. Time to complete a PSI course should be highly and (negatively), related to aptitude, and should be unrelated to final exam scores.
5. Number of attempts on unit quizzes should be unrelated to final exam scores, but should be related to aptitude.

Five hypotheses were formed according to the above five predictions and tested. The conclusion about these hypotheses follow:

1. At the end of PSI courses, students are not all equal in their mastery of course content.
2. Average performance in PSI courses is raised, but not as much as suggested by Bloom.
3. The strongest impact of PSI is not necessarily on the low aptitude student. It may be on the high-aptitude student. It probably depends on the way the teacher runs his course: the material he selects, the quizzes he designs, and numerous other factors.
4. Factors other than aptitude probably determine time needed to complete PSI courses. Aptitude seems to play a relatively small role.

5. Students who repeat quizzes often and who take longer to finish PSI courses generally learn less, at least as measured by final exam scores (Kulik and Kulik, 1976).

It seems that the mastery model for PSI is a worthy one, although it may also have some deficiencies or false hopes for some teachers. Nonetheless, in general, it is an almost ideal model for the PSI.

Another model was called for by Snow in 1957. His "Aptitude by Treatment Interaction" focuses on the performances of certain types of students under certain types of instructional settings. (For details see Stinard and Dolphin, 1981.)

Audio-Tutorial

Another approach to teaching technology first proposed and implemented at Purdue University in 1961 by Samuel Postlethwait is called the Audio-Tutorial (A-T) system. The idea behind the A-T is that a teacher assembles the materials that would be used for instruction of a student and talks into a tape recorder as if he were tutoring that student through a sequence of learning activities. The tape can be duplicated as many times as needed according to the number of students. These tapes are usually supported with study guides, film loops and other instructional materials.

The students carry out the learning activities as directed, experiencing a teacher-student situation by listening to the tapes.

Effectiveness of the A-T Hundreds of studies have been performed which attempted to evaluate the A-T approach. The papers and studies that have been reviewed expressed varying results with regard to student achievement in A-T compared with the traditional system. Some studies indicated that no significant differences in level of achievement were produced by the different methods of instruction (Durst, 1968 and Grobe and Allen, 1973). On the other hand, several investigators have found significant differences in favor of students' achievement in A-T system.

In 1975, J. J. Mintzes reviewed, summarized and discussed 19 studies, which he classified into three categories:

- | | |
|-------------------------------------|-----------|
| 1. Comparative method (achievement) | 7 studies |
| 2. Trait-Treatment interaction | 7 studies |
| 3. Instructional variables | 5 studies |

In terms of achievement, he concluded that there were some significant differences showing that the A-T is better than the Traditional at .05 level of significance, but his overall conclusion was disappointment with instruction, due in part to lack of methodological sophistication.

The advantages of A-T There are some advantages to the A-T system over the Traditional method. Gothberg (1977) summarized these advantages as follows:

1. Since the system emphasizes that learning is the responsibility of the learner, it helps students to develop a sense of responsibility, maturity, and independence.
2. It is an efficient and sometimes more economical process than the Traditional, in that it frees both student and teacher. Students are free to schedule much of their own learning and to spend as much or as little time as needed. The teacher, in turn, is free of the repetitive monotony of the lecture method and can be assured that the content is accurate.
3. It is an individualized approach to learning that can be both personalized and humanized.
4. It is a highly flexible system.

Learning for mastery strategy

This approach, also known as Bloom's Mastery Learning Strategy, named after its inventor, Benjamin S. Bloom, in 1968, occurred at the same time that the Keller plan was conceived. There are similarities and differences between Bloom's strategy and PSI represented in Keller's plan. (For details, see Najmaie, 1979.)

Bloom's theory is designed primarily for use with group-based instruction. It is influenced by John Carroll's model (1963) of school, which proposed that if students are normally distributed with respect to aptitude for some subjects and all students are given

exactly the same instruction (the same in terms of amount and quality of instruction and learning time allowed), then achievement measured at the completion of the subject will be normally distributed (Bloom, 1974).

Bloom's strategy and learning time Bloom's strategy is influenced by Carroll's model of school learning, which is each student could master a given topic if he was provided with the time that he needed to learn that topic. It, therefore, attempts to minimize the time a student needs to learn within the amount of instructional time available.

In a study done by Bloom (1974) on two groups, mastery students grouped under similar conditions and fixed time, it was found that the mastery students group achieved more in the time available than did the non-mastery students group.

The effectiveness of Bloom's mastery strategy and the individual differences Block, in 1974, reviewed a number of articles and issues with regard to the effectiveness of Bloom's mastery learning. It is worth mentioning here that Block chose some of these studies from instructional situations in which mastery learning approaches might be expected to work best.

He reported that Bloom's mastery learning strategy is predicated upon the assumption that up to 95 per cent of our students can learn much of what they are taught to

the same high levels typically reached by only our best students.

Visual based instruction

Visual based instruction (VBI) consists of several major areas, including: (1) still projection, (2) closed circuit television, (3) educational television, (4) use of video for instruction and observation, and (5) use of video for feedback and other purposes.

Cohen, Ebeling and Kulik (1981) have described a statistical investigation of findings from 74 studies of visual based instruction college teaching. They applied Glass's meta-analytic methodology to research on the effectiveness of visual based instruction at the college level focusing on the following questions:

1. How effective is VBI in the typical comparative study at the college level?
2. Under which conditions does this teaching approach appear to be most effective?
3. Is it especially effective for certain types of students or on certain measures of instructional effectiveness?

They also examined the results of more complex multifactor and aptitude-treatment studies.

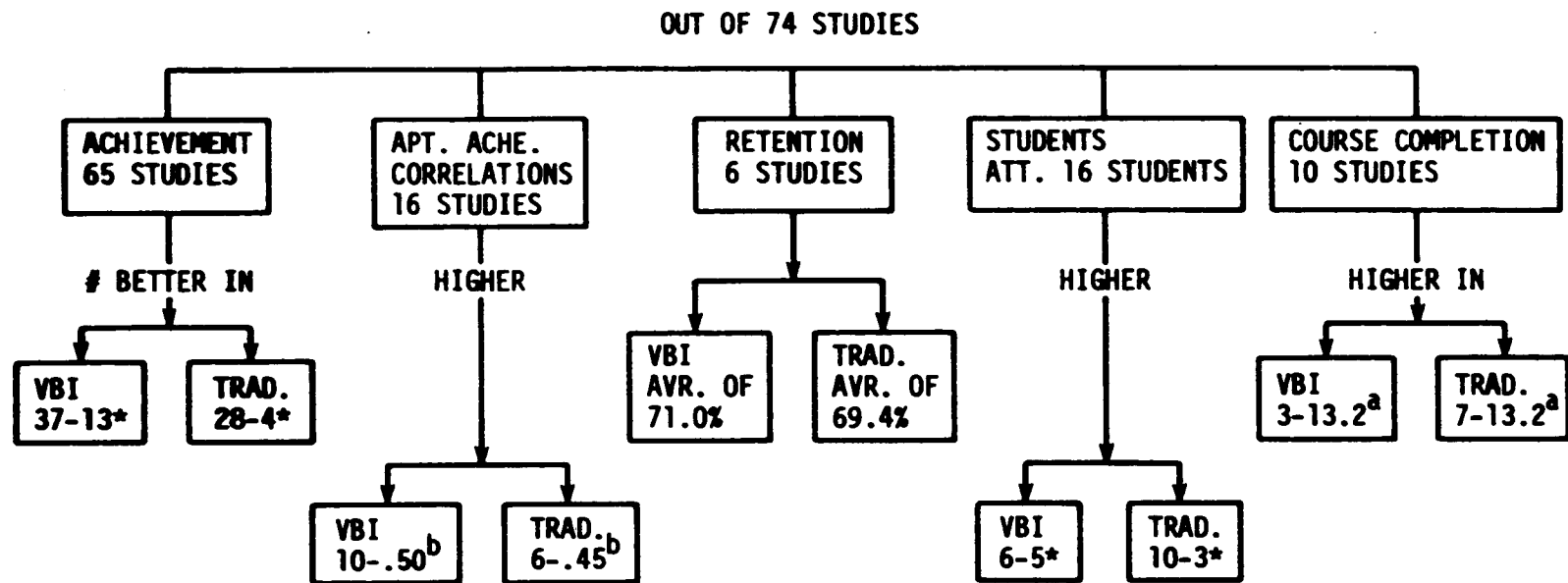
The results of their statistical analysis comparing effects of the VBI and the Traditional, in five areas-- student achievement, aptitude achievement correlations, retention, student attitude and course completion or withdrawal--are explained in Figure 2.

Phase Achievement System (PAS)

PAS is a self-paced mastery system, developed by Dolphin and his colleagues at Iowa State University in 1973. It was designed to overcome some disadvantages of the individual differences and was implemented in large enrollment introductory courses at the college level. PAS shares some common characteristics with other approaches to self-paced learning. These characteristics were mentioned by Latta, Dolphin and Grabe (1978):

- a. Printed educational objectives
- b. Small discrete study units
- c. Competence before progress to subsequent units
- d. Multiple opportunities to take tests
- e. Non punitive and diagnostic use of tests
- f. Remedial activities keyed to students' deficiencies
- g. Allowances for individual variations in work rate.

In PAS, the learning objectives must be clearly defined and selected and organized in relatively small units to help students as a guide and to provide competence for mastery. Students' final grades are based on passing a minimum number of units successfully by a multiple choice



^aOn a more sensitive test, the average withdrawal rate.

^bThe average correlation coefficient in two kinds of classes.

*Statistically reliable.

Figure 2. Results of statistical analysis comparing effects of the VBI and the Traditional

test, regardless of the order of the units, with a minimum score on each unit. Those tests play a major diagnostic role for students' achievement, in that they help the student know his strengths and weaknesses, and they can be taken more than one time. PAS provides for individual differences where students differ in their ability and learning speed.

As there are some similarities between PAS and other approaches, there are also differences. Najmaie (1979) mentioned that the role of lectures in PSI is a motivational role, and the emphasis is more on the written materials, whereas in PAS the instructor discusses all materials in his lecture. The role of lectures in PAS differs from that of Bloom's since it is optional for students to attend. Bloom's lectures are closer to the traditional method than they are in PAS or PSI. (For details, see Najmaie, 1979.)

A study guide and an audio tape are available for the Phase Achievement students. Those are intended to provide instructional supplements for students. Video tapes were produced in 1977. These tapes are available now at the Iowa State University library. If comprehensive library tapes were available, PAS could be used without lectures, since lectures at this point are considered as only supplementary to the traditional method. Even though

the attendance at lectures is optional, it is encouraged. Study guides and video tapes will be discussed later in this chapter.

The effectiveness of PAS Since Phase Achievement System is relatively recent compared to other approaches, there have not yet been many studies done on it. However, because PSI and Phase Achievement System are theoretical and operational examples of self-paced mastery instruction (Stinard, 1980), and because literature on the PSI is more available, many studies and comparisons of PSI were reviewed. (See Stinard, 1980, pp. 26-30.)

Studies on Phase Achievement System which were reviewed indicated that the Phase Achievement System is more beneficial to female students than Traditional. The study by Latta, Dolphin and Grabe (1978) evaluated the phase achievement system versus the traditional, showing that, in general, perseverance was positively related to performance in the mastery learning system, whereas in the traditional system this relation was found only for males. Female students in the Traditional system did not receive a grade commensurate with the time they spent in the learning process. Studies also show that the Phase Achievement System apparently led to a desirable relationship between test anxiety and perseverance for female students.

This indicated that highly test-anxious female students received a greater benefit from Phase Achievement System than they did from Traditional.

Stinard (1980) compared the Phase Achievement System versus Traditional, considering the following purposes:

1. To evaluate Phase Achievement System with comparative evaluation designs; that is, to compare the students' outcomes and study patterns of Phase Achievement System with those of students tested with Traditional,
2. To investigate the relationships of a number of students' academic and personality characteristics with course outcomes and study patterns in the overall group, and
3. To evaluate Phase Achievement System and Traditional with an Attribute by Treatment Interaction (ATI) designed to discover if certain types of students achieved higher in one of the instructional methods.

With regard to the first purpose, results indicated that the Phase Achievement System testing and grading policy encouraged students to have a positive attitude toward the alternative testing procedure. There was also an apparent reduction in test anxiety for Phase Achievement System male students. The results further

indicated that Phase Achievement System students as a group reported spending significantly more time on the course than Traditional students did. The second purpose will be discussed later in this chapter. For the third purpose, results of the attribute by treatment interaction evaluation model indicated that the Phase Achievement System was differentially beneficial for female students with poor background. It seemed that less prepared female students expended more effort and time on the Phase Achievement than in the Traditional, because testing procedure in the Phase Achievement System plays a diagnostic role so that students can remedy their weakness (see Stinard, 1980).

Summary

The previous sections focused on general descriptions and evaluations of the instructional technology. These descriptions and evaluations indicated that some of these strategies are superior to the Traditional methods in certain aspects and some of them have no advantages over the traditional methods.

Two of these technologies, PSI, and A-T, are included in Kulik, Kulik and Cohen's (1979) meta-analysis study of findings from 312 comparative studies of instructional technology in college teaching, broken down as follows:

1. Keller's personalized system of instruction, 74 studies
2. Computer-based teaching (CB), 59 studies
3. Postlethwait's Audio-Tutorial approach (A-T), 48 studies
4. Programmed instruction (PI), 57 studies
5. Visual-Based Instruction (VBI), 74 studies

The main concern of this study (Kulik et al., 1980), is the effectiveness of these five approaches and whether these approaches are especially effective for certain types of students or certain types of educational outcomes.

The 312 studies were carefully selected based on three criteria.

- 1) Studies had to take place in actual college classrooms.
- 2) Studies had to report on quantitatively measured outcomes in both technology based on conventional classes.
- 3) Studies had to be free from crippling methodological flaws.

In addition, a guideline was established to insure that each study was counted only once.

Four major types of outcomes were described:

1. Student achievement
2. Rating of course quality
3. Course completion
4. Correlation between aptitude and achievement

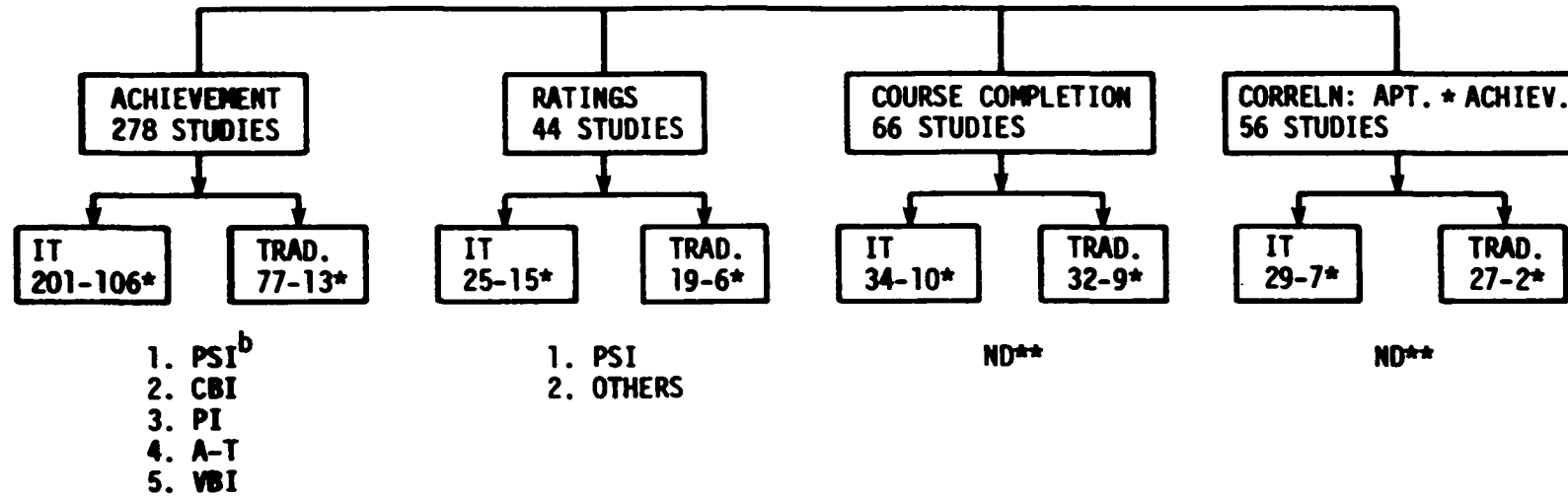
Figure 3 summarizes the distribution and the results of all the located studies. Figure 3 indicates that, in general, for the first categories, student achievement and the student ratings, the instructional technology was strongly favored to the Traditional. Yet, Keller's personalized system of instruction has the strongest effect on the student achievement and ratings among the other four technologies.

The results of the other two outcomes, course completion and correlations of aptitude and achievement, indicated no significant difference between the Traditional and the instructional technologies.

Study Patterns

There are four sources of information that students use to help them master the course content to achieve better scores: lecture notes, study guides, videotapes, and textbooks. Scholastic success, measured in terms of examination results, is due in part to the study strategies employed by the students. It has been suggested that the most effective of those strategies could be taught to the students in formal study method courses where numerous students encounter problems with their study techniques (Dobson, 1979). It is believed that such problems result from poor study habits and attitudes, so students should

312 STUDIES IN INSTRUCTIONAL TECHNOLOGIES (IT) COMPARED WITH TRADITIONAL^a



^aArrows indicate # of studies that are significant.

^bRating of 1-5. For example, the rating of IT, where PSI has the strongest effect among other technologies.

*Studies which are highly significant.

**No significant difference was reported between IT and Trad.

Figure 3. Distribution and results of located studies

be given some direction and/or courses on study behavior (Gadzella, 1979). Therefore, a review of students' study habits and behavior will be presented.

Instruction and counseling on students' study skills can assist students to learn effective study techniques and to develop positive study attitudes toward learning (Brown, 1965). Therefore a verbal questionnaire, a survey of study habits and attitude (SSHA), was devised by Brown and Holtzman in 1953. It is believed that this was a useful instrument in measuring not only the individual's study habits but also his/her attitude toward study.

The SSHA has a score of four basic scales: Delay Avoidance (DA) and Work Method (WM) which combine to form the Study Habits (SH); and Teacher Approval (TA) and Education Acceptance (EA), which combine to produce the Study Attitude (SA). A Study Orientation (SO) category is obtained by adding together the SA and SH components.

Goldford and D'Zurilla (1973) mentioned that those who used the SSHA claimed a strong element of success in relating its scores to students and emphasized that its high predictive validity had been maintained through the experimental stages of its construction. This, they used as evidence of its suitability as a counseling as well as a measuring instrument. Some of the studies

on the reliability and the effect of the SSHA are summarized below.

Gadzella, Goldston, and Zimmerman (1978) investigated whether academically successful university students, when exposed to effective study skills, would differ significantly from students who were not exposed to these skills in perceptions of study habits and academic achievement. In this study, the subjects were students enrolled in introductory and educational psychology classes during two different semesters. All subjects responded to the SSHA inventory three times (beginning, middle, and end of the semester) and took the California Short-form Test of Mental Maturity (CTMM) and the Cooperative Reading Test (CRT). Subjects of this study, 160 students, were chosen as follows. In the first semester, 80 students served as an experimental group. Students in this group studied the topics in the guides, took written quizzes, and participated in any class discussions. In the second semester, 80 students were not given any study guides or quizzes and did not participate in any class discussions. They served as a control group. At the end of the second semester, subjects in the experimental group were matched with those in the control group on five variables: sex, college status, race, mental ability, and reading test scores. The outcome was that eighty subjects in the experimental group matched with eighty

subjects in the control group on the five variable base. These two groups were put together to serve the need of this study.

The results indicate that providing students who are academically successful with guides on how to study more effectively and stressing the content by administering quizzes and providing for class discussions changes students' perceptions of their study habits. The authors concluded that these changes may be due to several reasons: gaining greater confidence in their study habits, increasing insight on how they could improve their study skills or a combination of these and other factors. The insight and the confidence gained by the students in this experimental study may have appreciated more than their knowledge of facts.

At Kansas State University during the fall of 1975, Robyak (1978) investigated differences in knowledge and use of effective study skills, the number and the type of adjustment problems, and the academic aptitude of students (a) who are enrolled in a study skills course, (b) who report study problems but who are not currently enrolled in a study skills course and (c) who do not report study problems and are not enrolled in a study skills course. There were one hundred fifty-nine male and female undergraduate students who served as subjects in this

study. Seventy subjects were enrolled in six sections of a study skills course, while the remaining 89 subjects were assigned from different undergraduate classes. According to the three categories above, subjects were divided into three groups: Group I (30 males and 40 females) was composed of study skills students; Group II (9 males and 30 females) was composed of students with study skills problems who were not enrolled in the study skills course; Group III (16 males and 34 females) was composed of students with no study problems and who were not enrolled in the study skills course.

The students who were enrolled in the study skills course were administered all measures immediately prior to the beginning of the study skills instructions, while the remaining subjects were tested during their regularly scheduled class times in the second and third week of the semester. All subjects were asked to indicate whether or not they had study problems.

Different reliable statistical instruments for evaluating this study showed that both male and female students in each of the three groups could be successfully differentiated on the basis of a combination of study skills knowledge, study skills usage, adjustment problems, and academic aptitude scores. Although students enrolled in study skills classes could be differentiated from

students with and without study difficulties, female students could be identified to a greater extent than male students. Figures of this study show that the male students in the three groups appeared to be differentiated along with the adjustment and the academic aptitude dimensions, whereas female students could be differentiated better along with the study skills and the academic aptitude dimensions.

