THE EFFECT OF PERCEIVED RELEVANCE ON ACHIEVEMENT IN A SELF-PACED PHYSICS COURSE

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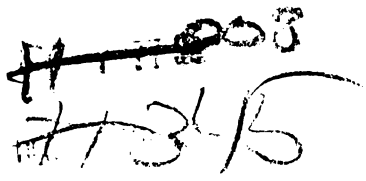

ABSTRACT

THE EFFECT OF PERCEIVED RELEVANCE ON ACHIEVEMENT IN A SELF-PACED PHYSICS COURSE

By

Howard Daniel Greenwood

The goal of this study was to search for a relationship between the career relevance of subject material in physics as perceived by the student and achievement in self-paced and traditionally taught sections of an undergraduate physics course. An exploration for relationships between selected individual variables and the correlation of perceived relevance with achievement was made.

The tendency of some innovators to suggest that the individualization of instruction to fit instruction to students' individual purposes increases the effectiveness of instruction suggested an investigation of the relationship between perceived relevance and achievement in an individualized course.

It was hypothesized that the correlation between perceived relevance and achievement would be positive in both the traditional and the self-paced methods of instruction, and that the correlation would be greater in the

self-paced than in the traditional method. It was further hypothesized that the students in the self-paced method would earn higher final grades than students in the traditional method of instruction, and that there would be differences in final grades and in the correlation of perceived relevance with achievement among groups differentiated by sex, high and low dogmatism, high and low test anxiety, and high and low reading aptitude.

The sample consisted of 126 students from 286 students in the traditional section and 35 of 104 students from the self-paced section of an undergraduate physics course. The sample was self-selected, consisting of students who completed and returned usable questionnaires.

The questionnaire obtained demographic data, and contained the Rokeach Dogmatism Scale, the Sarason True-False Test Anxiety Scale, and a relevance scale. Michigan State University Reading and Mathematics Test scores were obtained from the Office of Evaluation Services, Michigan State University.

The hypothesis of the study were supported. The correlations of perceived relevance with achievement are generally positive and the correlations are generally more positive in the self-paced than in the traditional section. There are differences in final grades and in the correlation of perceived relevance with achievement between the groups.

Mean final grades are greater in the self-paced than in the traditional section in nearly every group. However, there are some groups for which the correlation of perceived relevance with achievement was negative. Recommendations for further research and for interim guidance practices were made.

THE EFFECT OF PERCEIVED RELEVANCE ON ACHIEVEMENT IN A SELF-PACED PHYSICS COURSE

By

Howard Daniel Greenwood

A DISSERTATION

Submitted to

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College of Education

1974

DEDICATION

To my parents,

and to น.ค.

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I am especially grateful to Dr. Sweetland for his help in developing the framework for my thesis and to Dr. Kovacs for his cooperation in the use of the Keller Plan section of Physics 288, created by him and Dr. Peter Signell, and to both gentlemen for directing my research.

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A study of this design cannot succeed without the cooperation of the subjects. I am most grateful to the students who returned completed questionnaires.

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CHAPTER ONE

INTRODUCTION

The Purpose of the Study

The purpose of this study is to search for an association of the relevance of course material as perceived by the student, with student achievement in a self-paced course in physics.

Secondary objectives of this study include a search for an association of perceived relevance with achievement in a traditionally taught course in physics and for interactive effects of perceived relevance and selected variables on both types of course.

A comparison of the effects of perceived relevance in the two types of course will be attempted. The study is exploratory in nature and is correlational, not experimental.

Need for the Study

By what right do you intervene in another person's life by instructing him?

James E. McClellan arrives at that question in his examination of the justifications for individualization of instruction offered in the sixty-first Yearbook of the

National Society for the Study of Education (NSSE) and the 1964 Yearbook of the Association for Supervision and Curriculum Development (ASCD). He deduces two basically different philosophies of education from the two yearbooks (McClellan, '72).

The authors of the NSSE Yearbook, he says, find that

> Careful and methodical research will always reveal a range of variation much greater than we would have believed on the basis of casual observation alone . . . . The more carefully and methodically we carry on research, the more we are forced to recognize that school age children vary enormously on just about any scale we choose to apply, vary much more than we would have believed.