Bray, Maxwell and Schmeck (1980) investigated the psychometric properties of the SSHA scales using Confirmatory Factor Analysis (see Joreskog, 1978) to determine the reliabilities of the scales. Subjects used in this study were 1,899 undergraduate students at a large southwestern university, and the data employed in this study represented archival SSHA scores from all the students taking a course on reading and study skills between 1974 and 1977 where SSHA was, in all cases, administered during the first week of the course. The authors used the SSHA 100-item questionnaire which was designed to measure the students' study methods, motivation for studying, and attitudes toward academic activities.

The results of this study showed that the four basic subscales generally have low reliabilities. The first order subscores DA, WM, TA, EA had reliability coefficients of .653, .812, .848, and .749, respectively. Although the

reliabilities of the WM and TA scales fall within the acceptable range for group research, none of the scales has a reliability generally considered acceptable for individual counseling (Seibel, 1968). The second order subscales SH and SA had reliability coefficients of .878 and .830, respectively. This, according to Seibel, (1968) indicates that the reliability of the SH scale is within the acceptable range for group and individual purposes, whereas the reliability of the SA scale is acceptable for group use only. The confirmatory Factor Analysis procedure based on item intercorrelations did not support Brown and Holtzman's four scale model.

Literature reviewed on the SSHA indicated, in general, that individual students are willing to devote some time to learning how to study. Since these study methods appeared to be helpful to both high school and college students, it is believed that, after investigating the students' study patterns and finding out the best study method (or methods depending on what type of students choose what type of method) using these patterns, offering recommendations telling students what sources to use more and which to invest more time in may be helpful, too.

The literature on the study patterns combined is meager. Therefore, the study patterns will be reviewed

independently along with reviewing any combination(s) whenever possible and available.

Lecture notes

Note taking is a behavior which can potentially aid or hinder memory for lectures, depending to some extent on the quality of the notes and how they were taken by the individual learner. They appear to facilitate learning by serving the following two major functions:

- (a) an encoding function in which verbal information is transformed into meaningful forms
- (b) an external storage function where notes are used for later review (DiVesta and Gary, 1972; DiVesta, 1975)

Yet it is believed some students contend that taking notes during a lecture hampers their listening comprehension. Students maintain that while they are busy writing down one point they do not hear others (Petters, 1972).

Surprisingly, literature on note taking indicates that there has been little systematic effort to determine whether or not the instrumental activity of note taking actually improves performance on subsequent testing situations.

Immediate and delayed recall Fisher and Harris

(1973) reported that the external storage function of notes was of more benefit for immediate recall than was the encoding function. They found that subjects who took no notes during a lecture but reviewed a lecture summary, recalled more information on an immediate test than did subjects who took notes while listening and then mentally reviewed before testing. This difference, however, did not demonstrate itself in a delayed recall condition. In the immediate recall condition, the authors also reported that subjects who recorded and reviewed their own notes recalled more information than did subjects who recorded their own notes but reviewed lecture summaries. This finding was not replicated in the delayed recall condition.

Using a delayed recall test, Annis and Davis (1978) reported that there was no significant difference in recall by students who reviewed lecture summaries or their own notes. These findings suggest that when a delayed recall test was used, the external storage value of subject-generated notes was no greater than the value of lecture generated summaries.

In the extreme case, note taking which was used solely for the purpose of external storage can only be incompatible with efficient learning. Such notes tend to be taken in a mechanical fashion, interfering with

attention, and possibly engendering a feeling that the task has been accomplished (DiVesta and Gary, 1972).

Taking notes while listening to lectures may interfere with the encoding process. Aiken, Thomas and Shennum (1975) found that when the act of note taking was separated from listening to a segmented lecture, recall was facilitated. Students who took notes during an interval between lecture segments recalled more information than did students who took notes while listening or students who took no notes. In another study (1975), the same authors indicated that coding such as taking notes on a topical outline between lecture segments, further improved recall performance.

Kay (1955) described a study which examined the roles of adult learners in a 7-trial task that required recall of meaningful prose passage. This experiment continued over 7 weekly sessions, in each of which the subjects attempted recall and then listened to the correct passage. This procedure, which involves repeated presentation of the correct materials, would seem to afford excellent opportunities for subjects to correct their imperfect retention, yet Kay found that there was no week-to-week improvement, and that from one session to the next the students tended to recall very accurately what they had themselves reproduced on the previous recall trial. Items reproduced on one trial, even if incorrect, were much more likely to be

recalled on subsequent trials than previously nonrecalled items, despite the repeated presentations of the latter as part of the correct passage.

The effect of note taking Petters (1972) investigated the effects of note taking on listening, using eighty-two undergraduate students assigned to two note taking conditions and to one of three presentation conditions in a 2 X 3 analysis of variance. The Attribute by Treatment interaction was also used in this study. The results showed that students not engaged in taking notes scored significantly better on the criterion measure. The ATI result suggested that, in general, low scores on the aptitude measures performed better when the material was read and when they were not required to take notes.

Petters and Harris (1970, reported that subjects permitted to take notes during a taped presentation or who were provided with prepared notes performed significantly better on subsequent multiple choice tests than did a no note control group. The first author (Petters) of this study appears to be more satisfied with his more recent study (1972) than with this one, indicating that it appears that the effect of note taking on performance is more complete than was suggested in the previous research.

Time and note taking The literature reviewed placed little attention on the time students spend using their

notes outside of the classrooms. However, Stinard (1980) pointed out that the PAS female students as a group reported spending more time on the course and completing more of the reading assignments, when compared to the Traditional students.

Mohammed (1980) reported that the LO HSR (or Low High school Rank) students who invested their time in the lecture notes achieved lower mean scores than those achieved by LO HSR students who spent less time using them.

The lecture time (morning or afternoon) seemed to have no influence on students' note taking. Hollaway (1965) investigated the influence of lecture time on students' note taking using 53 undergraduate students. The results of this study showed that some students favored one time while others favored the other. For each student, a decision was made as to whether he attended a greater proportion of morning than afternoon lectures. Thirty students attended more afternoon lectures while twenty-one attended more morning lectures. This difference was significant.

Study guides

A study guide is an essential part of most of the Individualized Instruction strategies. Typically, it

consists of a list of questions that students may answer while they read their texts, lecture notes and/or viewing videotapes.

Hursh (1976) indicated that in most personalized courses the units of study materials are combined by study questions and/or objectives to give students an explicit indication of what are considered the important points of information. Miles, Kibler and Pettigrew (1976) found that for units with study questions students' pre-to-post-test gain scores are significantly higher than for units without study questions. This result was replicated by Santogrossi and Colussy (1976). Similarly, Semb, Hopkins, and Hursh (1973) demonstrated that when study questions appear on unit quizzes, students answer them 20 to 30 per cent more accurately than they do questions not drawn from the study questions provided with each unit. In this study, mean performance on study questions is above 40 per cent. A supplementary finding is that the more study questions provided on a given unit, the more likely students are to accurately answer quiz questions not drawn from the study questions. The result of this study also indicated that providing study questions with each unit of material substantially increases quiz performance. The same result was also reported by Whitehurst (1972).

Lloyd and Eastman (1977) noted that if answering test questions drawn from a study guide is important, study guides are an effective way to promote learning. It may be so; students have reported that they skim the text to fill out the study guide and then study from the guide rather than from the textbook, while other students reported that they sometimes answer part of the study questions and then exchange their answers with students who have answered the remaining part of the study questions (Volo, Lloyd, and Lloyd, 1976). However, it may be that study guides control reading to such an extent that students do not pay attention to those parts of the text not directly covered by the study guides. This may be one of the reasons that caused the negative effect of the textbook on student achievement which was reported by Mohammed (1980).

Lloyd and Eastman (1977) also analyzed whether the study guides reduce students' learning from those parts of the reading assignments not directly covered by study guide questions. In this study, the authors provided probe questions (test questions not appearing on the study guide and for which students would not earn course credits) to be used to assess the degree to which study guides controlled students' test performance. The result of this study indicates that the presence and absence of

study guides suggests that the use of study guides reduces to some extent the amount of what students learn from those parts of the text not covered by the study guide questions. But at the same time, the use of study guides may increase the amount students learn from those parts of the text that are covered by the study guide items. Lloyd and Eastman (1977) suggested that the easiest way for an instructor to use study guides without reducing the amount that students learn of parts of the textbook not covered by the study guide questions may be simply to add several test questions not on the guide to those test questions drawn from it.

Mohammed (1980) indicated that high ability student groups were able to use the questions on the study guide to achieve higher scores and also inferred that this type of students (high ability) was probably more able to locate and understand the information needed to answer the study guide's questions, and, therefore, achieved higher scores than the low ability students did. The research further reported that students with weak science background tried to answer the study guide's questions from the text book, but this process was not successful; for the significant interaction between the students' background and the study guide suggested that students with better background differentially achieved higher scores when using the

study guide. The effort that students invested in the study guide seemed to be associated with better achievement (Stinard, 1980).

Study guides seem to be even more effective when used with videotaped lectures, especially for a certain type of students. Mohammed (1980) reported that the use of study guides with televised lectures was differentially beneficial to the high ability students, yet the low ability students who used the study guide with the text which did not prove more successful in achieving higher grades.

Study guide's question format The format for study questions varies widely among personalized courses. Many instructors opt for a multiple-choice format, others use fill-in-the-blank questions, and a few use long answer essay questions which make quick grading difficult (Hursh, 1976). Studies reviewed in the literature did not indicate any preference toward a certain format of study guide questions, yet the multiple-choice format is the most widely used along with the true-false question format, to a lesser extent.

Videotapes

The videotape is considered an essential part of the Phase Achievement System of instruction but it was developed to supplement, not necessarily to replace, live lectures.

The preparation of the videotapes for Iowa State University CAUSE project is very well-described by Dr. Dolphin, the project director, below.

Almost all of the video-lectures produced were videotaped as is from beginning to end without subsequent editing. Approximately five time-base corrected copies were made at the time of the taping by rigging recorders in parallel. Other required copies were made after the videotapes were critiqued. Video lecture critiquing occurred in a number of ways. The authors always reviewed a lecture shortly after the taping and made an accept or reject decision. If accepted, various other reviews were solicited. In the beginning, staff from the television studios and members of the campus Media Resources Center gave advice on the technical quality of the lectures. Opinions of colleagues who taught the courses were solicited. Typically they would comment on subject content as well as technique. Tapes could have been rejected at this point but we asked our colleagues to keep in mind perfection versus production. The bottom line question asked was, "Should we allow students to use this tape?" The answer was always yes, though in some cases more qualified than in others. This kind of feedback built our confidence and gave us technique ideas for incorporation into future tapes... (Dolphin, 1980, p. 35).

Lecture attendance and videotapes Most of the early personalized courses include the use of lectures as optional activities for those students progressing at a reasonable rate through the course (Hursh, 1976).

Investigations of lectures within the individualized system of instruction revealed that the use of lectures is not as valuable as it is with the traditional methods. Lloyd et al. (1972) reported that attendance at such

lectures, within a personalized course, declines rapidly with no contingencies in effect. Keller (1968) mentioned that usually lectures do not serve as a motivating function within a personalized course. Research on this matter indicates that lecture attendance is found to be high only when the lecture precedes a quiz and produces no performance advantages over attendance of post-quiz lectures or participation in a personalized section of a course that offers no lecture at all (Phillip and Semb, 1976).

It is believed that one of the direct reasons for decreasing lecture attendance (for both Traditional and Phase Achievement Systems) is the availability of the television or the videotapes, depending upon the students' attitude and the learning environment. Chu and Schram (1967) implied that college students tend to prefer small lecture classes to instructional television, but prefer the opposite when the lecture classes are large; i.e., students prefer instructional television to large lecture classes. Furthermore, students' opinions may vary depending on their attitude toward the television.

Linder and Golmon (1976) mentioned that some students felt that television lectures were impersonal and suggested that lectures should be presented in a live format.

Voorhies (1960) also found that direct observations were

rated higher than television observation by students who had experienced both as part of special method courses.

Research on the effect of videotapes Results of recent research on videotapes indicate that this device is helpful and effective for both Phase Achievement System and Traditional students. Dolphin (1980) reported that the videotaped lectures supported both Traditional and Phase Achievement System students.

Linder and Golmon (1976) used videocassettes along with audio-cassettes in a general zoology course at the University of Maryland where more than 2000 students enrolled each year. They arranged for a careful record to maintain the use of video and audio cassettes by students who participated in this study during Fall, 1973, and Spring, 1974, semesters, when a day-by-day record was maintained during both semesters for each of the media format. In this study, it was evidenced that during the spring semester attendance in the lecture section dropped while videocassette utilization increased almost beyond the ability of the library staff to cope with the demands. Records on this study indicate that the average frequency use of the media format during Spring, 1974 semester was higher than during the Fall, 1973 semester. Yet, the daily use of these media format during the Fall, 1973 semester never exceeded 18% of the class when the enrollment during this semester

was 1,273 students. The overall evaluation of this study indicates that student achievement seemed to improve and a general positive attitude was generated among the students toward this technique.

Kulik and Jaksa (1977) have reviewed ten studies on the effectiveness of the video cassette as an alternative to the Traditional method in college teaching. Their findings indicated that in only two studies out of the ten, the video students' achievement was significantly higher than the Traditional students' achievement. In only one study out of the ten reviewed studies, it was reported that Traditional students achieved significantly higher scores than the video students did. The remaining seven studies showed no significant difference in students' achievement between the two groups.

Mohammed (1980) evaluated the effect of six phases of videotapes on the PAS students' achievement in Zoology 155 in Fall, 1978 and Winter, 1979 at Iowa State University. In this study, the students were divided into two main groups according to their abilities and science backgrounds. Two variables, High School Science (HSCI, see Chapter III), and College Biology Credits (or CBI0), were used as indicators of student background. Three other variables, High School Rank (HSR), Minnesota Scholastic Aptitude Test (MSAT), and Grade Point Average, were used to represent

the students' abilities. The two main groups were then divided into two subgroups each: high and low ability, and high and low science background. Using different valid statistical procedures, Mohammed inferred that, in general, students who used the video-taped lectures achieved better scores in all phases, whether they had low or high ability or different background preparation and then concluded "High school science background had a tendency to affect the score at the beginning of the quarter, but as students progressed into the course, this effect began to decrease, and the same tendency could be observed also in the effect of college biology credits."

Time investment with the videotapes and the effect of combination of videotapes with other study patterns In general, the Phase Achievement System students reported spending more time on course requirements, especially the female students (Stinard, 1980). Students who spend more time reviewing the videotapes apparently are able to gain higher scores than those who spend less time.

Mohammed's (1980) general conclusion regarding the effect of time will be summarized by the following points:

- (a) Students who had studied more college biology invested more time reviewing the videotapes by using them more frequently.

- (b) Students who had reviewed more tapes (spent more time) achieved higher grades by the end of the Fall, 1978 quarter.
- (c) Students who reviewed the videotapes less (did not spend more time with the videotapes) are those who have lower abilities and weaker college biology backgrounds and achieved lower scores than those who invested more time with the videotapes.

In this study, the author also indicated that videotapes were differentially beneficial for those students who used them answering the questions of study guides. Yet, it is not known to the author whether the higher achievement is associated with the quality of tapes or whether it is due to great effort and time that students spend using these videotapes. Such questioning is part of the concern of the current study.

Anderson (1977), in a study of the relationship between student note-taking during an instructional television lesson and student learning, compared different styles of note-taking when using instructional television. He reported that there was no indication that providing students with structured notes or requiring students to make responses over written materials facilitated the learning of television lesson content. In this case, one might believe

that videotaped lectures might not be as good as live lectures in helping students to be good note-takers. The author also mentioned that no data had been obtained suggesting one note-taking treatment was any better than another in improving students' learning from the instructional television lessons.

Textbooks

The textbook used to be the essential, and perhaps the only, source of information available to students in the traditional system of instruction. In 1928, Crawford wrote:

Probably the greatest single source of information open to the majority of students in school is the textbook. The most common classroom activity is some kind of elaboration of textbook material, and it is doubtless true that more hours of students' time are spent in studying textbooks than in any other form of study (p. 69).

Accordingly, it is believed that the more time students spend studying from the textbook, the greater achievement they have. This truth has become, to some extent, a shaky one. The self-paced instruction strategy provides more than one single source of information to the students beside the text. Furthermore, the textbook may not be as good as one of these sources in the new technology. Certainly, learning from the textbook could be improved.

The use of specific goal-descriptive direction with test material has been shown to produce substantial increases in students' performance on goal-related and test items (Duchastel and Brown, 1974; Kaplan and Rothkopf, 1974).

Studies reviewed on the specific objectives showed some inconsistency with regard to the incidental learning from the textbooks. Some reports (Kaplan and Rothkopf, 1974; Rothkopf and Kaplan, 1972) have indicated that the availability of specific learning goals during study increases incidental learning. Others have observed that goal-descriptive directions have resulted in decreases in students' performance on incidental learning (Duchastel and Brown, 1974).

Gangé and Rothkopf (1975) indicated, from previous research, that specific descriptions of learning goals are attractive adjunct aids for use with written instructional materials, particularly those classes in which teachers wish to adapt available text material to explicitly formulated instructional purposes.

In Gangé and Rothkopf's (1975) study, control groups received general direction, and experimental groups had goal descriptive directions provided for two treatments. In one treatment, the information elements required for each learning goal were nondispersed in the text, while

in the other treatment the information elements were dispersed. Subjects in this study were 157 high school students. The authors reported that learning goals resulted in substantial elevation of performance on all goal relevant test elements in the nondispersed text but only on the first relevant element for each goal in the dispersed passage. They reported also that incidental learning in both treatments was lower than in suitable control groups which received general directions.

The Phase Achievement System students, in general, used textbooks more but benefited less from them. Stinard (1980) indicated that on the average the Phase Achievement System students reported reading significantly more of the text assignments (20% difference) than did the Traditional students, but no significant difference in terms of student achievement was reported.

Mohammed (1980) indicated that the text's main effect was not significant, having instead a negative effect on achievement, especially for high ability students. For the low ability students, on the other hand, this negative effect was changed when they used the textbook with the study guide.

It could be that this negative effect of the textbook is due to the availability of the videotapes. Students use the videotapes to answer questions from the study

guide more than they use the textbook to answer such questions. This idea applies for both Phase Achievement System and Traditional students, since they all have access to the video tape. The study of Volo, Lloyd and Lloyd (1976) mentioned earlier indicated how the study guide affects the use of the text, allowing students to devote less time for the textbook.

Summary of the Literature Review

In the first section of the literature review, several instructional technologies were briefly reviewed. These instructional technologies emerged as a result of extensive research to solve some problems such as large enrollment and the heterogeneity of individuals, and to predicate for individual differences.

There is evidence that the effectiveness of the PSI not only is superior to the Traditional, but it is also considered the most effective teaching method among the other strategies. Comparisons among these strategies were also reviewed. It has also been evidenced that Phase Achievement System is superior to the Traditional for female students, especially for those who had high test anxiety. It also evidenced that Phase Achievement System generally required more time for course requirements than the Traditional did.

Since student study patterns are the main concern of the present study, and since this is related to student study behavior in and outside the classroom, a review of literature on the student study habits and whether it is helpful to direct students on how to study and how to use their time could be helpful. This review is presented in section two.

In this section, student study patterns were also reviewed. Unfortunately, the literature with regard to this matter indicated very little about the effect of any combination of these patterns. Yet it was evidenced that the study guide and the videotapes have had the most positive influence on students' academic performance when compared to the other two patterns (lecture notes and textbooks). Mixed results have been obtained about the effectiveness of lecture notes. Textbooks have had the weakest support in this literature. It was believed that the best combination of these patterns was study guide/ videotapes, when students used the videotapes to answer study guide questions.

CHAPTER III. METHODOLOGY

The objectives of this research were, first to determine in which section (Phase Achievement or Traditional) students spent more time on course requirements outside of class, next to investigate students' study patterns, and then to determine what combinations of the study patterns were most helpful for what type of students in either section.

In this thesis, it is believed such investigation would provide some understanding of the effectiveness of students' study methods, and it is hoped that suggestions and recommendations for some effective study techniques could be made.

This chapter describes the methodology of this study. It is organized into the following sections:

1. Course and subjects involved in this study
2. Data collection instruments
3. Variables under consideration
4. Statistical methods

Course and Subjects

The subjects of this study were students enrolled in two sections of Biology 101 (Principles of Biology) during fall quarter, 1978 at Iowa State University.

There were 375 students enrolled in the course, but for the purpose of this study, 12 students were deleted due to lack of response. The actual number used in this study was 363 students, which included 216 students in the Traditional section and 147 students in the Phase Achievement System section, both males and females.

Principles of Biology I consists of seven main areas, each of which is divided into several sub units. Multiple copies of fifty-eight videotaped lectures of the course material were available in the Media Center of the Iowa State University Library. Students in both the Phase Achievement System and Traditional sections had access to the videotapes. Review of the videotapes along with consultation of textbooks and lecture notes were to allow students to answer questions on the accompanying study guides.

Biology 101 was one of the courses that utilized large lecture sections, with lecture sections ranging in size from 100 to 250 major and nonmajor students. The course was offered three times a year with about 3200 students enrolling annually.

The main differences between the Phase Achievement System and Traditional sections were in testing and grading systems. In Phase Achievement System sections, students attended regularly scheduled lectures, yet

attendance in this section was optional. In order to receive a passing grade, the students were required to pass a certain number of the course unit tests with satisfactory grades as well as passing the final exam.

The Phase Achievement System students had a chance to retake any unit test as often as five times during the term in order to improve their grades on that unit. The highest score received was used in determining the grade for that unit.

In the Traditional sections, lecture attendance was required and students had no test options; i.e., students did not have the chance to retake any test in this section. The course passing grade was dependent upon two major exams during the term: a midterm exam with many questions shared with the unit tests in the Phase Achievement System sections and a common final exam, taken by both Phase Achievement System and Traditional sections at the end of the term.

Data Collection Instruments

The data of the present study came from a data bank built by the Iowa State University CAUSE project. In this project, all the students who were used in the research studies from the experimental sections indicated their willingness to participate by signing a written consent

form. Students were asked to sign these forms on the first or second day of classes. If they failed to sign it, they were contacted by phone and their reasons for not participating discussed. If a simple explanation did not convince them to sign the form, they were not included in the research study, although they continued in the class. Participation rates were on the average of 92%, with a range of 83% to 98% in 22 experimental studies.

At the beginning of the quarter, a questionnaire was administered to participating students to measure certain personality characteristics. At different times during the project, different questionnaires were used. These questionnaires contained standard educational psychology scales, such as the Mandler-Sarason Test Anxiety scales, the Haber-Alpert Facilitating-Debilitating Anxiety scale, the Rotter Locus of control scale, the California Personality Inventory Achievement Motivation scales, or some combination of the above. This questionnaire was called an attitude survey.

At the end of the quarter, the participating students were asked to answer a second questionnaire designed to measure study effort (Items 1-7); background in college science (Items 8-9); opinions about course materials, tests, procedures (Items 10-36); opinion of instructor (Items 37-45); and opinions about video lectures (Items

46-54). Copies of the pre and post questionnaires are in Appendix A.

Information gathered for each participating student came from four sources. The students supplied answers to the questionnaires, high school records came from the registrar, demographic information came from the university records, and the course instructors supplied achievement data. All of this information was entered into computer files by individuals, but all individuals were identified only by a unique four-digit number so that files were secure and private (see Dolphin, 1980). Variables of this study which came from such files are explained in the following section.

Variables Under Consideration

Variables under consideration in this study were selected as they related to the present study problem from both pre and post questionnaires. These variables were as follows:

A. Dependent variable

FINAL--The scores on a comprehensive common final exam administered at the end of the term. Final scores were available for all the students in this course.

B. Independent variables

METHOD--Two methods of teaching Phase Achievement System versus Traditional method involved, will be called sections instead of methods.

TIME--Indicate the total amount of time, represented in hours per week, that students reported spending on the course outside of the classroom. The response rate on this variable was 100%.

CUTS--The number of lectures that student reported missing during the term. The response rate was 100%.

LECTURE NOTES--Per cent of lecture notes was used for the percentage of the study time that students reported spending using the lecture notes. Some adjustments have been made on the data with regard to this variable.

The students' response to this variable had to be on a 1 through 9 scale represented by (0-10%) through (81% or more).

It was assumed that all outside time spent is equal to 100%, and the question was "What per cent of your outside study time went toward use of: lecture notes, textbook and tape viewing?" using a scale of percentage ranked from 1 (or 10%) to 9 (81% or more). For item numbers 3, 4 and 5 on the post questionnaire see Appendix A. There were 121 students who misjudged this question and their

responses to these items did not add up to 100%. Therefore, the adjusted time was used as follows:

$$\text{The response for \% Lecture Notes} = \frac{\text{Lec. Notes}}{\% \text{ Lec. Notes} + \% \text{ Text use} + \% \text{ Tape view.}}$$

Due to this lack of understanding of the students, it was decided that the percentage of time in using the textbook and in viewing the tape was not to be used in this study. Instead we used two other equivalent variables, Text and TV, explained below in this section. Yet lecture notes had to be used because it is the only variable measuring the use of lecture notes. The response rate for this variable was 100%.

TEXT--Fraction of the suggested textbook reading was used for the percentage of the text reading that students reported they had read during the term. The response rate was 100%.

STUDY GUIDE--Fraction of study guide was used for the fraction of questions in the study guide that students reported conscientiously answered. The response rate was 100%.

TV--Television was used to represent the frequency of videotape use. This was computed from the library slips turned in by the student each time he/she used the videotape. Out of the 363 students, 118 reported no responses to this

variable. This means that they did not have any library slips, indicating that their TV use is zero. Therefore, the responses of the students to this variable were considered zeros. The response was, thus, 100%.

MSAT--Minnesota Scholastic Aptitude Test. Administered routinely to all entering ISU students except transfer students, it is used here to represent the students' abilities. MSAT scores were available for 83% of the students.

H. SCIENCE--High school science is the sum of the number of credits in biology, chemistry and physics that students had taken in their high schools. Blanks were treated as missing values only if the three courses were blanks. The response rate was 89%.

Statistical Methods

According to the nature of the present study, the statistical procedures were carried out in three sequential steps, as follows:

Descriptive statistics

The purpose of this step was to inspect the distributions of the dependent and independent variables. A V-BAR procedure on Statistical Analysis System (SAS) package was used. Histograms were created for the variables.

Visual inspection of these histograms indicated that some variables were normally distributed and some were not. Therefore, a transformation procedure, recommended by Mosteller and Tukey (1977) was used. This transformation has two different formulas, assuming that the variable to be transformed is x and n is the number of subjects for that variable;

$$(1) x_{\text{transformed}} = \text{SQRT}(x-3) - \text{SQRT}(N+1-x-3);$$

$$(2) x_{\text{transformed}} = \text{SQRT}(x+1).$$

This is called the square root transformation or the Tukey transformation. Whichever of these formulas had the best fit was applied to the variables. The only variable used with such transformation was the videotape, where it was highly skewed and after transformation the skewness was slightly reduced (See Appendix B). The remaining variables which were not normally distributed could not be made approximately normal by either of these transformations.

Univariate analysis

Person Moment Correlation Coefficients were computed in two categories, Phase Achievement System section and Traditional section, of the dependent and independent variables. The purpose of this analysis was to see the univariate relationships between the dependent variable and

the independent variables, and to explore the interrelationships among the study patterns and see how they related to each other. Means and standard deviations were also computed for each variable in both sections.

Multivariate analysis

In this part, regression models were developed using the least squares regression technique and General Linear Model analysis. Several computer runs were carried out to decide upon a model that could predict, with as much precision as possible, student achievement from certain study patterns. This was done as follows.

Full model A full regression model for both sections, including the study pattern variables, total amount of time students spent on the course and the number of missing lectures, along with all possible first order interactions, was developed and studied.

According to the results from the full model for the entire group, the same model was applied and considered for each section independently.

Reduced model One particular technique used for model reduction eliminated all the nonsignificant terms in the models. The reason for doing this reduction was to drop off the unnecessary terms which might affect only slightly the contribution value in the model but not

significantly. R^2 -values were computed and discussed for each model.

Test for differences between models An F-test was used to determine whether there was any difference between the full and the reduced model in terms of predictivity, i.e., would the prediction in the full model differ significantly from the prediction of the reduced model? The following formula was applied for such tests.

$$F = \frac{(SS_{\text{full}} - SS_{\text{reduced}}) / (d.f._{\text{full}} - d.f._{\text{reduced}})}{MS_{\text{residual (full)}}$$

Residual analysis The main purpose of this procedure was to study the prediction of the models, with regard to the students' ability and background, and to determine if any of the study patterns compensated for the low ability and background of the students.

Students were classified into three groups: over-achievers (those who were over predicted by the model), predictable (those whose scores clustered closer to the zero line), and underachievers (for those who were under predicted by the model). Several t-tests were carried out to test for significant differences between the means of these groups.

CHAPTER IV. RESULTS

Study of Relationships

The purpose of this segment of the study was to investigate the effect of study patterns on the achievement of students, taking the following into consideration: ability, background, facilitating anxiety, debilitating anxiety, achievement by independence, achievement by confidence, the total hours the student has spent using these patterns, and the number of lectures they missed during the term. The first step taken to investigate this effect was to compute Pearson correlation coefficients to explore the relationships between the overall achievement of the students and the rest of the independent variables. For the sake of simplicity, correlations were used first to describe and compare the achievement and the study patterns along with ability and background for both Phase Achievement and Traditional sections. Table 1 presents these correlations.

Table 1 revealed high correlations between scores in the final exam and the number of high school science (H. Science) and Minnesota Scholastic Aptitude Test scores in a positive manner for both, indicating that students with high ability or high background achieved significantly higher than those with low ability or background. Study patterns correlating highest with

Table 1. Correlations between the dependent variable final score and the study patterns, ability and background^a

	N=216 ^b	Traditional	N=147	Phase achievement
TIME	03	[.63] ^c	03	[.69]
CUTS	-14	[.04]	-03	[.68]
LEC. NOTE	00	[.97]	04	[.63]
TEXT	16	[.02]	02	[.85]
S. GUIDE	44	[.01]	19	[.02]
TVT ^d	27	[.01]	23	[.01]
MSAT	44 (172)	[.01]	46 (128)	[.01]
H. SCIENCE	37 (183)	[.01]	38 (134)	[.01]

^aCorrelations without decimals.

^bList wised deletions were used unless mentioned.

^cLevel of significance.

^dTukey Transformation was applied to this variable.

the achievements were study guide (S. GUIDE) and TV use in both sections. Yet, study guide use correlated higher (.44) with the final scores in Traditional section than it did in the Phase Achievement System (.19). There was a low but significant correlation between text use and the final score for Traditional section only. The

correlation between textbook use and the final score seemed to be very weak in the Phase Achievement System. This correlation supported results explained in previous research, which reported that effort invested in the text reading was not associated with higher achievement in the Phase Achievement System (See Stinard, 1980). There were no significant correlations between lecture notes use and the final scores for either section. The number of lectures missed negatively correlated with the final score for the Traditional section.

Table 1 indicated also that the correlation between the final scores and the total amount of time spent on the course was not significant in either Phase Achievement or Traditional section.

The previous research indicated that Phase Achievement System students reported spending significantly more time on the course than the Traditional students (Stinard, 1980).

The second part of the correlation describes the interrelationships among the variables in Table 1. Results of such relations are presented in Table 2.

Table 2 shows that in both sections the time students spent using their lecture notes correlated negatively but at the .01 significant level with the time they spent studying from the textbook. This means that as students

study more from the text, they rely less on using lecture notes. Similar relationships were found between the use of lecture notes and the use of study guide in both sections; that is, the use of notes was significantly reduced as students study more using their study guides, where, according to the correlation matrix, students reported investing more time using their texts study guides and TV than they did using their notes in both Phase Achievement System and Traditional sections. Correlations between the use of TV and the use of lecture notes are significant at the .01 significant level in a negative manner for both sections; yet the correlation is higher in Phase Achievement System section (-.35) than it is in Traditional section (-.19).

Table 2 also indicates that there were no significant correlations between ability or background and the use of lecture notes. This fact held true for both Phase Achievement System and Traditional sections, indicating that neither ability nor background had any effect on the use of lecture notes.

Traditional students with low ability reported spending more time on the course than did those with high ability. This relationship does not hold for Phase Achievement System students. Background seemed to have no effect on the amount of time that students

Table 2. Person moment correlations between the study variables. Listwise deletion used, N = 216 and 147 for Traditional and Phase Achievement, respectively, unless mentioned

	TIME	CUTS	LEC. NOTES	TEXT	S. GUIDE	TV	MSAT	H. SCIENCE
Phase Achievement	TIME	-0.05 0.41	-0.08 0.23	0.26 0.00	0.21 0.00	0.31 0.00	-0.23 0.00 (172)	-0.04 0.55
	CUTS	-0.17 0.02	-0.32 0.63	-0.08 0.19	-0.06 0.34	0.01 0.82	-0.12 0.11 (172)	-0.03 0.60
	LEC. NOTES	-0.11 0.14	-0.32 0.00	-0.30 0.00	-0.01 0.79	-0.20 0.00	0.03 0.67 (172)	-0.02 0.71
	TEXT	0.17 0.03	-0.04 0.57	-0.33 0.00	0.09 0.16	-0.00 0.95	0.04 0.59 (172)	0.10 0.11
	S. GUIDE	0.24 0.00	0.22 0.00	-0.07 0.37	0.02 0.78	0.22 0.00	0.10 0.15 (172)	0.18 0.00
	TV	0.42 0.00	-0.09 0.27	-0.35 0.00	0.02 0.75	0.12 0.14	0.03 0.62 (172)	-0.10 0.13
	MSAT	-0.09 0.30 (128)	0.21 0.01 (128)	-0.02 0.78 (128)	-0.05 0.50 (128)	0.20 0.02 (128)	-0.00 0.93 (128)	0.17 0.01 (172)
	H. SCIENCE	.05 .51	-.08 .33	.02 .74	.03 .64	.11 .17	.02 .72	.07 .41 (128)

Traditional

spent on the course outside of class. This is true for both Phase Achievement System and Traditional sections.

There were no significant correlations between the use of the textbook and the study guide in either section. The same kind of relationship was found between the text and the TV use. This means that the time students spent using textbook did not appear to be affected by either the use of TV or the use of study guide. However, the total amount of time that students spent on the course outside of class correlated significantly with the time that they spent studying from their textbooks. This correlation is higher (.26) in Phase Achievement System sections, indicating that Phase Achievement System students studied from their textbooks more than Traditional students did. Neither ability nor background correlated with the use of textbook.

Study guide use correlated significantly with the use of TV in Traditional, while no significant correlations between these two variables was reported in Phase Achievement System. This means that under Traditional, students reported using more time studying from the study guide as they spend more time viewing TV. Study guide use correlated significantly with scores on ability in Phase Achievement System section but not in Traditional, while a significant correlation was found between study

guide and background in Traditional but not in Phase Achievement System. The correlations appear to indicate that the use of study guides was affected by students' ability in Phase Achievement System and by students' background in Traditional.

Table 2 also shows that time spent viewing TV did not correlate significantly with the students' ability in either section. A negative low correlation between TV use and students' background, however, is reported in Traditional, indicating that students with low background used more TV than did those with high background. There was no significant correlation between TV use and background under Phase Achievement System section.

The number of lectures missed (CUTS) did not correlate with the use of textbook, TV, or background in either section. It correlated significantly with the use of lecture notes under Phase Achievement System in a negative manner; that is, as Phase Achievement System students miss more lectures, they depend less on their lecture notes. Such a relationship was not significant under the Traditional section. The relationship between CUTS and study guide use was significant at the .01 level of significance only in the Phase Achievement System section. CUTS also correlated significantly with Phase Achievement System students' ability; students with higher ability missed

more lectures than did those with lower ability. The number of lectures missed seemed to have no relationship with the Traditional students' ability.

In summary, the study of the correlation revealed that the total hours of outside of class study time was essentially unrelated to the final score. Of the four sources of information considered in this study, study guide and TV viewing seemed to be the most effectively used sources by both sections. The Traditional students appeared to be spending more time using their textbooks than the Phase Achievement System students did.

Combinations of lecture notes with textbooks seemed to be significant in a negative manner for both sections; that is, more use of textbooks was associated with reduction in the use of lecture notes. The use of lecture notes with study guide seemed not to be significant for either section. Lecture notes with TV use seemed to be negatively significant in both sections, which indicated that viewing more TV causes students to depend less on their notes. Text and study guide use were also negatively significant in both Traditional and Phase Achievement sections. Textbook and TV use do not appear to be significant in either section. While the correlation between study guide and TV use seemed to be very weak under Phase Achievement System, it is highly significant for Traditional students:

Traditional students' use of TV associated positively with the use of the study guide. This finding seemed to conflict with results obtained in previous research, which indicated that as Phase Achievement System students viewed more TV, they studied more from the study guide (Mohammed, 1980). These combinations revealed that there are some minor differences between Phase Achievement System and Traditional sections with regard to the study methods.

An analysis of the correlations also indicated that abilities and backgrounds of the students had significant effects on their achievement, regardless of the teaching methods used.

The previous section considered mainly the simple Person correlation coefficient which is a measure of the linear relationship between two variables. Such a relationship is affected by the nature of the distributions of the two variables; i.e., if the two variables are similarly distributed, a maximum correlation should be obtained. If the distributions are markedly different in shape, the correlation will underestimate the true relationship. However, one should be reminded that in the case of the present study, some variables were skewed and none of the transformations used could produce a more normal distribution (see Appendix B).

Development of the Model

The second step in this study was to investigate the effects of the study patterns on the students' achievements, mainly to see how the students' study methods affected their final grades. Therefore, using General Linear Model procedures, a model including all the study patterns, TIME and CUTS was developed. Certain trials and efforts were made to create a model to serve the researcher's purposes. Such trials were as follows:

Full model

A full model that included the variables TIME, CUTS and the study patterns along with all possible first order interactions was developed for the overall group (both Phase Achievement System and Traditional sections together). Results of analysis of variance for this model are shown in Table 3.

In Table 3, because of the low R^2 value (.26) and because the model revealed that the adjusted means for method were significantly different, the researcher then began to explore the possibility of measuring a separate model for each method. Therefore, a model for each group was developed independently. Since two models, one for each group, will be fully discussed, then no further discussion of the model in Table 3 will be presented. However, R^2 values for the main variables but for no interactions, were also

Table 3. Analysis of variance for the dependent variable
FINAL; full model for the overall group

Source	d. f.	M. S.	F-Value	Significance level
Model	22	711.77	5.54	.0001
error	340	128.46		
Corrected total	362		$R^2 = .26$	
Source		Partial S.S.	F-Value	Significance level
Method		733.25	5.71	.02
TIME		105.50	.82	.36
CUTS		13.75	.11	.74
LEC. NOTES		1473.27	11.47	.01
TEXT		2045.09	15.92	.01
S. GUIDE		1357.79	10.57	.01
TVT ^a		374.80	2.92	.09
TIME x CUTS		157.36	1.22	.27
TIME x LEC. NOTES		21.34	.17	.68
TIME x TEXT		15.47	.12	.72
TIME x S. GUIDE		67.74	.53	.46
TIME x TVT		118.53	.92	.33
CUTS x LEC. NOTES		4.83	.04	.84
CUTS x TEXT		15.10	.12	.73
CUTS x S. GUIDE		358.07	2.79	.09
CUTS x TVT		137.33	1.07	.30

^aTukey transformation used.

Table 3. (Continued)

Source	Partial S.S.	F-Value	Significance level
LEC. NOTES x TEXT	1139.15	8.87	.01
LEC. NOTES x S. GUIDE	298.49	2.32	.12
LEC. NOTES x TVT	52.72	.41	.52
TEXT x S. GUIDE	675.67	5.26	.02
TEXT x TVT	237.31	1.85	.17
TEXT x TVT	9.21	.07	.78

calculated. The R^2 values indicated the amount of variance in the criterion variable, the final exam, which is attributable to the independent variables in the model. Such results are shown in Table 4.

This table reveals that in one variable model 10 per cent of the variance in points achieved by the overall group is explained by the use of the study guide. In the two variable model, 15 per cent of the variance is explained by the use of both study guide and TV. Thus, only 5 per cent of the total variance is explained by the use of TV alone after considering the study guide contribution, and so on, until the six variable model is reached. In this model, 20 per cent of the total

Table 4. Regression Models for the dependent variable
FINAL. Study variables for overall group

# in Model	Variables in Model	R ²
1	S. GUIDE	.103
2	S. GUIDE TVT	.150
3	S. GUIDE TVT TEXT	.165
4	S. GUIDE TVT TEXT TIME	.181
5	S. GUIDE TVT TEXT TIME LEC. NOTES	.197
6	S. GUIDE TVT TEXT TIME LEC. NOTES CUTS	.201

variance in the model is explained by all the six variables. It may be concluded from this that students in the overall group (Phase Achievement System and Traditional) studied from their study guides and used more TV than they used their lecture notes or textbooks. Full discussion will be presented later in this chapter where each section is considered independently.

Since, as mentioned before, there was a significant difference between Phase Achievement and Traditional sections with regard to the students' study methods, then it was decided to run the full model for each section independently. The reason for doing this was to test for the main effects and the interactions of the study variables

and their effects on the students' achievement in each section and then to compare and contrast the development of these two models. Results of analysis of such models for Phase Achievement System and Traditional are shown in Tables 5 and 6, respectively.

The R^2 values should be noted in Tables 5 and 6. In Table 5, Traditional section, ($R^2 = .36$) which is relatively low. This means that by using all terms in the model, it was possible to predict 36 per cent of the variability in the criterion measure while the remaining 64 per cent of the variability in the criterion remained unpredictable. In Table 6, Phase Achievement System section, ($R^2 = .31$) indicating that it was possible to predict only 31 per cent of the variability in the criterion measure. However, the relatively low values for R^2 may be due to some effects on the FINAL which were not taken into account. These may be Individual differences other than the study variables.

Nevertheless, Tables 5 and 6 reveal that the models are constructed very differently for each group. When the T-value for the parameter estimates were considered using the .05 level of significance, it appeared that for the Traditional section (see Table 5) TEXT (the use of textbook) was the only significant main effect, and its parameter estimate is 3.02, a positive value indicating that as textbook use increases, the final grade went up.

Table 5. Analysis of variance for the dependent variable FINAL; full model for Traditional section

Source	d.f.	M.S.	F-Value	Significance level
Model	21	636.37	5.13	.0001
Error	194	123.97		
Corrected total	215		$R^2 = .36$	
Parameter		Estimate	t-value	Significance level
Intercept		35.07	3.24	0.01
TIME		-2.36	-1.38	0.16
CUTS		-0.58	-0.41	0.68
LEC. NOTES		19.50	1.18	0.23
TEXT		3.02	2.77	0.00
S. GUIDE		1.35	0.95	0.34
TVT ^a		.59	0.20	0.83
TIME x CUTS		.31	1.84	0.07
TIME LEC. NOTES		.41	0.17	0.86
TIME TEXT		.19	1.47	0.14
TIME S. GUIDE		-0.06	-0.39	0.69
TIME TVT		-0.17	-0.58	0.56
CUTS LEC. NOTES		0.72	-0.37	0.71
CUTS TEXT		0.36	2.65	0.01
CUTS S. GUIDE		0.16	1.08	0.27

^aTukey's transformation applied on TV variable.