The NSSE Yearbook authors are idealogically committed to individualism but are aware that excessive variations among students seriously disrupt effective instruction under normal school procedures. McClellan notes that effective instruction should increase variation, since more able students are more able to benefit from instruction. The NSSE philosophy of individualization of instruction consists of searching for and using effective means to instruct each child in the skills chosen by the institution. Since instruction is more effective with homogeneous than with nonhomogeneous groups and groups do not stay homogeneous very long, individualization of instruction is implied.

McClellan finds that the ASCD Yearbook is a hymnal praising the value of individuality. The ASCD authors are

saying that the aim of instruction is the release of the full human potential of each individual child and youth. While the NSSE authors ask how far, how fast, and by what means can we move an individual down a chosen track, the ASCD authors ask what track the students want to follow. The ASCD authors are saying that the student has a right to demand, "By what right do you instruct me?"

McClellan notes that we normally don't consider such questions because we consider the instruction to be benevolent. He finds two objections to this. Bringing flowers to a woman who has hay fever is not benevolent. In order to claim benevolence as a justification we have to know what is good for the student, not assume we know. But more importantly, even benevolence is simply not a sufficient condition for an actions' being exempt from the question: By what right do you do it?

In the ASCD philosophy, the answer would be that the student has grounds to believe that the instruction is necessary to the achievement of his purpose and asks for it.

> In the NSSE sense, there is no more moral justification for individualization of instruction than for any other sort of gratuitous intervention in the lives of others. This is not to say that instruction is not justifiable, only that it is no justification to say that it is individualized. In the ASCD sense, one ought not claim that instruction is technically effective just because it is morally justified by appeal to student's purposes. It is a question to which research could make an important contribution by asking whether congruence with

> student's independent purposes makes instruction more effective. One imagines that there are conditions under which student purposes do constitute an important variable in determining effectiveness of instruction and other conditions in which they are of little significance.

These two philosophies have been observed by other writers. Charles Hensley writes that there are two viewpoints on the teachers role, one in which the teacher diagnoses and prescribes what each child should learn and another in which the learner selects his goals and directs his own learning, with the teacher acting as a consultant (Hensley, '71).

Rita S. Dunn gives a classification scheme for instructional programs that range from semi-individualized to totally individualized. "Self-selection of goals," "Self-selection of materials," and "Self-selection of learning activities" appear in some of the types of individualized programs (Dunn, '73).

The central determinant of strategy in individualized instruction, whether you individualize in the interests of the State or of the individual, is the fact that individuals vary. They vary in age, IQ, sex, previous education, personality, and other variables. Many of these have been found to interact with achievement.

A number of strategies for individualization of instruction have been proposed. One is the Keller Plan, created by Fred S. Keller of Arizona State University for

use in his psychology course, with J. G. Sherman (Keller, '68).

In the Keller Plan students work at their own pace with self-study materials. They may use up to two semesters to complete a one semester course, or they may complete the course in a fraction of a semester. Undergraduate tutors are available when needed, about ten students per tutor, with a faculty member supervising about ten tutors.

The course is divided into 20 to 30 instructional modules, each module consisting of a list of behavioral objectives, a study guide with references to resource materials, assignments, and self-administered diagnostic tests. When the student feels he has mastered the objectives he obtains a mastery test for the unit. The test is evaluated immediately by a tutor, in the presence of the student. The student is either given an "excellent" on the test or is directed to further study before taking the test again. The student begins work on the next module after receiving an "excellent." His grade is determined by the number of modules he passes. Students in Keller Plan courses are required to "master" material. Their performance is improved since they cannot pass the course by doing well on some "required" parts and flunking other "required" parts of the course. They may restudy and retake an examination until they pass it. Most students will earn A's in Keller Plan courses if they spend enough

time at it (Keller, '68). There is typically a larger fraction of A's in Keller Plan courses than in traditional courses (Green, '71).

The professor sets the goals of the course, assembles the materials, writes the examination, supervises the tutors, and gives an occasional lecture. His lectures contain no testable material. The student must win the privilege of attending a lecture by passing a specified number of modules.

Summary

The National Society for the Study of Education and the Association for Supervision and Curriculum Development have both pointed out that students vary enormously on any variable we may choose, and that this variability adversely affects the effectiveness of instruction under normal school procedures. Individualization of instruction has been suggested as the only remedy for the adverse effects of student variability (McClellan, '72).