Table 5. (Continued)

Parameter	Estimate	t-value	Significance level
CUTS TVT	-0.06	-0.20	0.83
LEC. NOTES TEXT	-2.70	-1.73	0.09
LEC. NOTES S. GUIDE	-0.72	-0.40	0.690
LEC. NOTES TVT	3.45	0.82	0.415
TEXT S. GUIDE	-0.10	-0.84	0.40
TEXT TVT	-0.29	-1.32	0.19
S. GUIDE TVT	0.62	2.51	0.01

Table 6. Analysis of variance for the dependent variable FINAL; full model for Phase Achievement System section

Source	d. f.	M. S.	F-value	Significance level
Model	21	317.64	2.69	0.0004
Error	125	118.17		
Corrected total	146		$R^2 = .31$	
Parameter		Estimate	t-value	Significance level
Intercept		-6.04	-0.33	0.74
TIME		0.56	0.17	0.86
CUTS		-1.03	-0.56	0.57
LEC. NOTES		82.18	3.56	0.01
TEXT		5.12	2.42	0.01
S. GUIDE		7.26	3.21	0.01
TVT ^a		7.53	1.92	0.06
TIME CUTS		-0.04	-0.18	0.85
TIME LEC. NOTES		-2.43	-0.63	0.52
TIME TEXT		-0.08	-0.31	0.75
TIME S. GUIDE		0.22	1.11	0.26
TIME TVT		-0.28	-0.98	0.33
CUTS LEC. NOTES		1.18	0.34	0.73
CUTS TEXT		.32	1.64	0.11

^aTukey Transformation applied on TV variable.

Table 6. (Continued)

Parameter	Estimate	t-value	Significance level
CUTS S. GUIDE	-.47	-2.94	0.01
CUTS TVT	.37	1.39	0.17
LEC. NOTES TEXT	-6.65	-2.59	0.01
LEC. NOTES TVT	-1.03	-0.21	0.84
TEXT S. GUIDE	-0.40	-2.56	0.01
TEXT TVT	-0.82	-0.82	0.41
S. GUIDE TVT	-0.49	-1.95	0.05

In a similar fashion, Table 6 indicates that the textbook main effect, with a parameter estimate of 5.12, is also a substantial positive effect on FINAL. On this factor, the models seem similar.

It is here that the similarity ends, however, with the most striking difference being that most of the other main effects were significant for the Phase Achievement System section whereas only a few were significant for the Traditional section. Comparisons of the main effects between the two sections are summarized in Table 7.

Table 7. Comparisons of main effects in the models for Phase Achievement System and Traditional sections for study pattern variables

Variables	Traditional		Phase Achievement System	
	t	Significance level	t	Significance level
LEC. NOTES	1.18	.24	3.56	.01
TEXT	2.77	.01	2.42	.02
S. GUIDE	.95	.34	3.21	.01
TV	.20	.84	1.92	.06

The other main difference between the models concerns the inclusion of the interactions. These differences are summarized in Table 8.

Table 8 presents interactions which are significant (at .05 level) or nearly so. It reveals that the only significant interactions for Traditional section are CUTS TEXT, with an estimate of .36 indicating that as Traditional students missed more lectures they invested more time using their textbooks so that they had greater success in final scores than those who depended on lectures and did not re-enforce them with the text. This interaction does not appear significant for Phase Achievement System students.

Table 8. Comparisons of interactions in the model for Phase Achievement System and Traditional sections for study pattern variables

Interactions	Traditional			Phase Achievement System		
	Est.	t	Signif. level	Est.	t	Signif. level
TIME CUTS	.3	1.84	.07	N.S. ^a		
CUTS TEXT	.36	2.65	.01	N.S.		
CUTS S. GUIDE	N.S.			.47	-2.94	.01
LEC. NOTES TEXT	-2.7	-1.73	.09	-6.65	-2.59	.01
LEC. NOTES S. GUIDE	N.S.			-5.31	-1.97	.05
TEXT S. GUIDE	N.S.			-0.04	-2.56	.01
S. GUIDE TVT ^b	.62	2.51	.01	-.49	-1.95	.05

^aNot significant at .10 level.

^bTukey Transformation used.

CUTS interacted significantly with study guide use for Phase Achievement System with an estimate of -.47. This means that as Phase Achievement System students missed more lectures, they increased their use of study guides.

TV use interacted significantly with the use of study guide under the Traditional and marginally at .05 level of significance under Phase Achievement System

with estimates of .62 and -.49, respectively. This means that the use of TV increased the use of study guide and also supported the results from the study of correlations mentioned earlier, which found that there was no relationship between TV and study guide uses under Phase Achievement and a significant positive relationship between them under Traditional.

It appears that there were nearly significant interactions (TIME CUTS and LEC. NOTES TEXT) under Traditional with estimates of .31 and -2.7, respectively, while they were not significant under Phase Achievement System. Also, the interactions TEXT S. GUIDE, LEC. NOTES TEXT and LEC. NOTES S. GUIDE were significant under Phase Achievement System with estimates of -.40, -6.65 and -5.31, respectively, while they were not significant under Traditional.

The remaining interactions were not significant at the .10 significance level in both models (see Tables 5 and 6).

In summary, there were very confused effects, with only TEXT, CUTS TEXT, and S. GUIDE TV at an acceptable level of significance in the Traditional section model. However, the full model seemed to be a better predictor for this section than for this Phase Achievement. In contrast, the Phase Achievement model has several effects of acceptable level of significance with one effect (TV use)

very close to significance. Yet, the model does not, as a whole, fit quite as well.

The only similar variables between the 2 models are TEXT, with almost the same estimates of around 5, and marginally, LEC. NOTES TEXT, again with estimated parameter values of -2.7 for Traditional and -6.65 for Phase Achievement System. Otherwise, all the other significant values differ between the two sections. This difference could be due to the easier estimation of some of the values for Phase Achievement System since there is not much of an overlap between each main effect in Phase Achievement compared to the overlap in the Traditional. This could mean that more time is devoted to all the study helps in Traditional, whereas in Phase Achievement System, lecture notes seemed to be predominant. Thus, there was much more confusion in the Traditional model than in Phase Achievement System model.

Reduced models

Study of the Full Models section revealed that more than half of the interaction terms were not significant at the .10 level. Therefore, it was believed that reducing the models would be better for the sake of interpretation and precision.

One of the strategies used for reducing the models was to include the main effects and the interactions which were

significant with partial F-value at the .10 level or less. Results of this analysis of the models are given in Tables 9 and 10.

Once again, the first items to be considered in these tables are the R^2 values. The total variance accounted for in the full Traditional model was 36 per cent, while in the reduced model it was 34 per cent, a difference of 2 per cent which is not much of a sacrifice. The R^2 value reduced in the Phase Achievement model from 31 per cent to 24 per cent, a difference of 7 per cent. The difference of R^2 values is due to the trimming of some terms from the models, even though those terms were not significant at the .10 level.

The difference between the full and reduced models in both sections should also be noted. With regard to the main effects, TIME appeared to be highly significant under the Traditional reduced model while it was not in the full model for the same section. TIME's main effect also changed under the Phase Achievement models from nonsignificant in the full model to significant at the level of .06; however, this value is above the .05 level chosen for this study. Other main effects differing in the reduced models are CUTS, which was not significant in the full model but is in the reduced one for the Phase Achievement System section only, and with no change for Traditional, LEC.

Table 9. Analysis of variance for the dependent variable
FINAL; reduced model for Traditional section

Source	d. f.	M.S.	F-value	Significance level
Model	10	1260.77	10.42	0.0001
Error	205	121.01		
Corrected total	215		$R^2 = .34$	
Parameter		Estimate	t-value	Significance level
Intercept		39.9	6.34	.01
TIME		-1.9	-3.74	.01
CUTS		-0.13	-.12	.90
LEC. NOTES		18.72	1.96	.05
TEXT		2.17	3.18	.01
S. GUIDE		.81	1.45	.15
TVT ^a		-.27	-.20	.83
TIME CUTS		.37	2.55	.01
CUTS TEXT		-.32	-2.68	.01
LEC. NOTES TEXT		-1.64	-1.22	.22
S. GUIDE TVT		.46	2.27	.02

^aTukey Transformation applied.

Table 10. Analysis of variance for the dependent variable
FINAL; reduced model for Phase Achievement
System section

Source	d. f.	M. S.	F-Value	Significance level
Model	11	473.54	3.94	.0001
Error	134	120.24		
Corrected total	146		$R^2 = .24$	
Parameter		Estimate	t-value	Significance level
Intercept		-.76	-.06	.90
TIME		-.88	-1.85	.06
CUTS		2.23	2.76	.01
LEC. NOTES		71.88	4.46	.01
TEXT		4.76	4.46	.01
S. GUIDE		7.76	4.08	.01
TVT ^a		3.65	3.25	.01
CUTS S. GUIDE		-.42	-3.07	.01
LEC. NOTES TEXT		-6.16	-3.60	.01
LEC. NOTES S. GUIDE		-5.16	-2.25	.03
TEXT S. GUIDE		-.43	-3.21	.01
S. GUIDE TVT		-.28	-1.43	.16

^aTukey Transformation applied.

NOTES, which was not significant in the full model but very close to the significance level .053 for Traditional only, and with no change for Phase Achievement System.

Here also the contribution of the interactions changed slightly. For the Traditional section TIME by CUTS was marginally significant in the full model but highly significant in the reduced one. Further, LEC. NOTES by TEXT was marginally significant at .09 level in the full model but not significant in the reduced model. For the Phase Achievement System section, the only interaction changed was the S. GUIDE by TV where it became nonsignificant in the reduced model.

The differences mentioned above seem surprising when some of the main effects became significant in the reduced model. For example, why is the major effect of the CUTS not significant in the full model but significant in the reduced one? There is no direct answer to such a question, but it is believed that there might be some negative effects due to the removal of interactions which were sharing the main effect.

Test for models

It is believed that an F-test would help make a decision to determine whether these differences are significant enough or not. Accordingly, which model for which group could be determined. Therefore, an F-test was used for

this purpose. The results of this test are found in Table 11.

Table 11. Test of significance between models; full and reduced models for both sections

	Traditional	Phase Achievement System
F-value	.54	1.2

This table shows that neither value of F was significant at .05 level. This means that the predictions from the full or the reduced models are equal for both Phase Achievement System and Traditional sections. Since working with the reduced model is much less complicated as compared with working with full model, and since there were no significant differences between them, then it was decided to continue to utilize only the reduced models.

Residual Analysis

The major objective of this part of the study was to discover how well the prediction from the models fit the actual performances of students and how students with different abilities and backgrounds compared with regard

to their study methods. This was achieved, first by dividing students into high and low subgroups using a median split according to their MSAT and high school science. Such division created subgroups called high ability and low ability, using MSAT scores, and high background and low background using high school science scores. Each student was then classified into one of four categories, numbered in Table 12.

Table 12. Classification of students with identification numbers

Background	Identification numbers	
	Ability	
	Low	High
Low	1	2
High	3	4

Next, the actual final score minus predicted score was plotted as a function of predicted score. Such plots are presented in Figures 3 and 4 for Traditional and Phase Achievement System sections, respectively, where each point is plotted as a number 1-4 as identified from Table 12.

**Figure 4. Residual plots from the Phase Achievement System
model--10 observations hidden**

- (1) = low ability and low background**
- (2) = high ability and low background**
- (3) = low ability and high background**
- (4) = high ability and high background**

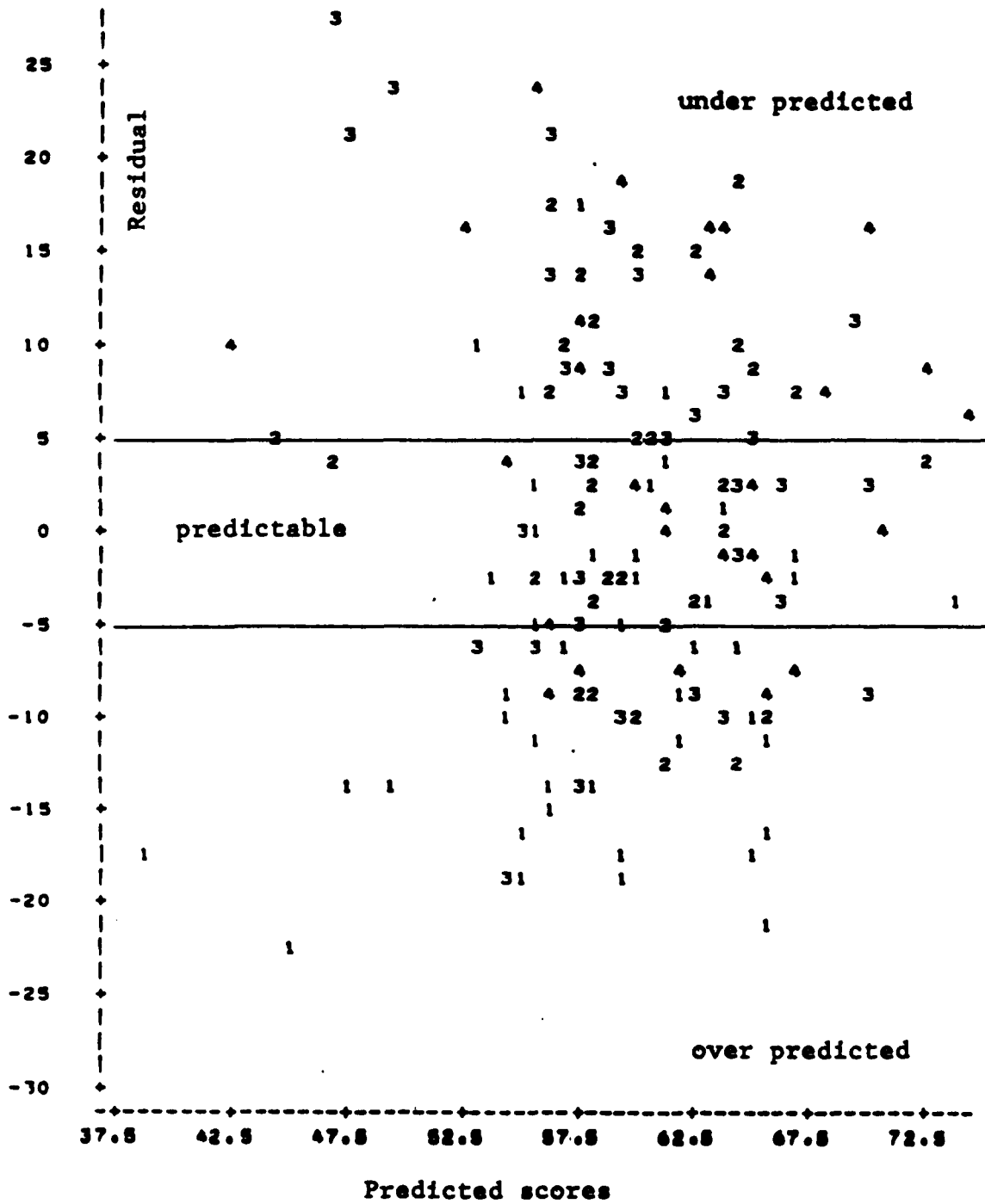
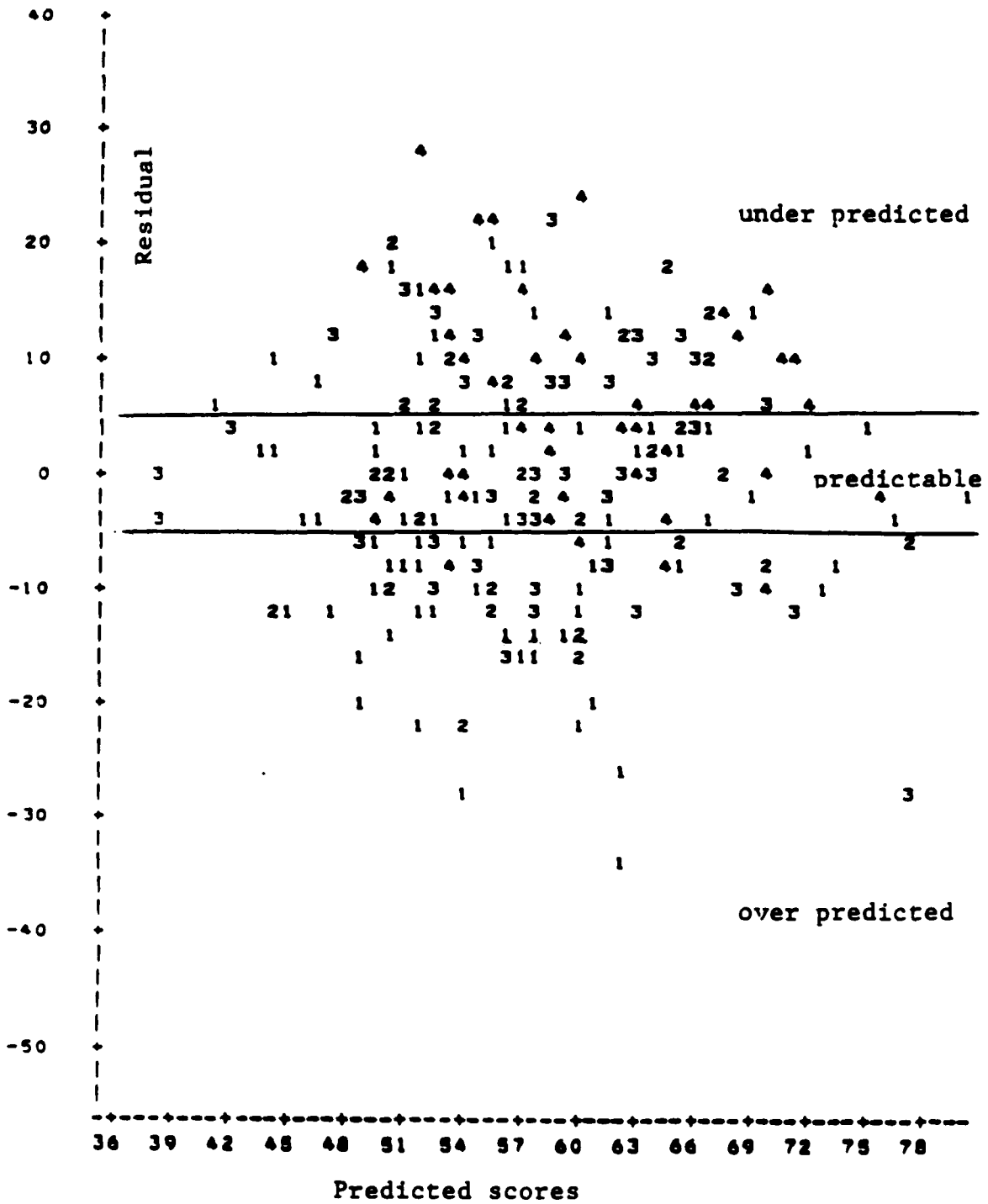


Figure 5. Residual plots from the Traditional model--26
observations hidden
(1) - low ability and low background
(2) - high ability and low background
(3) - low ability and high background
(4) - high ability and high background



Regardless of the classification, it is clear that all the plots on Figures 4 and 5 are randomly spread with no observable specific trends.

It may also be seen from the figures that most of the fours (high ability and high background) are clustered above the residual value of zero while most of the ones are below it. This means that certain types of students did better than the model predicted and are above the zero lines, while others who did less well than the model fell below the zero lines. Therefore, in each section (Phase Achievement System and Traditional) students were, again, classified into three categories: under predicted, over predicted, and "predictable."

Using such a classification scheme made it possible to do a profile analysis to compare these three groups across sections with regard to the students' actual achievement and use of study patterns along with their ability and background. (Observation easily clarified the differences within the sections.) Several t-tests were used for comparisons between means. Results of these analyses are in Tables 13, 14, and 15, and reveal that most of the under predicted are those with high ability and high background, which was associated with higher achievement, and most of the lesser achievers are from those with low ability and low background, which was associated with low achievement. These results supported

Table 13. Means and t-values of the study variables for the under predicted group under the Phase Achievement and the Traditional sections

Variable	Traditional		Phase Achievement System		t-value
	Mean	N	Mean	N	
MSAT ^a	44.70	56	46.27	40	-1.20
H. SCIENCE ^a	5.61	62	5.86	42	-.20
TOTAL TIME	4.42	67	4.35	45	.15
CUTS	2.21	67	2.71	45	-1.20
LEC. NOTES	.31	67	.31	45	0.0
TEXT	7.10	67	6.86	45	.42
S. GUIDE	5.50	67	4.17	45	2.36*
TV	2.24	67	2.90	45	-2.32*
FINAL	70.20	67	72.02	45	-1.2

^aThe cutoff point for high and low ability (MSAT) by using the median split is 41: that is > 41 high ability; < 41 low ability. For background (H. SCIENCE) > 5 is high background and ≤ 5 low background.

*Significant at the .05 level.

Table 14. Means and t-values of the study variables for the over predicted group under Traditional and Phase Achievement System sections^a

Variable	Traditional		Phase Achievement System		t-value
	Mean	N	Mean	N	
MSAT	36.72	57	36.65	43	.01
H. SCIENCE	4.20	61	4.33	46	.04
TOTAL TIME	4.50	69	4.57	51	-.10
CUT	1.91	69	2.96	51	-2.78*
LEC. NOTES	.34	69	.30	51	1.2
TEXT	6.96	69	7.33	51	-.79
S. GUIDE	5.22	69	4.41	51	1.70
TV	2.22	69	2.75	51	-1.80
FINAL	43.46	69	47.98	51	-1.54

^aThe cutoff point for high and low ability (MSAT) by using the median split is 41: that is > 41 high ability; < 41 low ability. For background (H. SCIENCE) > 5 is high Background and ≤ 5 low background.

*Significant at the .05 level.

Table 15. Means and t-values of the study variables for the predictable group, under Traditional and Phase Achievement System sections^a

Variables	Traditional		Phase Achievement System		t-value
	Mean	N	Mean	N	
MSAT	41.37	59	42.20	45	-.5
H. SCIENCE	4.92	66	4.83	46	.08
TOTAL TIME	4.47	80	4.47	51	0.0
CUTS	2.20	80	3.37	51	-2.7*
LEC. NOTES	.38	80	.29	51	2.89*
Text	6.28	80	7.65	51	-2.37*
S. GUIDE	5.30	80	4.29	51	2.0*
TV	2.30	80	3.30	51	-2.2*
FINAL	57.31	80	61.00	51	-2.55

^aThe cutoff point for high and low ability (MSAT) by using the median split is 41; that is > 41 high ability; < 41 low ability. For background (H. SCIENCE) > 5 is high Background and ≤ 5 low background.

*Significant at the .05 level.

the previously obtained results (See Table 1) which indicated that both ability and background significantly correlated with achievement in a positive manner. However, no significant difference was found between Phase Achievement System and Traditional with regard to final achievement within either under predicted or the over predicted groups. That is, Traditional under predicted achieved almost the same final scores as did Phase Achievement under predicted and the Traditional over predicted achieved almost the same as did the Phase Achievement System over predicted.

Students in the predictable group (Table 15) achieved differently. In this group, students were a mixture of high ability and low background. Phase Achievement System students in this group achieved significantly more than did the Traditional students, (See Figure 6.) This difference could have been due to different study strategies adopted by either group.

The tables also reveal that the Traditional under-achievers adapted almost the same study patterns as the Phase Achievement System over predicted, as there was no significant difference in the use of the study patterns between the two sections. The only difference between the two sections was that Phase Achievement System students missed more lectures than did the Traditional students.

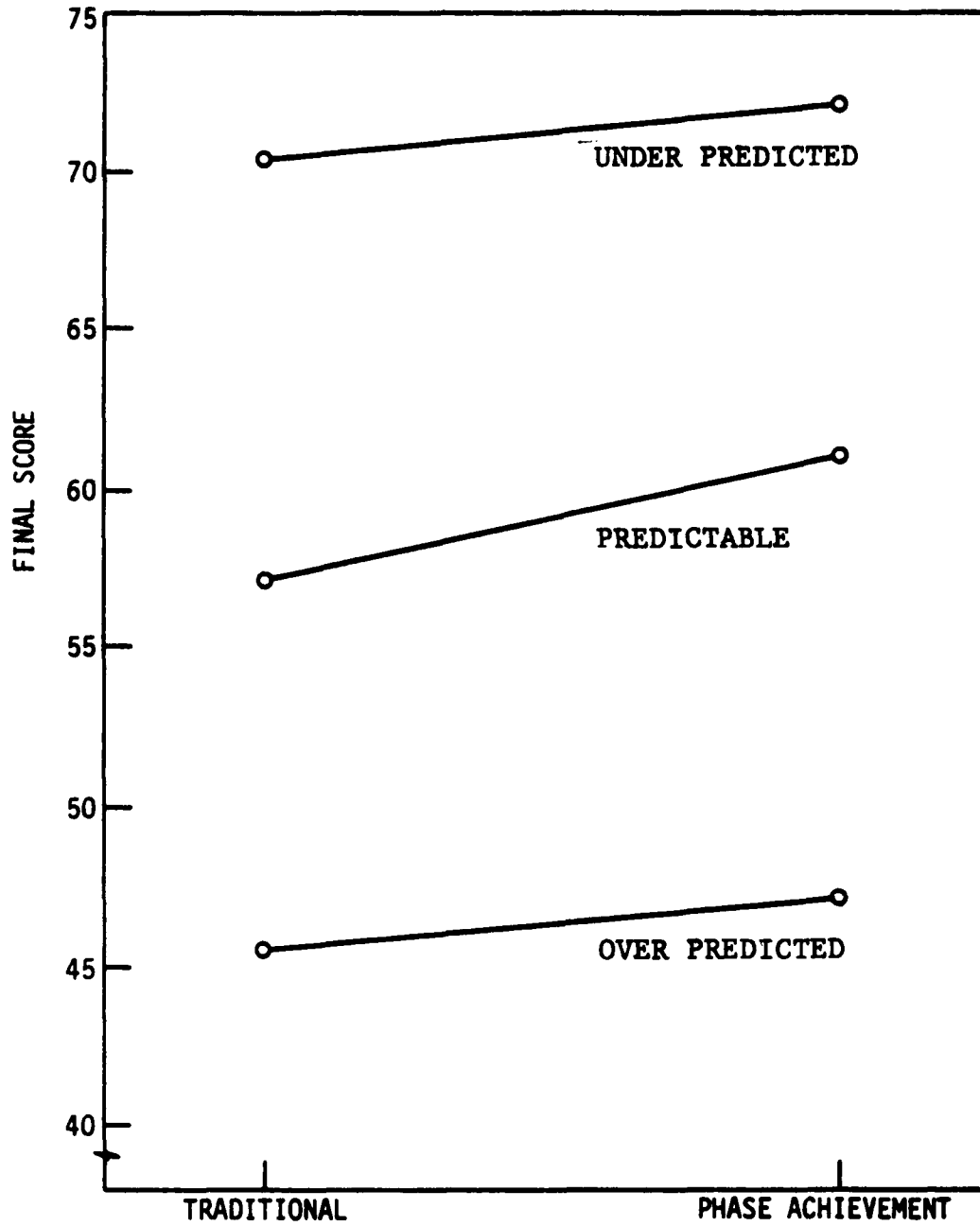
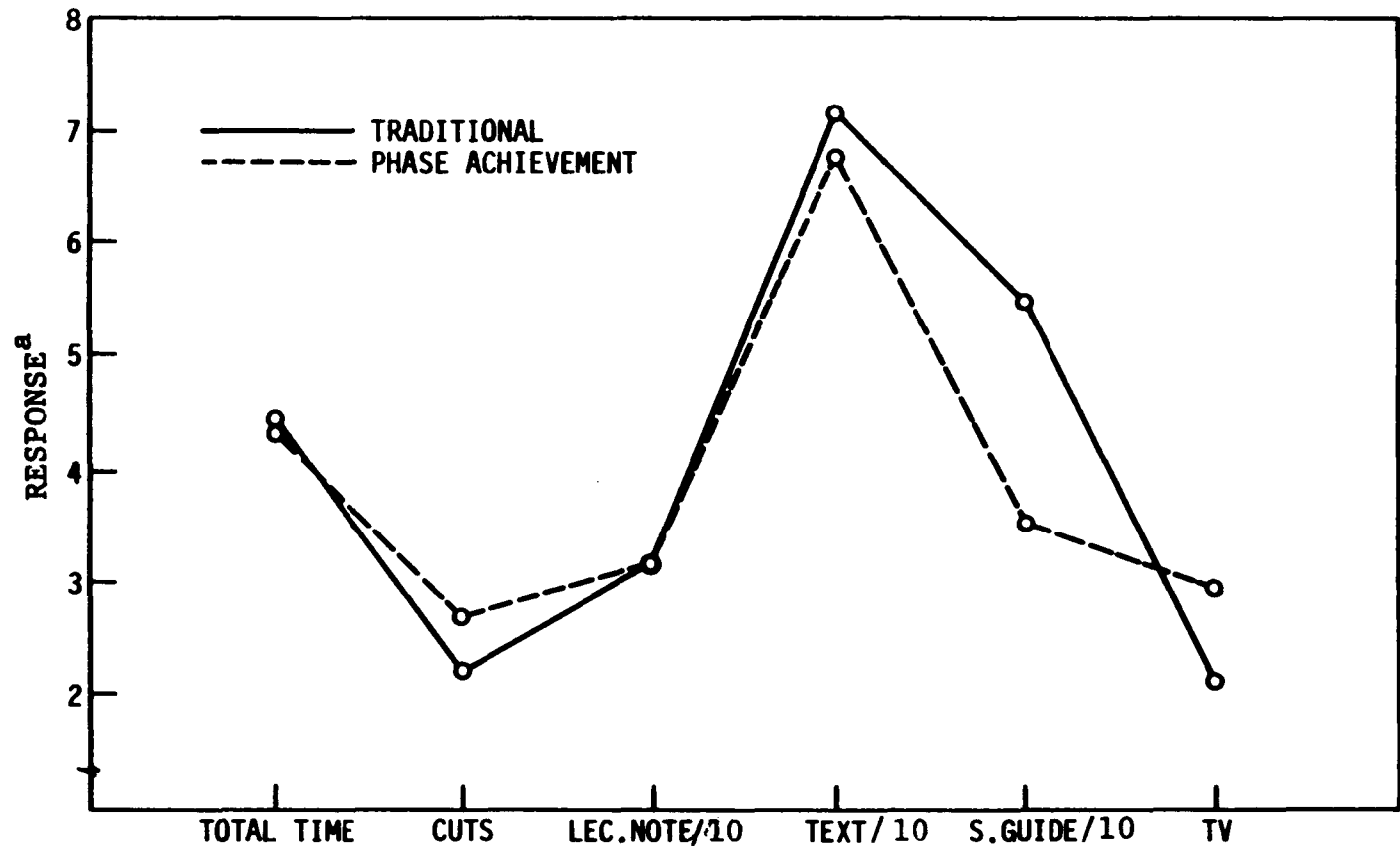


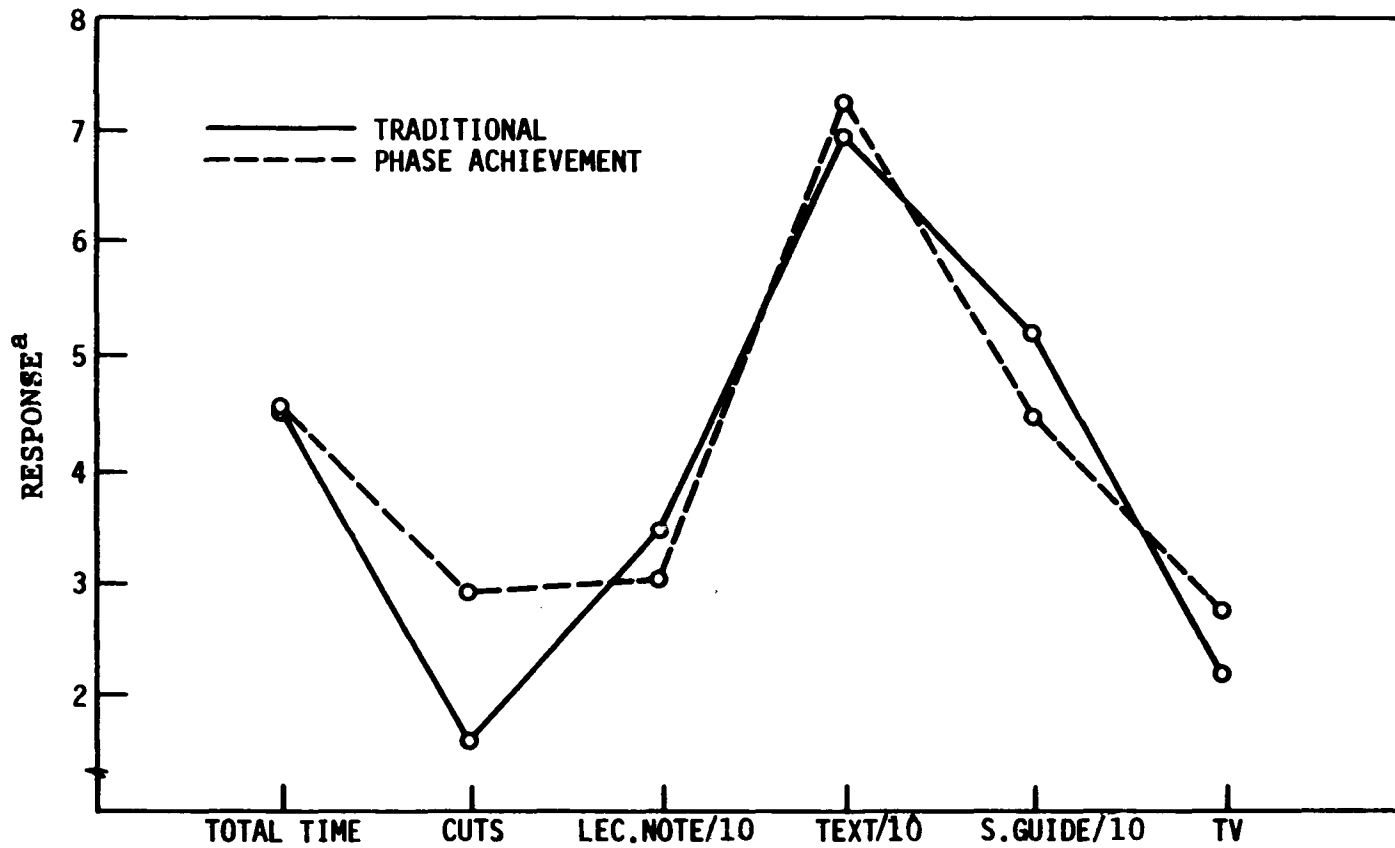
Figure 6. Profiles from the residual analysis on the final exam for the three groups

In the overachievers group, the Traditional students spent significantly more time using the study guide than did the Phase Achievement System students, while the Phase Achievement System students spent significantly more time viewing TV than did the Traditional students. The most significant differences between the two sections with regard to the use of the study patterns appeared within the predictable group (Table 15), where Traditional students spent more time using their notes and study guide, missing fewer lectures than the Phase Achievement System students did, while the Phase Achievement System group used more TV and more text than did the Traditional group. Yet, the total amount of time spent using the study patterns seemed to be exactly the same for both Traditional and Phase Achievement System sections. Figures 7, 8, and 9 reveal the comparisons between Traditional and Phase Achievement System sections, with regard to the use of study patterns, total time and number of lectures missed, for the three groups of predictions.



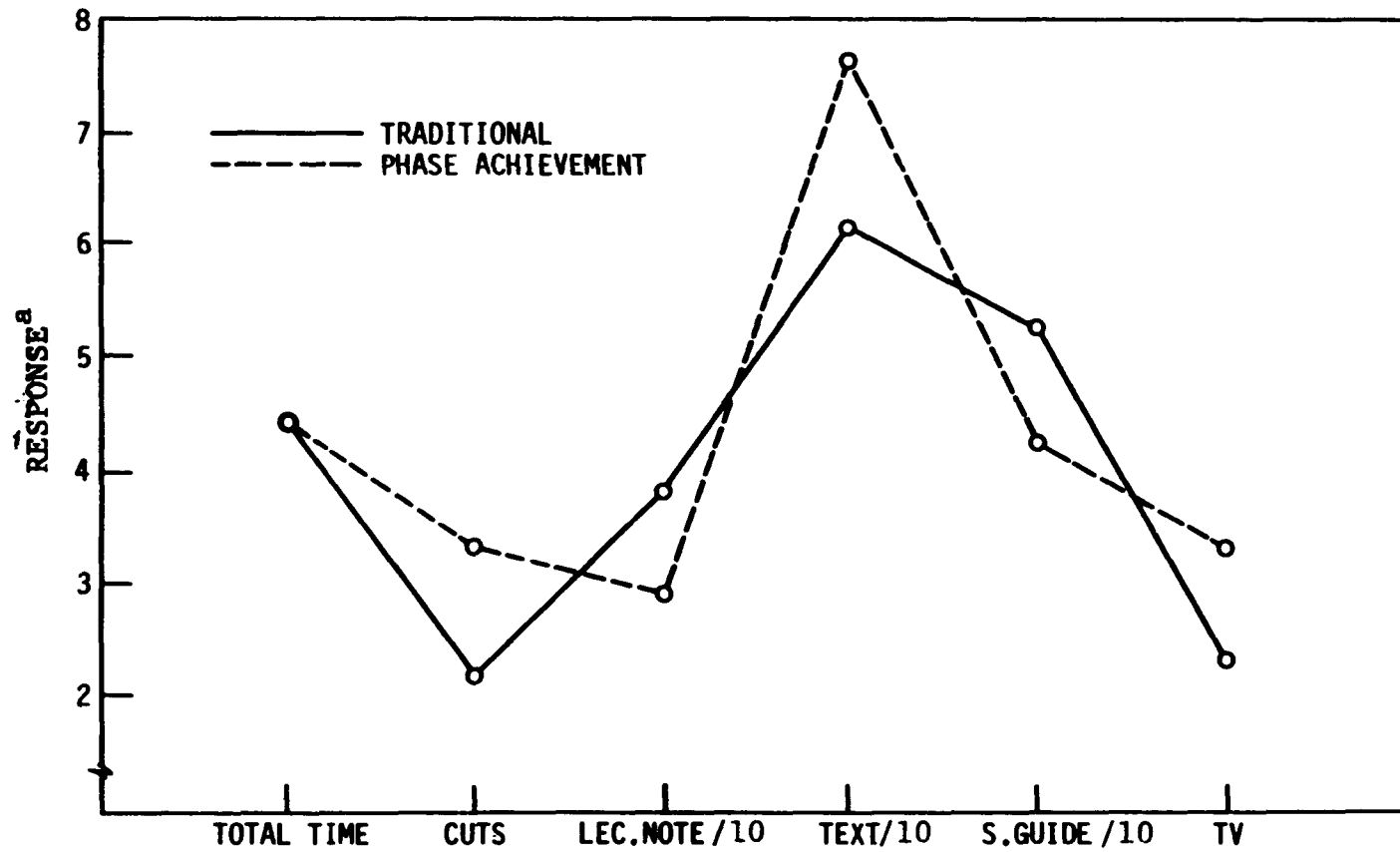
^aFor response mode, see page 163.

Figure 7. Profiles from the residual analysis - the under predicted.



^aFor response mode, see page 163.

Figure 8. Profiles from the residual analysis - the over predicted.



^aFor response mode, see page 163.

Figure 9. Profiles from the residual analysis - the predictable.

CHAPTER V. DISCUSSION AND CONCLUSIONS

Introduction

This study compared the usage of study patterns in two different sections of Biology 101 during Fall quarter of 1978. The first section was taught by the Traditional method and the other section by the Phase Achievement System.

Before discussing the results it is necessary to point out that this investigatory study was hypothesis-forming rather than hypothesis-testing. The general linear model was used chiefly as the procedure. Accordingly, three main groups were formed in each section. These groups were an overachiever group, involving students with high ability and high background; an underachiever group, involving students with low ability and low background; and a predictable group, including students with high ability but low background. The first two groups were used mainly for comparison. The major predictions were drawn from the third (predictable) group, since students in this group were closer to the prediction (zero error line thus had less error associated with their predictions) than the other two groups in the models.

Summary and Comparison of Results

Total amount of time

Preliminary results of the study of relationships between the study pattern variables and student achievement revealed that students in both the Traditional and Phase Achievement Systems spent almost the same total amount of time on the course requirements. These results were contradictory to those obtained in previous research. Earlier reports showed that students in the Phase Achievement System spent more hours on the course than did those students in Traditional system. Stinard (1980) in evaluation of self-paced mastery learning and traditional instruction, reported that students under the Phase Achievement System invested more time in the course than the Traditional students did; the difference he found was mainly among the female students. This contradiction may be due to the fact that when both males and females were considered as one group in either section, the time mean difference showed no significance.

Analysis of the main effects indicates that TIME had a significantly major effect on the students' achievement in both sections. This means that more time spent on the course outside of class associated with higher achievement, regardless of the instructional method. Furthermore, the students' ability as measured by the Minnesota

Scholastic Aptitude Test had an affect on the time that students invested on the course only for the Traditional section. This implies that students in the Traditional section with higher ability reported spending less outside class time on the course than those with lower ability did. No such effect was found for the students in the Phase Achievement System section.

Previous science experience or background had no relationship to the total time spent on the course. Thus, the poorly prepared students spent just as much time studying as the well-prepared students did. This relationship held true for both sections.

Neither academic ability nor previous background interacted with the instructional method in the prediction of the final scores: neither the Traditional system nor the Phase Achievement System held special benefits for lower ability or poorly prepared students. Regardless of the instructional methods used, brighter and well-prepared students achieved significantly higher final scores than did those who were less able and poorly prepared students. Analysis of variance analysis confirmed these results.

Missing lectures

Lecture attendance affected students' achievement in the conventional section more than it did to the Phase Achievement System section, where the results revealed that as the Traditional students missed more lectures, their final grades went down. The situation was not so for the Phase Achievement System students. The indication was that lecture attendance was more beneficial for the Traditional section than it was for the other section. The main effect of CUTS (lectures missed) was significant in the Phase Achievement System model, indicating that some of those students achieved somewhat better scores when they missed more lectures. This seems to mean that these students invested more time studying from other sources than they did attending classes. This appears to be due chiefly to the low ability students, where the low ability students reported missing more lectures than those with higher ability in this section. Student background did not have any effect on lecture attendance in either section.

Class attendance interacted significantly with the use of the study guide in the Phase Achievement System section. This means that students in this section studied more from the study guide when they missed fewer lectures. These results agreed with results from the earlier study or correlations. On the other hand, Traditional students

studied more from their textbooks when they missed more lectures. This is clear from the significant interaction between lectures missed and the text use.

Study Patterns

Lecture notes

According to the sample and the methods presented in this study, the results indicated some overlapping effects with regard to some of the study patterns, especially with the lecture notes.