However, James E. McClellan points out that the two organizations mentioned above have expressed two different philosophies of individualization. The NSSE seeks the most effective methods of instruction for the purpose of teaching skills chosen by the institution. The ASCD seeks to help the student learn skills that the student has chosen to attempt to learn.

A strategy for individualization of instruction has been developed by Fred S. Keller and J. G. Sherman. The strategy is in the NSSE philosophy. The instructor chooses the content of the course and the student proceeds through the material at his own pace and with his own selection of study activities. However, some student selection of course content is included in many versions of the Keller Plan.

McClellan seriously raises the question, "By what right do you intervene in another person's life by instructing him?" The NSSE answer--for the good of society--makes the individualization of instruction merely convenient. The ASCD answer--that the student has grounds to believe that the instruction is necessary to the achievement of his purpose and asks for it--makes individualization of instruction unavoidable.

McClellan suggests that research could make an important contribution by asking whether congruence with student's independent purposes makes instruction more effective, since proponents of the idea that the aim of instruction is the release of the full human potential of each individual tend to claim that instruction aimed at that purpose is also more effective in improving the specific skills involved. There are no studies that have asked this question in physics.

Two demands are becoming stronger in our society. One is the necessity that students learn more than they

have ever learned before in schools (Flanagan, '67), and the other is the demand that they have a larger degree of choice in what they learn. Fallers suggests that the latter demand is partially a result of the former. American cultural values stress individual choice. Now that we do not really have a choice about going to school, we insist on a choice of what we study in school (Fallers, '70).

If granting choice to students makes instruction less efficient, contrary to the claims of some innovationists, or if congruence of instruction with student purposes makes instruction less efficient in individualized programs than in traditional programs, then the two demands are in conflict. Evidence that that is not true would be valuable.

There is evidence that individualized instruction is more effective and efficient than traditional modes of instruction (Shavelson, '70). There is evidence that allowing students to select some of their subject material and study activities improves learning (Mathis, '70; Mager, '63). There is evidence that perceived relevance improves learning among culturally deprived students in traditional modes of instruction (O'Leary, '71).

There is no evidence that perceived relevance improves learning even within an individualized program, to say nothing of making instruction at least as effective

in individualized programs as in traditional programs. In this study an attempt is made to examine the relationships between perceived relevance and achievement in an individualized program.

Hypothesis

The first three of the following null hypotheses have been chosen to fulfill the primary and secondary purposes of this study. Hypotheses four and five are a check on work that has been done by many others. Hypothesis six checks to see if there are differences in absolute achievement as contrasted with the correlation of achievement with perceived relevance in various groups of the population.

The method of correlation has been chosen in this study because of the nature of the available population. No experimental method could be employed because the choice of traditional or self-paced course was left to the students and the courses could not be tampered with.

Each of the following hypothesis is treated in this study as a set of separate hypothesis, one for each sub-group in the sample population:

1. The correlation between perceived relevance of the course and final course grade will be negative or zero, in each of the two methods of instruction, traditional and self-paced, and among sub-groups in each method of instruction differentiated by

sex, MSU reading score, test anxiety, and dogmatism.

2. The correlation between the perceived relevance of subject material topics in physics, and scores on test items in each topic, will be negative or zero, in each subject matter topic and among subgroups in each method of instruction differentiated by sex, MSU reading score, test anxiety, and dogmatism. The achievement score in the traditional section will be the mean of standard scores on exam questions in each topic. The achievement score in the self-paced section will be: (a) The number of modules passed beyond requirements in each topic, and (b) The negative of the number of "not yets" in required modules in each topic.
3. The numbers obtained as the correlation coefficients in the self-paced section will be less than or equal to the corresponding numbers in the traditional section.
4. The grade distribution in the self-paced section will not be skewed with the majority of students earning high grades.
5. The mean grade in the self-paced section will be equal to or lower than the mean grade in the traditional section.

6. There will be no differences in final grades within sub-groups within each method of instruction differentiated by sex, MSU reading score, test anxiety, and dogmatism.

Summary and Preview

The call for individualization of instruction has been based on the claim that student variability makes the traditional methods of instruction ineffective. Individualization of instruction is desired alternately as a means of more effectively teaching skills chosen by the institution and as a means of teaching the student what the student wants to know (McClellan, '72).