Results from the study of relationships showed that the use of lecture notes did not correlate with the scores on the final exam in either the Traditional or the Phase Achievement System. These results indicate that, regardless of the instructional method used, the achievement of students related very little to the use of individual lecture notes, while the main effects of lecture notes in both models were positively significant in both sections. Yet, the lecture notes contributed the least among the rest of the study patterns (see R^2 value, Table 3).

When students were divided according to their abilities and backgrounds into high and low groups using the median split, results of the profile analysis indicated that neither ability nor background had any effect on the use of lecture notes for either section;

i.e., students in the Phase Achievement System section with low ability and low background (over predicted) used notes as much as those of high ability and high background (under predicted) did in the same section. This result held true also for students in the Traditional section. Furthermore, the under predicted in the Phase Achievement System section studied from their lecture notes as much as the under predicted did in the Traditional section. This was not true for the over predicted where students in the Phase Achievement System section used notes significantly less than did the Traditional section.

Results also suggested that, in the predictable group, students in the Phase Achievement System section achieved significantly higher scores in the final exam and used lecture notes less than those in the Traditional section.

Lecture notes appeared to be of less benefit to students in the Phase Achievement System section, for they used notes less. This may be because they missed more lectures than the Traditional students did. One should note that in this group the Phase Achievement System students have mixed high ability and low background, whereas the Traditional students were of high ability and high background. This means that students with high ability and low background in the Phase Achievement System section did not benefit much from their lecture

notes. These results supported those obtained in the previous research. Mohammed (1980) carried out a study involving comparisons of student study patterns over high and low ability and background for students in Zoology 155 taught by the Phase Achievement System. This work reported that students with low background did not invest more time using their lecture notes.

Previous research also indicated that the use of lecture notes was of more benefit for immediate recall (Fisher and Harris, 1973). It is also believed that the use of lecture notes was affected by listening to lectures. Aiken, Thomas and Shennum (1975) reported that when the act of note taking was separated from listening to a lecture, recall was facilitated. This result, along with the results from the present study, suggests that, regardless of the instructional method used for students who were not able to take good notes for some reason or other, it is strongly recommended that they can enhance their note efficiency by using more videotaped lectures (add Stinard study).

Textbooks

Textbooks used to be the essential, and perhaps the only source of information available to students in the Traditional system. Accordingly, it was believed that

higher use of the text always associated with higher performance. According to the methods and analysis used in this study, results suggest that textbooks are not the most used source of information, even though in both Traditional and Phase Achievement System sections, the use of textbook associated with higher final grades.

As students in both sections used more of the textbook, they relied, to some extent, less on their lecture notes, and as Traditional students missed more lectures they further invested more time studying their texts.

Results also indicate that the under predicted (students with high ability and high background) reported using the textbook a great deal in both sections. Thus, the Traditional students used the textbook as much as the Phase Achievement System students did in this particular group. Yet, in this group students in both sections achieved higher grades with no significant difference in the achievement. The over predicted (students with low ability and low background) showed almost the same use of textbooks as the under predicted did, i.e., the low achievers in the Phase Achievement System section read as much from their textbooks as did the under predicted in the same section. Almost the same findings were reported with regard to the Traditional section. The over predicted

achieved significantly less on the final exam than the under predicted in both sections, while using almost the same amount of text. One could infer that studying more from the text was not of much help to this type of student, indicating that the higher and/or lower achievements in these particular groups were not affected by the use of the textbook. Even though the less able and poorly prepared students had spent considerable time studying from their textbooks, they achieved lower scores.

The only students who benefited more from their textbooks are those in the Phase Achievement System section who were brighter but had poorer backgrounds. In the predictable group (students with high ability but low backgrounds) students in the Phase Achievement System spent significantly more time studying from their textbooks than the same type of students in the Traditional section did. In this group, the Phase Achievement System students achieved higher grades than the Traditional students did, suggesting that textbook use was more beneficial to the students with high abilities but poor background only in the Phase Achievement System section.

Previous research indicated that on the average the Phase Achievement System students reported reading significantly more from text assignments than did the Traditional students, but no significant difference in

terms of student achievement was reported (Stinard, 1980). The results from this study agree, in part, with what had been found in his study.

Mohammed (1980), as described above, reported that the main effect of textbook was not significant, having instead a negative effect on achievement, especially for high ability students. The results of the present study show no such negative effect. But Mohammed related the cause of the negative effect of the textbook to the availability of the videotapes, so that students spent more time studying from the videotapes than they did from their textbooks. This reason might be acceptable for this study, yet no negative main effect was found with regard to the textbook use. This inconsistency between the present study and Mohammed's (1980) could be due to the following reason: Mohammed (1980) used Zoology 155 in winter 1979, in which students have had some more experience with the use of Phase Achievement System, while for the current study subjects were students in Biology 101 in fall 1978, which means that they have less experience with the Phase Achievement System. It should also be noted that Mohammed (1980) used students only from the Phase Achievement System section.

Study guides

Results from the present study clearly indicate that the study guide is the source of information most used by students in the Traditional section, and was of secondary importance after the videotape use in the Phase Achievement System section. It was, however, highly beneficial for both sections.

A study of relationships showed highly significant correlation between the study guide use and the final scores in the Traditional section, and significant, yet low correlation between the study guide and the final score in the Phase Achievement System. Students in both sections had spent a considerable amount of time studying from their study guides. The study guide seemed to compensate for the missing lectures in the Phase Achievement System section, for as students missed more lectures they spent more time using their study guides. Furthermore, students in the Phase Achievement System sections with higher ability studied more from the study guides than did students with lower ability. On the other hand, in the Traditional section well-prepared students studied more from the study guides than did those with poor background; i.e., student background did not affect the use of study guides in the Phase Achievement System section, while ability did. This was unlike the Traditional section

where student background had an effect on the use of study guides but abilities did not.

Results from the general linear model and profile analysis supported the previous results. Students in the Traditional section used the videotape only to a slight degree to answer questions from the study guide; conversely, students in the Phase Achievement System section used their text only a little to answer questions from the study guide.

In the under predicted group, a significant difference between the two sections on the use of study guide indicated that the Traditional students invested more time studying from their study guides than did students in the Phase Achievement System section. Yet there was no significant difference in the final achievement between the two sections. In the over predicted group, students in both sections spent almost the same amount of time using their study guides. Students with low ability and low background spent as much time studying from their study guide as did students with high abilities and high backgrounds, but achieved significantly lower scores.

The main tangible difference between the two sections appeared within the predictable group. In this group of high ability but low background, Traditional students achieved significantly less on the final score than

did the Phase Achievement System students, even though they spent more time studying from their study guides. This may be an indication of the superiority of study guide use in an individualized instructional system. This indicates that with this type of student (high ability but low background) study guides are more beneficial for Phase Achievement System students than they are for the Traditional students.

Results presented in this study are consistent with many previous results which reported that in most cases the use of study guides resulted in higher achievement. Miles, Kibler and Pettigrew (1976) reported that for units with study guide questions, students' pre-to-post-test gain scores are significantly higher than for units without study questions. Semb, Hopkins, and Hursh (1973) reported that when study questions appeared on the exams, a situation similar to the present study, students answered these 20 to 30 per cent more accurately than they did questions not drawn from the study guide questions. A supplementary finding is that the more study questions provided on a given subject, the more likely students are to accurately answer test questions not drawn from the study guide questions.

Mohammed (1980) reported that high ability student groups in the Phase Achievement System were able to use the questions on the study guide to achieve higher scores. This

could mean that students with higher abilities were probably more able to locate and understand the information needed to answer the study guide questions and, therefore, achieved higher scores than the low ability students did. The same author also reported that students with less experience or weak science background tried to answer the study guide questions from their textbooks, but achieved lower scores than those with higher backgrounds.

Results of this study also supported what was previously found by Stinard (1980) who reported that the effort students invested in study guide use seemed to be associated with better achievement.

Videotapes

Videotapes were used most by students in the Phase Achievement System section. They were also considered of some value for students in the Traditional section.

Students in both sections spent a considerable amount of time viewing videotaped lectures, yet the Phase Achievement System students spent more time viewing the videotapes than did the Traditional students. Further, the study of relationships showed that use of the videotape associated with higher achievement in both sections.

Viewing the videotapes negatively affected the use of lecture notes in the Phase Achievement System section; that

is, students who spent more time studying from the TV invested less time in studying from their lecture notes. The same result held true from the Traditional section, but to some extent took less from their lecture note time. The results also suggested that one possible reason for decreasing the lecture attendance in the Phase Achievement System section (depending on the students' attitude and the learning environment) was the availability of the videotapes.

Results from the general linear model and the profile analysis showed some conflict with the study of relationships with regard to videotape usage in the Traditional section. Study of the main effect of the videotapes in the Traditional section indicated that the videotape for this group did not have the same high extent of usefulness it had in the Phase Achievement System section. Students in the Phase Achievement System benefited more from investing more time in videotape viewing than did the Traditional students.

The results also suggest that the Traditional section students' use of the study guide causes some reduction in the use of videotapes, indicating that students in this section answered questions from their study guides by reading more from their lecture notes and their textbooks than they did from the videotapes. In contrast, the

Phase Achievement System students answered questions from their study guides by reviewing more videotapes (of course, in addition to their lecture notes and textbooks).

Further, the results of the present study, show that the Phase Achievement System students with the high ability and high background (under predicted) spent significantly more time than did the same type of students in the Traditional section. With regard to the low ability and background (over predicted), students in the Traditional section spent almost as much time as did students from the Phase Achievement System section on tape viewing. Even though students with low ability and low background spent as much time viewing the videotapes as did those with high abilities and high backgrounds, they achieved significantly lower scores. This is true for students in both sections.

In the predictable group (high ability but low background) videotape use seemed to be compensated for by the phase achievement students, where they viewed significantly more videotapes and achieved higher scores than did the traditional students. Nonetheless, in this particular group, the Phase Achievement System students achieved higher scores not only by viewing more tapes but also by reading more from their textbooks than did the Traditional students. They probably were able to use their study

guide more carefully than the Traditional students did. With regard to the use of videotapes, results of the present study agreed with many of the previous studies. It was reported that the videotaped lectures supported both Traditional and Phase Achievement System students (Dolphin, 1980). Linder and Golmon (1976), regardless of the instructional methods, evaluated the effects of video cassettes along with the audio-cassettes in a general Zoology course at the University of Maryland. In their study, it was evidenced that during the period of the study, attendance in the lecture section dropped while videocassette utilization increased almost beyond the ability of the library staff to cope with the demands. An overall evaluation of this study showed that student achievement seemed to improve and a general positive attitude was generated among the students toward the video and audio cassette techniques.

Kulik and Jaksa (1977) reviewed ten studies on the effectiveness of videotapes on the student achievement as an alternative to the Traditional method. They reported that, in only two studies, achievement of students using video was significantly higher than that of Traditional students. In only one study did Traditional students achieve significantly higher than the video students did, the remainder of the studies showed no significant

difference between the two groups in students' achievement.

Mohammed (1980), in her evaluation of videotape use in six phases under the Phase Achievement System of instruction, reported that, in general, students who used the videotaped lectures achieved better scores in all phases, whether they had low or high ability or different background preparation. Further, Mohammed reported that the most effective study strategy used by the students in the Phase Achievement System was the study guide/videotape strategy. This means that videotapes were beneficial for those who used them in answering questions from study guides. Findings from this study support these previous results.

Conclusion

Over the last two decades, educational research has put forth a tremendous effort in comparing student achievement between the conventional method and the personalized system of instruction. The result of these efforts favored the personalized system in many cases. This study compared student achievement between the two methods with regard to the students' study strategies.

In the traditional instruction, the textbook was the essential, and perhaps, the only source of information available for students. It is assumed that higher

achievement has always been associated with higher use of the textbook, while students in the personalized system of instruction had more than one source of information available to them.

In the present study, both the Traditional section and the Phase Achievement System section had the same sources of information available for use. According to the samples and the statistical procedures used, one could conclude that students in both Traditional and Phase Achievement System sections spent almost the same amount of time meeting the course requirements. Different levels of ability and background did not affect the total amount of time students spent on the course in either section. Students did, however, use their study time differently, allowing different amounts of time to different patterns. There was no significant difference in achievement of the brighter and well-prepared students in the Traditional section and those in the Phase Achievement System section. There was also no significant difference in achievement between the less able and poorly prepared students in the Traditional section and the Phase Achievement System section. Regardless of the instructional method used, students with high ability and high background achieved significantly better than did those with low ability and low background.

Students with high ability but low background achieved significantly higher scores in the Phase Achievement System section than did similar students in the Traditional section. It was found in this group that the Phase Achievement System students missed more lectures and invested more time studying from their textbooks and viewing videotaped lectures than did the Traditional students. The Traditional students spent more time using their study guides and more time reviewing their lecture notes than did the Phase Achievement System students. The lesser use of study guides by the Phase Achievement Section could have been due to the frequent quizzes that this section had had. It seems, however, that the study guide did not compensate for the Traditional students as much as the videotape did for the Phase Achievement System students. It is clear that the best combination of the study patterns used in the Phase Achievement System was the videotaped lectures, study guides and the textbooks. The strategy of videotape and study guide seemed to be used more effectively in this section, while in the Traditional section the best combination used was the lecture notes, the study guides, and the textbook. Further, even though they used the videotapes to some extent, they did not benefit from them as much as the Phase Achievement Students did. Therefore, in general, students should be encouraged to use study guides. More particularly, students in the Phase Achievement system should be motivated

students in the Phase Achievement system should be motivated to use more videotapes and study guides.

Results obtained in this study indicated that the Phase Achievement System students were better able to organize their time according to the importance of the study patterns than were the Traditional students. The reason could be due to the frequent quizzes in the Phase Achievement System, which provided students with more experience in locating the most important pieces of information in each pattern.

However, anyone using this study should be aware that he must consider adjustments which might be necessary for transferring or adapting the results to different settings, such as other locations or other cultures.

Suggestions and Recommendations for Further Studies

It was hoped for the sake of confirmation some applications based on the results of the present study could be carried out using a different set of data, but due to time limitations, it has been decided to leave such analysis for future studies. Such applications would involve some of the following hypotheses:

There is no difference between Traditional and Phase Achievement System students in the use of videotapes;

There is no difference between Traditional and Phase Achievement System students in the use of study guides;

High ability and high background students achieve as well in the Traditional method as do the same type of students in the Phase Achievement System;

There is no interaction between method used (Traditional vs. Phase Achievement System) and student ability; and

There is no interaction between method and student background.

In addition, emerging from the results discussed are some other questions needing more investigation, including the following.

1. How do male students in the Traditional method use their study time compared to female students?
2. How would male students in the Phase Achievement System use their study time compared to female students?
3. How would female students in the Traditional method use their study time compared to male students in the Phase Achievement System?
4. What is the effect of student ability on the use of study patterns in either method? What is the effect of student background on the use of study patterns in either method?

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O my Lord! So order me that I may be grateful
for Thy favours, which Thou has bestowed on
me...

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APPENDIX A. THE PRE- AND POST-QUESTIONNAIRES
DEVELOPED AND USED BY THE PROJECT PERSONNEL

Attitude Survey

Print your name and social security number in the appropriate boxes on the answer sheet. Blacken the spaces corresponding to the letters and numbers in the columns beneath. Fill in the course and section number.

Please use the following scale to indicate the degree of your agreement or disagreement with each of the statements which follow. Mark your answers on the answer sheet. Be sure the number of the statement agrees with the number on the answer sheet. Do not leave any blank spaces. Do not use response zero (0).

1 2 3 4 5 6 7 8 9
 (Strong disagreement = 1) (Neutral = 5) (Strongly agree = 9)

These questionnaires will be analyzed by an independent agency after course grades are awarded. There are no right or wrong answers. Please be honest in your response.

1. I feel that I learn effectively in classes that are taught primarily by the lecture method.
2. I feel that I learn effectively by reading textbooks and outside readings.
3. I feel I learn effectively by discussing information with instructors and other students.
4. I feel I would learn effectively if courses utilized films and audiovisual tapes to present the required material.
5. I feel I learn effectively by direct experience with materials, e.g., doing projects or experiments.
6. Since I have a good background in the sciences, I expect I will do well in this course.
7. I see no benefit in taking this course but I must since it is a requirement for graduation.
8. I have always been interested in biology.
9. My high school and college background in science is poor.

10. Nervousness while taking an exam or test hinders me from doing well.
11. I work most effectively under pressure, as when the task is very important.
12. In a course where I have been doing poorly, my fear of a bad grade cuts down my efficiency.
13. The more important the examination, the less well I seem to do.
14. While I may be nervous before taking an exam, once I start, I seem to forget to be nervous.
15. I look forward to exams.
16. I find that my mind goes blank at the beginning of an exam, and it takes me a few minutes before I can function.
17. Nervousness while taking a test helps me do better.
18. When I start a test, nothing is able to distract me.
19. When I am poorly prepared for an exam or test, I get upset, and do less well than even my restricted knowledge should allow.
20. During exams or tests, I block on questions to which I know the answers, even though I might remember them as soon as the exam is over.
21. I find myself reading exam questions without understanding them, and I must go back over them so that they will make sense.
22. The more important the exam or test, the better I seem to do.
23. Time pressure on an exam causes me to do worse than the rest of the group under similar conditions.
24. Although "cramming" under pre-examination tension is not effective for most people, I find that if the need arises, I can learn immediately before an exam, even under considerable pressure, and successfully retain it to use on the exam.

25. I am so tired from worrying about an exam, that I find I almost don't care how well I do by the time I start the test.
26. In courses in which the total grade is based mainly on one exam, I seem to do better than other people.
27. When I don't do well on a difficult item at the beginning of an exam, it tends to upset me so that I block on even easy questions later on.
28. I enjoy taking a difficult exam more than an easy one.
29. I looked up to my father as an ideal man.
30. Our thinking would be a lot better off if we would just forget about words like "probably," "approximately," and "perhaps."
31. I have a very strong desire to be a success in the world.
32. I liked "Alice in Wonderland" by Lewis Carroll.
33. I usually go to the movies more than once a week.
34. I have had very peculiar and strange experiences.
35. I am often said to be hotheaded.
36. When I was going to school I played hooky quite often.
37. I have very few fears compared to my friends.
38. For most questions there is just one right answer, once a person is able to get all the facts.
39. I think I would like the work of a school teacher.
40. When someone does me a wrong I feel I should pay them back if I can, just for the principle of the thing.
41. I seem to be about as capable and smart as most others around me.
42. I usually take an active part in the entertainment at parties.

43. The trouble with many people is that they don't take things seriously enough.
44. It is always a good thing to be frank.
45. It is annoying to listen to lecturers who cannot seem to make up their mind as to what they really believe.
46. I don't blame anyone for trying to grab all they can get in this world.
47. Planning one's activities in advance is very likely to take most of the fun out of life.
48. I was a slow learner in school.
49. I like poetry.
50. There is something wrong with a person who can't take orders without getting angry or resentful.
51. Sometimes without any reason or even when things are going wrong, I feel excitedly happy, "on top of the world."
52. I wake up fresh and rested most mornings.
53. It is all right to get around the law if you don't actually break it.
54. Parents are much too easy on their children nowadays.
55. I have a tendency to give up easily when I meet difficult problems.
56. I certainly feel useless at times.
57. I have the wanderlust and am never happy unless I am roaming or traveling about.
58. I am sometimes cross and grouchy without any good reason.
59. My parents have often disapproved of my friends.
60. Teachers often expect too much work from the students.
61. My way of doing things is apt to be misunderstood by others.

62. I have had blank spells in which my activities were interrupted and I did not know what was going on around me.
63. I like to keep people guessing what I'm going to do next.
64. I think I would like to fight in a boxing match sometime.
65. If given the chance, I would make a good leader of people.
66. I like to plan a home study schedule and then follow it.
67. I have often found people jealous of my good ideas, just because they had not thought of them first.
68. In school I was sometimes sent to the principal for cutting up.
69. People pretend to care more about one another than they really do.
70. I like to read about history.
71. I am so touchy on some subjects that I can't talk about them.
72. The future is too uncertain for a person to make serious plans.
73. I like to talk before groups of people.
74. The person who provides temptation by leaving valuable property unprotected is about as much to blame for its theft as the one who steals it.
75. I like to plan out my activities in advance,
76. I must admit I find it very hard to work under strict rules and regulations.
77. I like large, noisy parties.
78. I sometimes feel that I am a burden to others.
79. Only a fool would try to change our American way of life.

80. I always try to do at least a little better than what is expected of me.
81. Lawbreakers are almost always caught and punished.
82. I would be very unhappy if I was not successful at something I had seriously started to do.
83. I dread the thought of an earthquake.
84. I often lose my temper.
85. My parents were always very strict and stern with me.
86. I am bothered by people outside, on streetcars, in stores, etc., watching me.
87. I often get disgusted with myself.
88. Society owes a lot more to the businessman and the manufacturer than it does to the artist and the professor.
89. I think I would like to belong to a motorcycle club.
90. I used to like it very much when one of my papers was read to the class in school.
91. I feel that I have often been punished without cause.
92. I don't seem to care what happens to me.
93. I don't like to watch television.
94. Indicate what grade you expect to earn in this course:
(1) F; (2) D; (3) C; (4) B; (5) A.

Course Questionnaire

Print your name and social security number in the appropriate boxes on the answer sheet. Blacken the spaces corresponding to the letters and numbers in the columns beneath. Fill in the course and section number.

The real use of an evaluation is to improve the course for future students. For that reason, we would like to use your experience in this course as the basis for evaluations which may strongly influence how we structure the course in the future. These questionnaires will be analyzed by an independent agency after course grades are awarded. Please be honest in your response.