It is claimed that teaching the student what he wants to know is more effective than teaching him something he does not actively want to know. The purpose of this study is to search for an association of the relevance of course material as perceived by the student, with student achievement in a self-paced physics course.

In Chapter Two of this study the literature for individualized instruction is reviewed. In Chapter Three the population and sample are described, followed by descriptions of the instruments and of the methods used in handling the data. In Chapter Four the calculated correlation coefficients, scatter diagrams, and mean course grades within each method of instruction and in sub-groups differentiated by sex, MSU reading scores, test

anxiety, and dogmatism are presented. Conclusions and recommendations are presented in Chapter Five.

CHAPTER TWO

REVIEW OF THE LITERATURE

The individualization of instruction is proposed as a response to the fact of individual differences. This review will deal with: studies of the effects of various individual differences on achievement, discussions of the need for or meaning of individualization of instruction, the description of or listing of several programs for individualization of instruction, and studies of the effects of some programs of individualized instruction on achievement.

The fact that individuals differ is undisputed but typically ignored (Newsom, '72). Researchers generally ignore variations from the mean rather than search for a common factor. Studies of groups generally yield group data whose graph does not even remotely resemble the data for an individual. The intrinsic individual differences that are the root of this discrepancy include: response to type of learning (rote, conditioning, trial and error, concept), procedural variables (response interval, pacing, distribution of practice, intra-task similarity), and the content and modality of presentation (verbal, numerical,

spatial). As these variables are manipulated the rank order of subject learning performance varies (Jensen, '67).

Newsom et. al continues, briefly describing the results of several studies involving the physiology of the nervous system, the orienting response, extraversion-intraversion, cognitive structure, and attitude and belief systems (dogmatism). Their conclusion is that individualization of instruction based on a profile of tests of individual differences would be a superior method of instruction.

Effects of Personality on Learning

Anxiety:

Kirkland reviewed the literature on the effects of tests on students and schools. She made several generalizations:

1. A high level of anxiety generally causes impaired performance but occasionally causes improved performance.
2. Subjects react differently to anxiety; some anxious subjects exhibit mental alertness, others reduced functioning.
3. A critical factor is what the test situation means to a particular student in terms of his learned patterns of response to anxiety. If the test is considered important to the individual and if he

is anxious when taking tests, he is more likely to perform poorly on tests than one who is less anxious.

4. There is a negative relationship between level of ability and level of test anxiety. Poorer students tend to be most anxious when facing a test.
5. There is a positive correlation between level of anxiety and level of aspiration. Those who are least anxious when facing a test tend to be those who have the least need or desire to do well.
6. Extreme degrees of anxiety are likely to interfere with test performance; mild degrees of anxiety facilitate test performance.
7. The more familiar a student is with tests of a particular type, the less likely he is to suffer extreme anxiety.
8. Test anxiety can enhance learning if it is distributed at a relatively low level throughout a course of instruction rather than being concentrated at a relatively high level just prior to and during a test.
9. A high level of anxiety tends to be positively correlated with the following: Negroes, rural children, children with emotional problems, unpopularity with peers, and low socio-economic level.

10. There is no consistent relationship between the anxiety scores of students and anxiety as rated by teachers and psychologists.
11. There is generally no relationship between anxiety and sex at the elementary school level; however, junior high school girls score higher on anxiety measures than junior high school boys.
12. There are low to moderate negative relationships between measures of anxiety and performance on very complex tasks. This negative relationship tends to increase as the task becomes more test-like.
13. Test anxiety increases with grade level and appears to be long range rather than transitory.
14. Relationships between anxiety and personality variables can generally be found: (a) both active and passive forms of dependency are positively related to anxiety; (b) aggression is negatively related; (c) negative concepts of self and general behavior constriction are positively related (Kirkland, '71).

Lin and McKeachie hypothesized that differences in grade point averages of students differing in anxiety might be explained by differences in aptitude. They used the Alpert-Haber scales of debilitating and facilitating anxiety, the College Entrance Examination Board Scholastic

Aptitude Test, and several other performance measures, including course grades, to verify their hypothesis. Performance does not vary significantly with test anxiety when college aptitude test scores are used as a covariant. However, college aptitude tests are tests. Student scores on college aptitude tests might be expected to vary with test anxiety, in which case Yin and McKeachie's results might have been anticipated (Lin, '70).