1. How many hours per week did you spend on this course outside of class? (1) 1 hr; (2) 2 hrs; (3) 3 hrs; (4) 4 hrs; (5) 5 hrs; (6) hrs; (7) 7-8 hrs; (8) 9-10 hrs; (9) more than 10 hrs.
2. How many lectures did you not attend during this quarter? (1) 0-1; (2) 2-3; (3) 4-5; (4) 6-7; (5) 8-9; (6) 10-11; (7) 12-13; (8) 14-15; (9) 16-17 or more.

We are interested in how you spent your time outside of class. Assuming that all outside time spent is equal to 100%, what % of your outside study time went toward use of:

3. Lecture notes: (1) 0-10%; (2) 11-20%; (3) 21-30%; (4) 31-40%; (5) 41-50%; (6) 51-60%; (7) 61-70%; (8) 71-80%; (9) 81% or greater.
4. Text book: (1) 0-10%; (2) 11-20%; (3) 21-30%; (4) 31-40%; (5) 41-50%; (6) 51-60%; (7) 61-70%; (8) 71-80%; (9) 81% or greater.
5. Tape viewing - (1) 0-10%; (2) 11-20%; (3) 21-30%; (4) 31-40%; (5) 41-50%; (6) 51-60%; (7) 61-70%; (8) 71-80%; (9) 81% or greater.
6. Approximately what fraction of the suggested textbook readings did you read during the quarter? (1) 0-10%; (2) 11-20%; (3) 21-30%; (4) 31-40%; (5) 41-50%; (6) 51-60%; (7) 61-70%; (8) 71-80%; (9) 81% or greater.

7. Approximately what fraction of the questions in the study guide did you conscientiously answer? Use preceding scale.
8. How many quarter hours credit have you had in other college level biological science courses concurrent with or prior to this course? (1) none; (2) 2 cr.; (3) 3 cr.; (4) 4 cr. (5) 5 cr.; (6) 6 cr.; (7) 7 cr.; (8) 8 cr.; (9) 9 or more cr.
9. There is a companion lab course for this lecture section (either Biol. 105 for Biol. 101 or Zool. 156 for Zool. 155). Are you currently enrolled in the companion lab course? (1) Yes; (2) No.

Please use the following scale to indicate your opinion on each of the statements which follow. Mark your answers on the answer sheet. Do not leave any blank spaces. Do not use response zero (0).

1 2 3 4 5 6 7 8 9
 (Strong disagreement = 1) (Neutral = 5) (Strongly agree = 9)

10. I felt that I had to do all of the assigned readings in order to do well in this course.
11. Compared to other courses at ISU, the tests in this course were more threatening.
12. Too much emphasis was placed on testing and grades in this course.
13. During the course, my interest in biology increased.
14. In this course, cramming for tests was the most effective means of obtaining a high grade.
15. The tests were an adequate measure of my knowledge and will allow the instructor to assign me the grade I deserve.
16. The grade standards in this course are too high.
17. I felt that I had to answer all of the study guide questions in order to do well in this course.
18. I think this is one of the better courses I have had in science.

19. I felt that I could determine my grade in this course more than in most ISU courses.
20. I adjusted my study during the course according to the test scores I received.
21. I perceived that I had freedom in this course to arrange my study schedule to accommodate my interests and the demands placed on me by other courses.
22. Frequent attendance in this class is essential to good learning.
23. Compared to other courses I took this quarter, I spent too much time on this course for the credit assigned.
24. The lectures were not useful.
25. This course forced me to regard myself as being unable to comprehend the basic concepts of biology/zoology.
26. I felt the study guide was helpful.
27. This has been a very difficult course.
28. I would prefer to take tests at my own pace rather than as required midterms.
29. I feel that I have learned the relevant content of this course.
30. My final grade will be limited because I lack a science background.
31. I would recommend that other students take this course.
32. This course had enough flexibility to help all kinds of students to learn.
33. Because of the course organization, I frequently did not know what was expected of me.
34. A reasonable amount of material was covered in this course.
35. The format of this course allowed me to learn at my own pace.
36. I liked the testing methods used in this course.

37. The classroom instructor contributed to my interest in this subject.
38. The instructor does not stress important material.
39. The instructor makes good use of examples and illustrations.
40. The instructor does not inspire class confidence by his knowledge of the subject material.
41. The instructor has given me new viewpoints and appreciations.
42. The instructor is not clear and understandable in his explanations.
43. The instructor did not show sensitivity to individual interests and abilities.
44. The instructor promoted and expected self-discipline on the part of students.
45. I do not like to watch television.

NOTE: If you did not use a videotape lecture this quarter, then skip the following questions.

46. The television tapes helped me learn biology/zoology.
47. I did not think the television tapes were useful.
48. I would recommend that other students look at television tapes.
49. The television tapes coordinated well with the lecture.
50. The television tapes helped me learn difficult concepts.
51. The television tapes should be available to students in future.
52. I would like to see more courses have television supplements.
53. The television tapes were boring and a waste of time.
54. The television tapes give you the background needed to understand the concepts taught in this course.

APPENDIX B. CHARTS

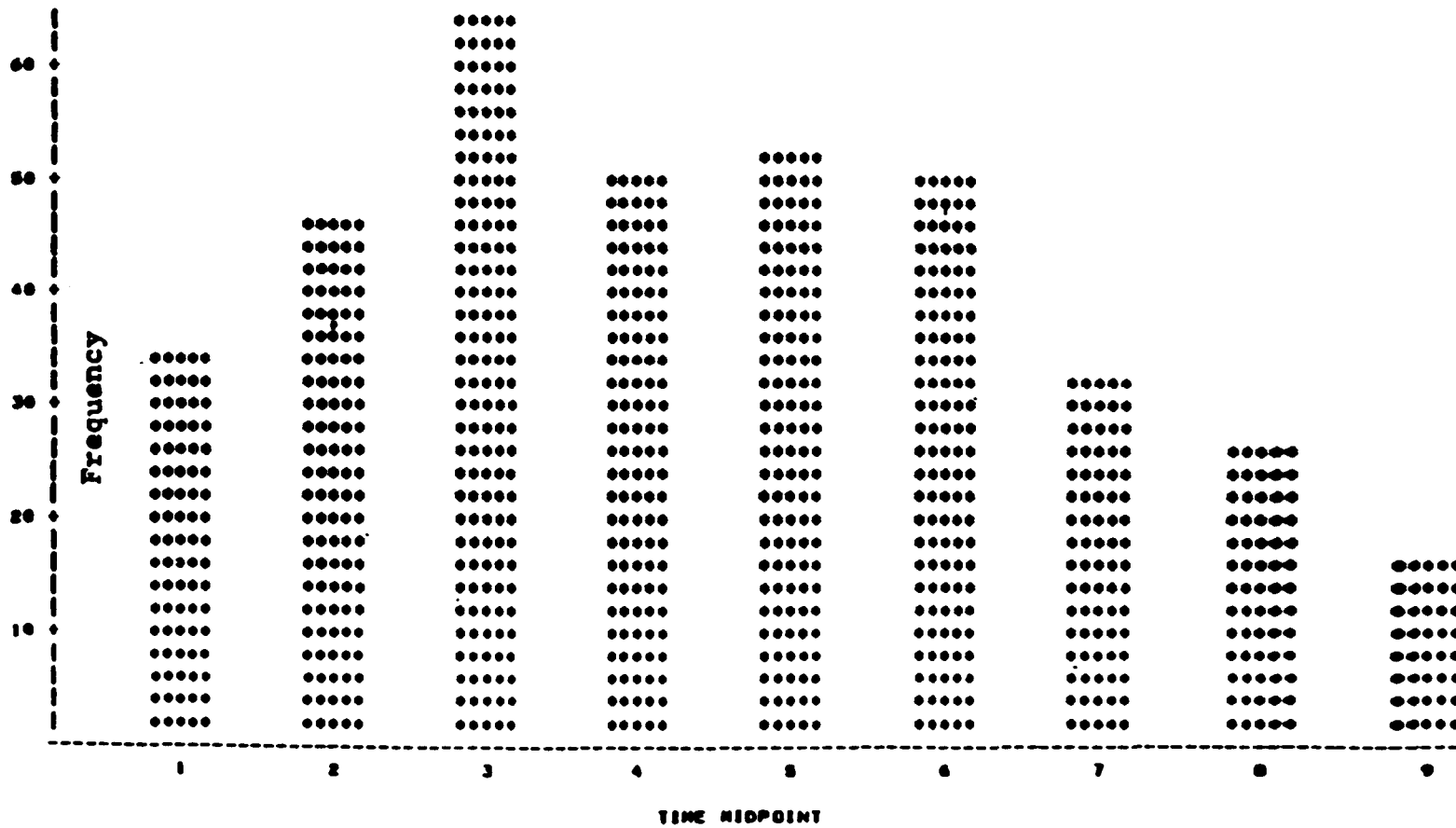


Chart 1. Frequency bar chart of independent variable: TIME

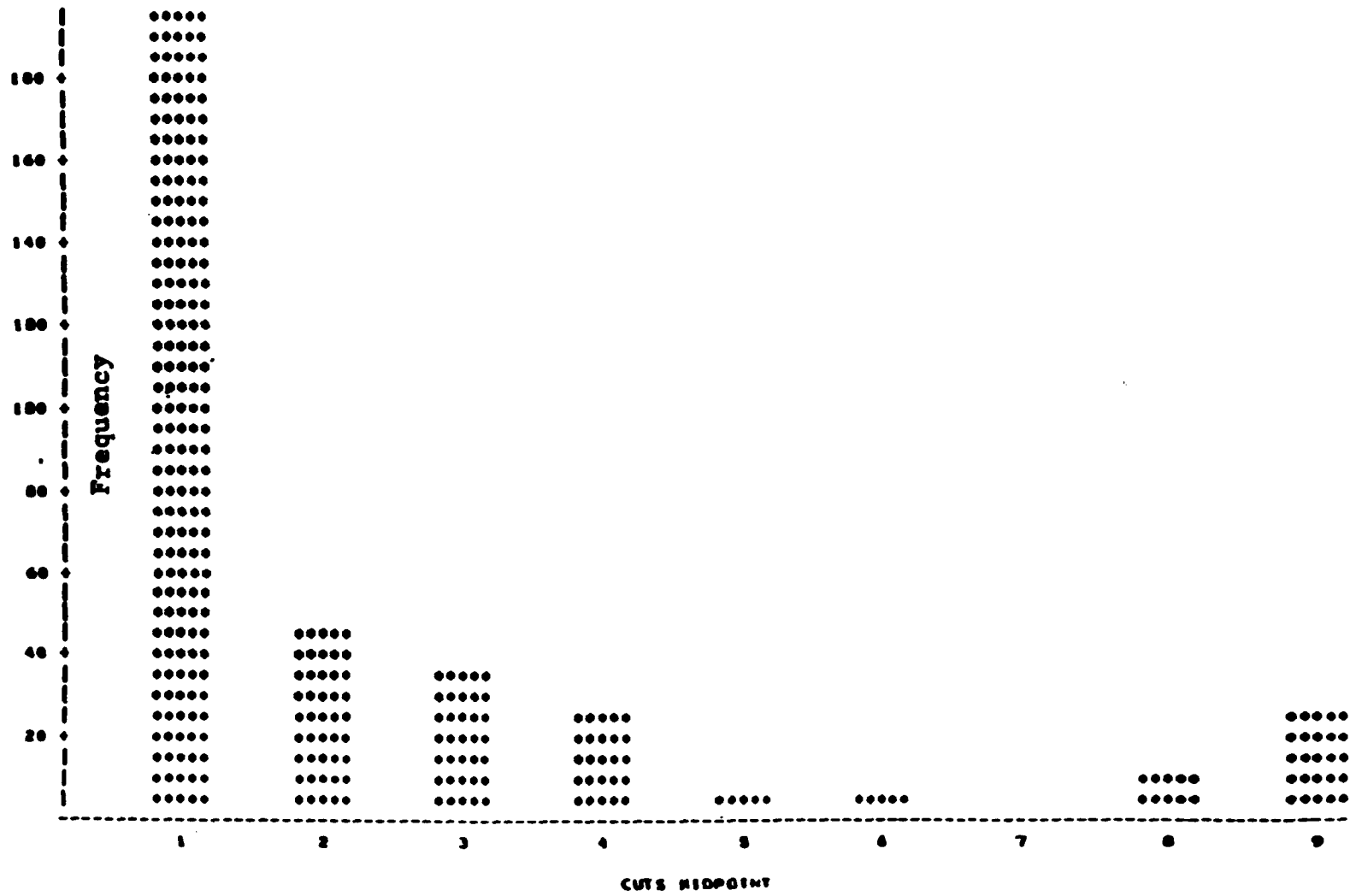


Chart 2. Frequency bar chart of independent variable: CUTS (Number of lectures missed)

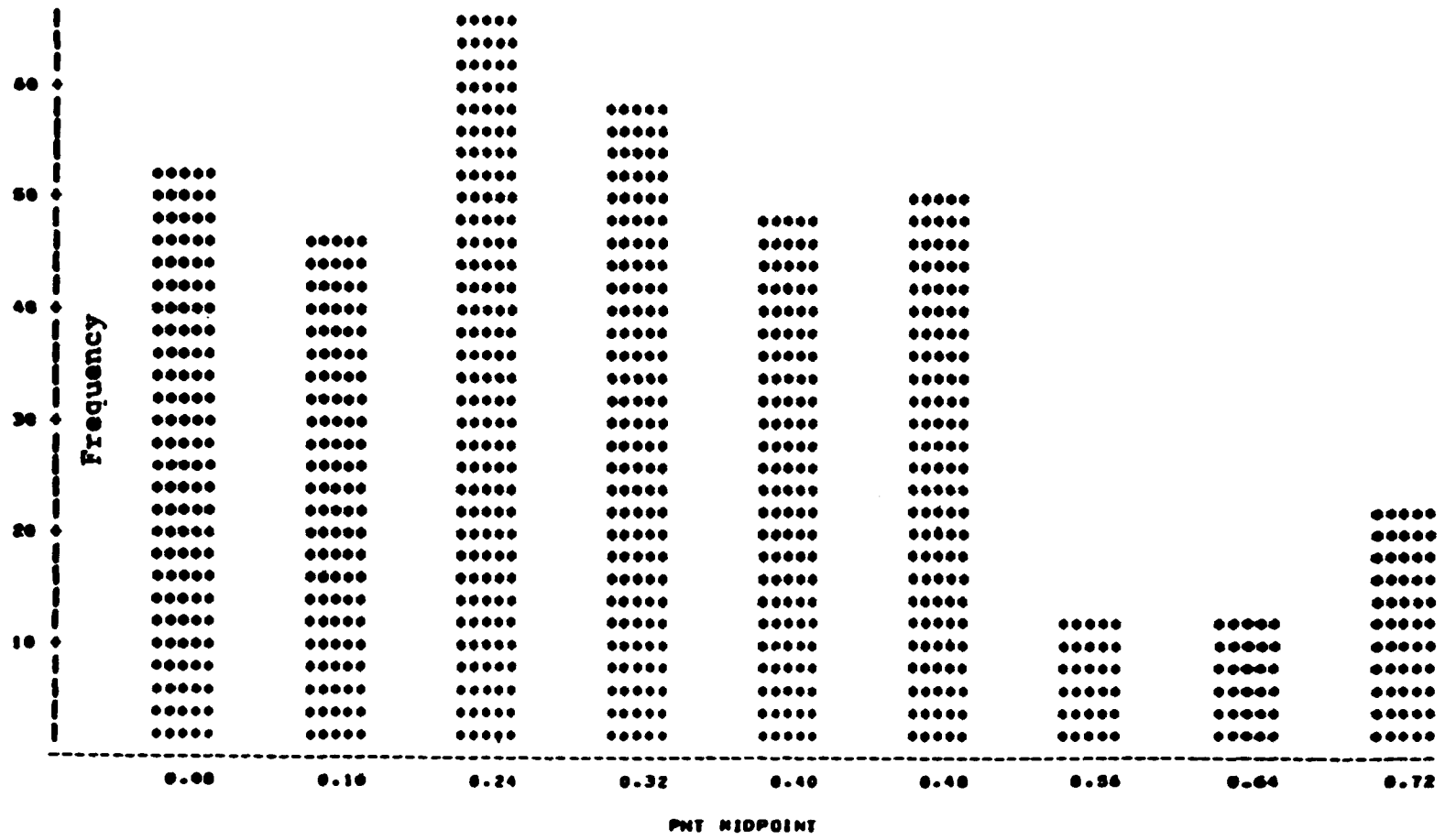


Chart 3. Frequency bar chart of independent variable: Lecture Notes

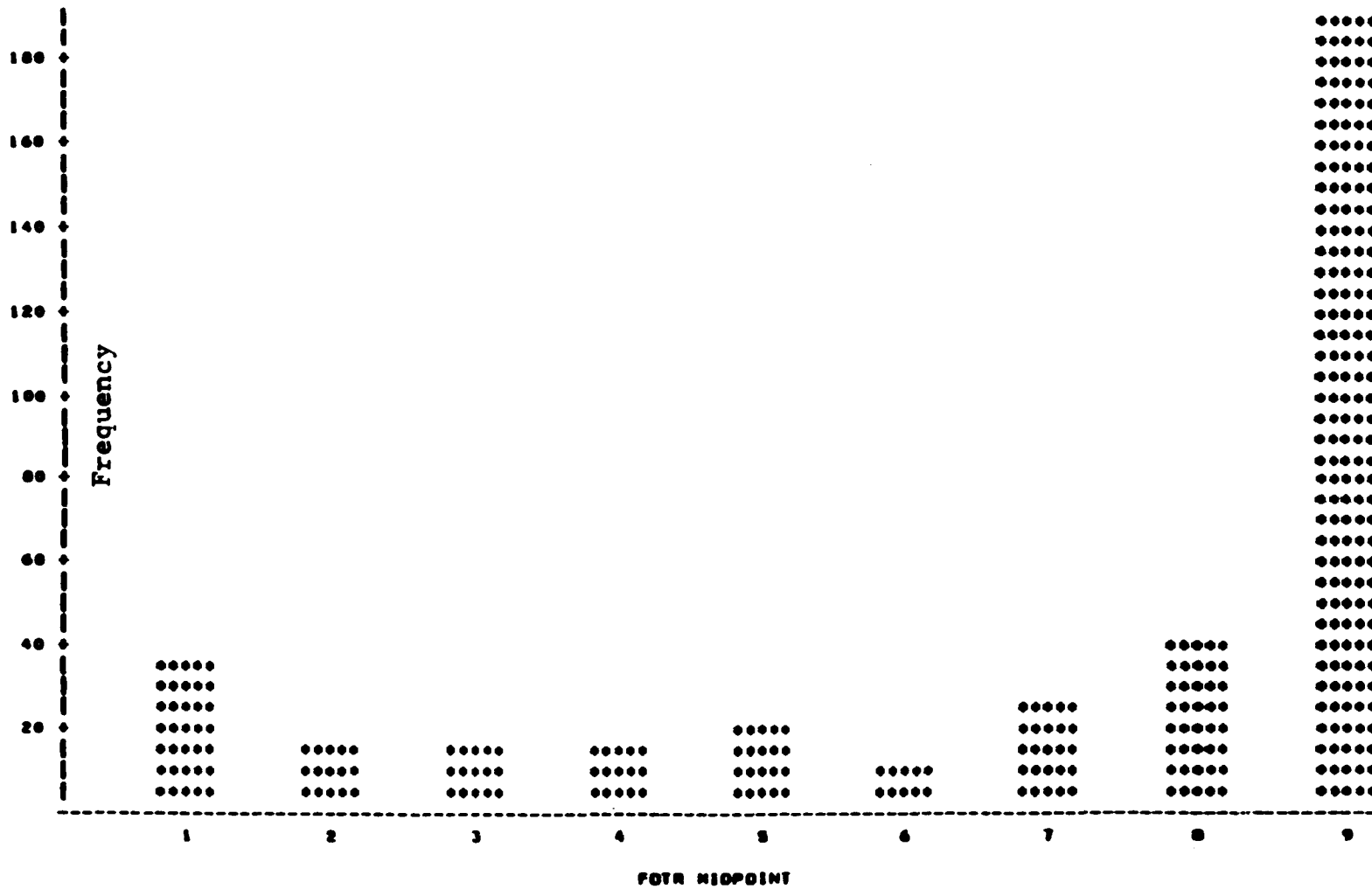


Chart 4. Frequency bar chart of independent variable: Textbook

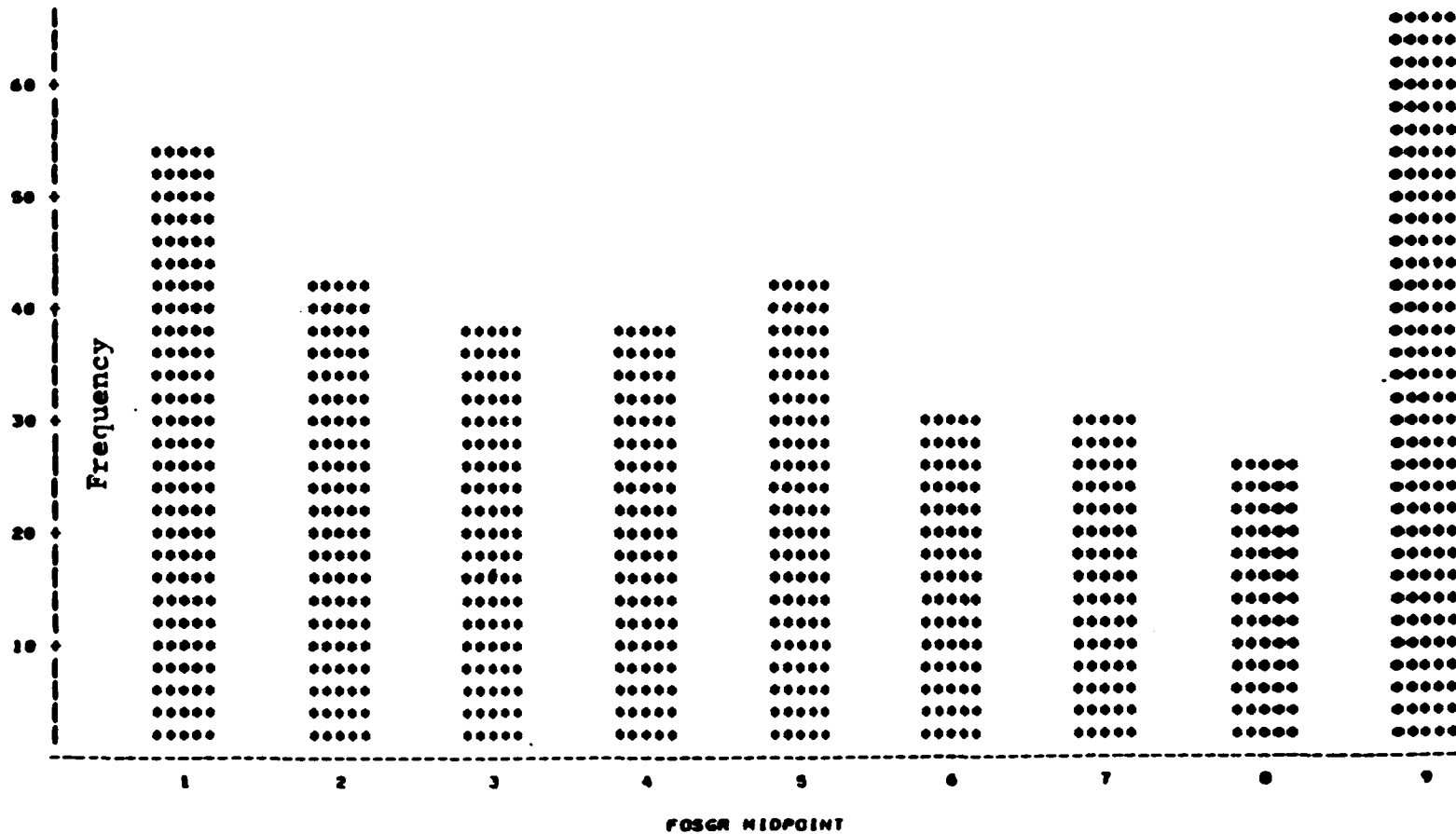


Chart 5. Frequency bar chart of independent variable: Study Guide

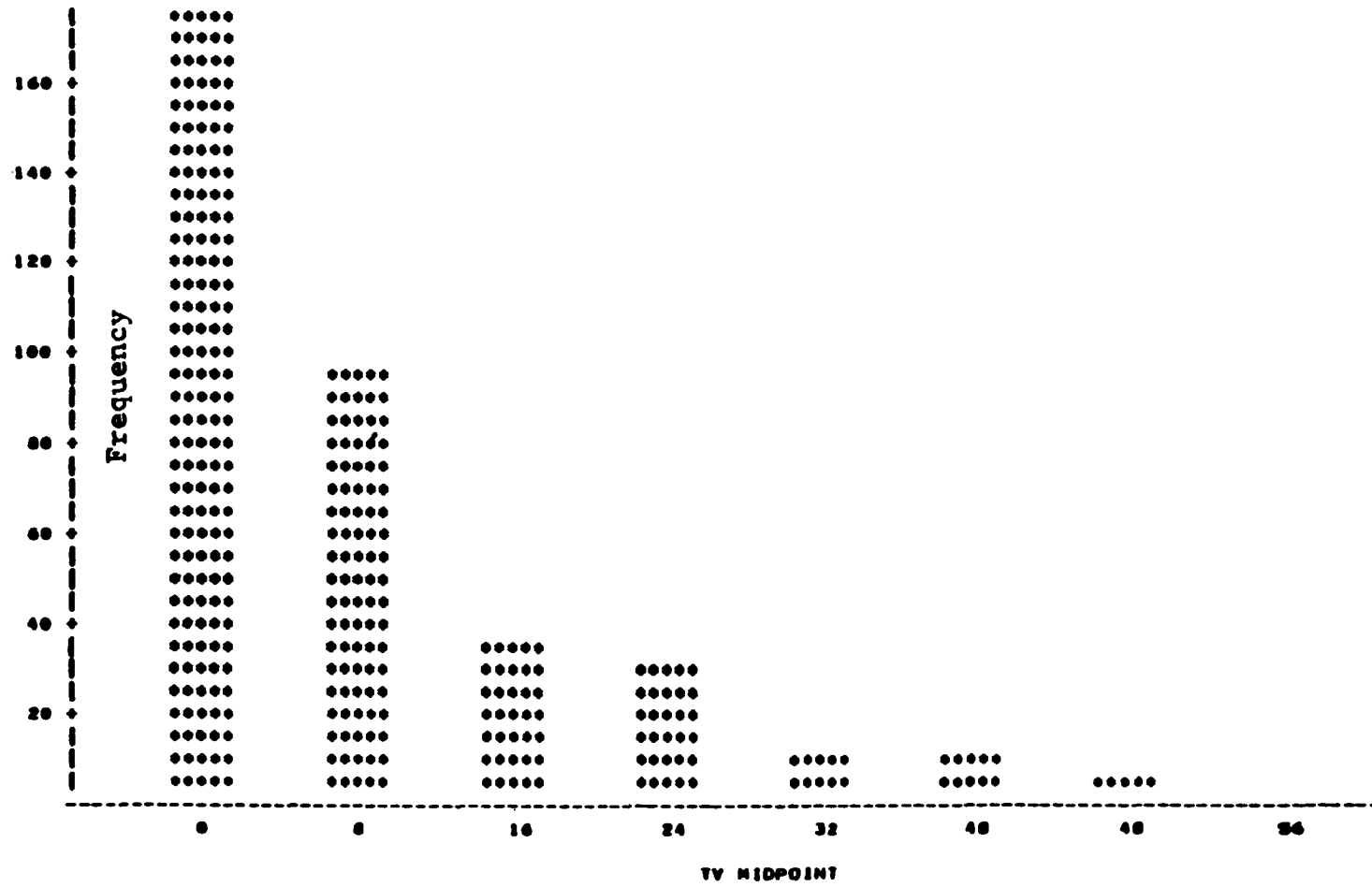


Chart 6. Frequency bar chart of untransformed independent variable: TV

Chart 7. Frequency bar chart of transformed independent variable: TV

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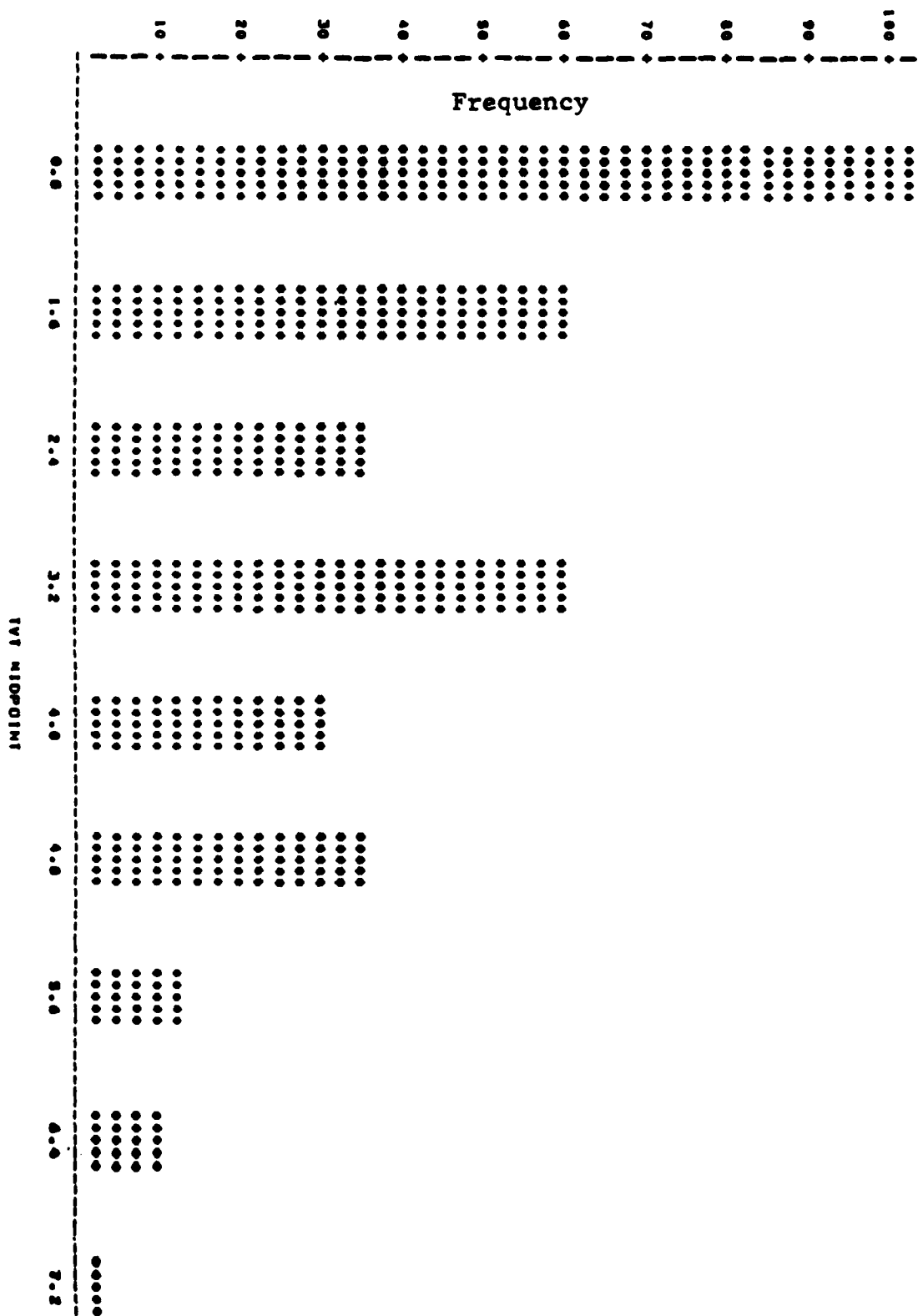
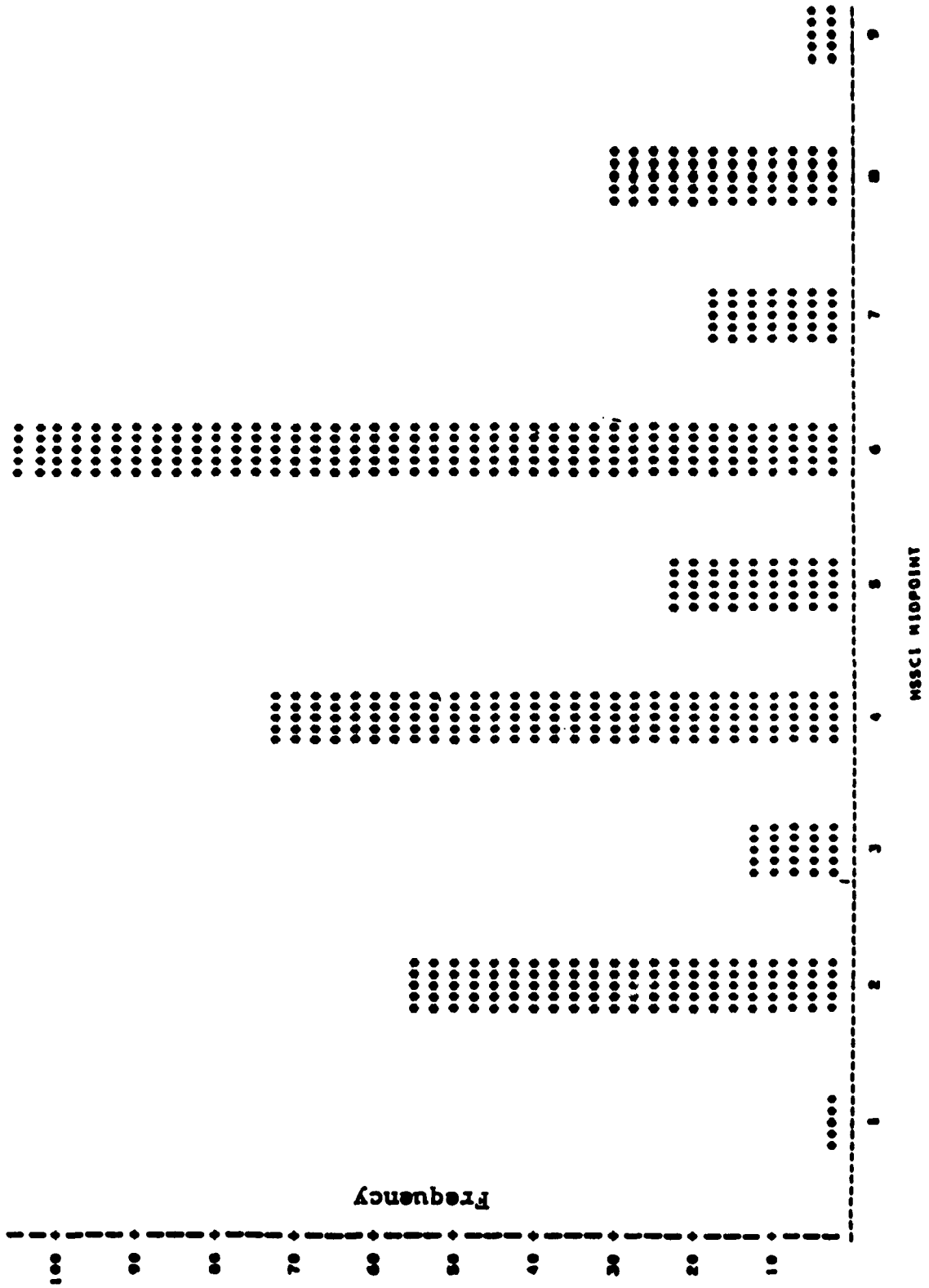


Chart 8. Frequency bar chart of independent variable: High School Science

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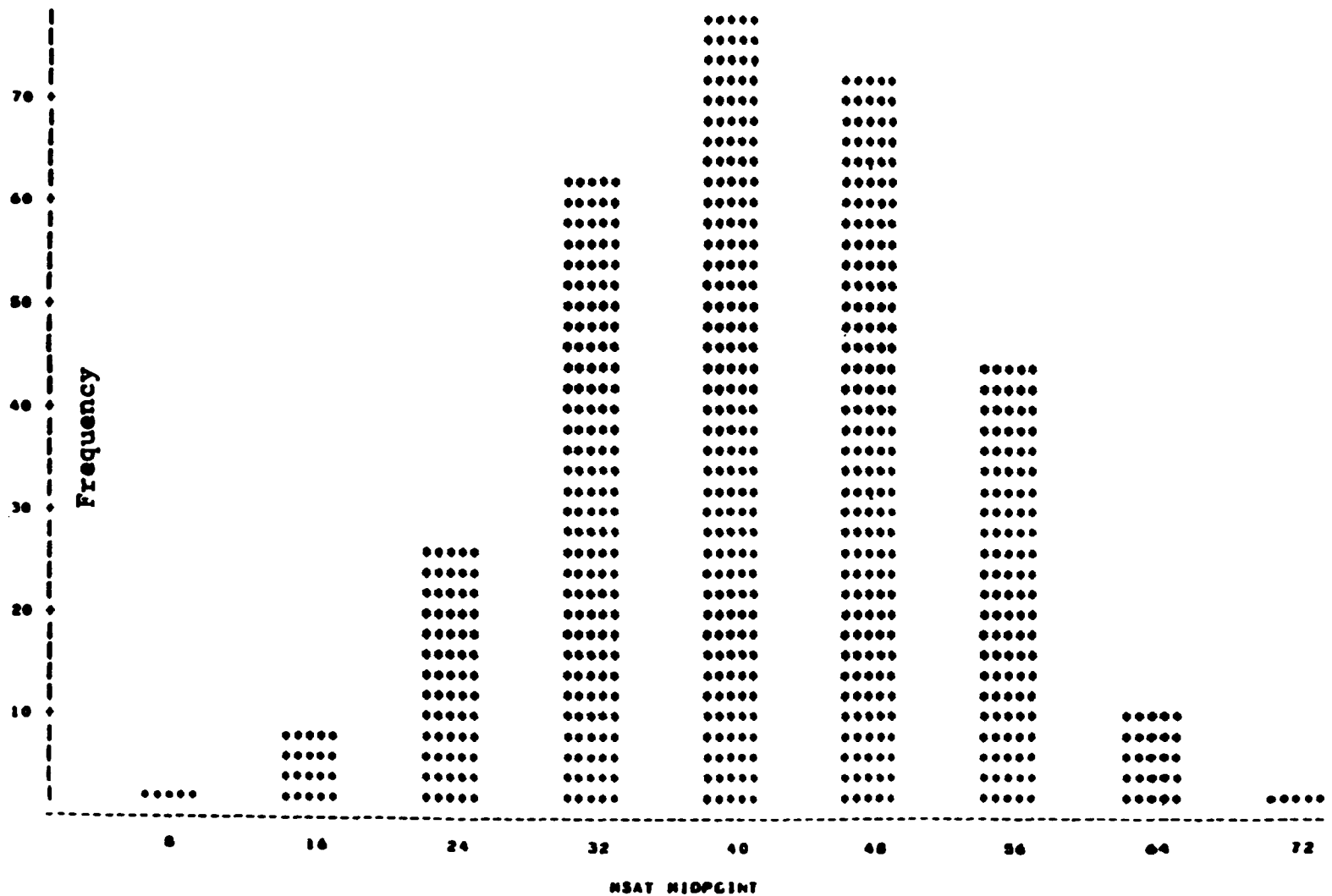


Chart 9. Frequency bar chart of independent variable: Minnesota Scholastic Aptitude Test

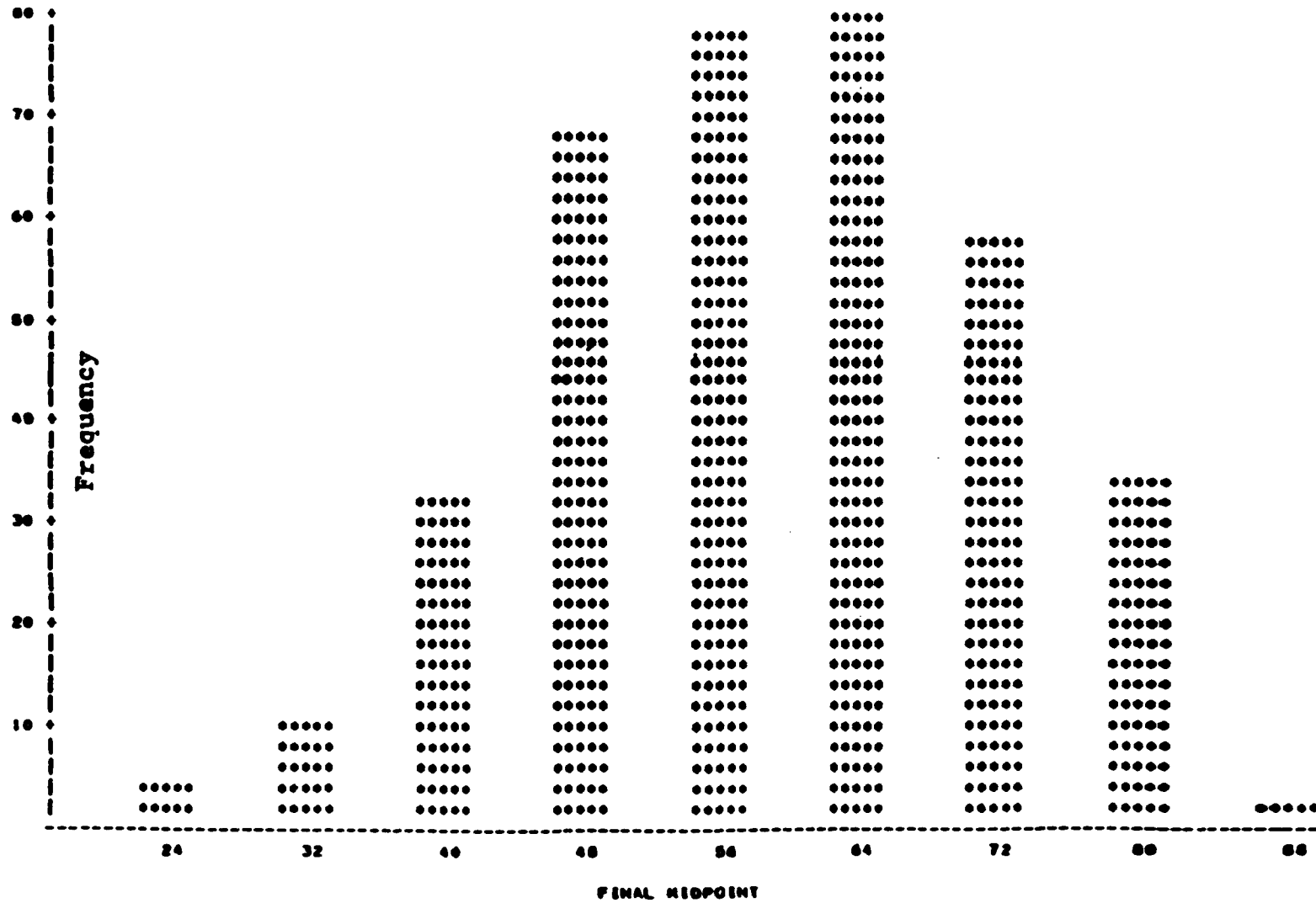


Chart 10. Frequency bar chart of dependent variable: Final