Significant negative correlations have been found between test anxiety and task performance on the lowest levels of Bloom's Taxonomy of Educational Objectives, knowledge and comprehension, among college students (Carlson, '69).

Marso investigated the effects of feedback immediately after tests, more frequent tests, and not grading mid-term tests, on performance on a comprehensive final exam. Aptitude determined by the Quick Word Test and achievement pretests and postests were used as covariants. Feedback, more frequent testing, and not grading midterms all increased student achievement on the final examination, but test anxiety had no effect. High test anxious students reported that they strongly preferred more frequent tests (Marso, '70).

White, Gaier, and Cooley found that academic failure did not increase anxiety among adult evening college students (White, '66).

Receiving lower scores than expected increases test anxiety and test anxiety is negatively correlated with test-retest performance, using the Mandler-Sarason Test Anxiety Questionnaire (Cohen, '72).

Lin and McKeachie review studies that are inconclusive about the sex differences of test anxiety, and others that show sex differences in relationships between personality variables and test anxiety. They found that high test anxious individuals are poor in both intellectual and social competence (Lin, '71).

Schultz and Dangel found that the performance of high test anxious students (debilitators on the Albert and Haber Achievement Anxiety Test) on a multiple choice test is inversely related to the number of responses they are required to make in recitations (Schultz, '72).

There is no effect of general anxiety on GPA among women, but test anxiety (high DEB anxiety on the Albert-Haber AAT) is negatively correlated with GPA according to a study by Desiderato and Kaskinen. Study habits (good vs bad) were correlated with test anxiety. The authors suggest that repeated failures due to poor study habits produce test anxiety (Desiderato, '69).

Self-Concept:

Very high ability students who are highly motivated to avoid failure will take the easiest courses while low ability students motivated to avoid failure will

choose the most difficult courses, according to Isaacson. If a low ability high failure avoiding student succeeds in the first difficult course he chooses he will transfer to an easy course in the same area. If he succeeds too easily in an easy course he will transfer to a difficult series (Isaacson, '64).

Koenig and McKeachie found that students who thought the instructor should be authoritarian tended to do poorly in independent study (Koenig, '59).

Albott and Haney used the Leary '57 ICL and standardized performance tests to study interactions between sex, self-concept, and two study options: "independent" and "regular." They found no difference in study option for people with different self-concepts generally. However, males in the regular option held managerial autocratic self-concepts while managerial autocratic females prefer the independent study option. Performance was slightly better in the regular option, with highly dominant males doing better in independent study than in regular study, while highly dominant males and females did worse in both regular and independent study than low dominance males and females (Albott, '72).

Binder, Jones, and Strowig studied the relationships among self-expectations (SE), self-concept (SCA), academic achievement (CPA), and ability (APT), among twelfth grade students. Two independent studies showed

essentially the same relationships among self-concept of ability, self expectations, aptitude, and grade point average. Correlations ranged from roughly .30 (SE-APT) to .60 (SCA-GPA, SCA-APT) (Binder, '70).

Psychological Inventory Measures of Personality

Bigelow, Gordon, and Egbert asked whether there existed personality differences, as measured by the California Psychological Inventory, among: (1) successful independent study and successful traditional study students, (2) successful independent study and unsuccessful independent study students, and (3) satisfied independent study and unsatisfied independent study students.

With success defined as a course grade equal to or higher than past GPA and satisfaction indicated by a desire to take another independent study course, there were no significant differences between independent study and traditional study students. Among independent study students, successful students scored higher on Intellectual Efficiency and Responsibility. Successful and satisfied independent study students scored lower on Sociability and Socialization than successful but unsatisfied independent study students (Bigelow, '68).

The California Psychological Inventory has been used to add to a regression equation predicting freshman GPA. A multiple R of .52 was found for women using Math

and Verbal scores from the Scholastic Aptitude Tests and Socialization, Achievement via Conformity, and Flexibility scores from the CPI. A multiple R of .57 was obtained for men using Feminity in place of Achievement via Conformity (Stroup, '70).

Majer reviews studies of relationships between personality, performance, and modes of instruction. He reports studies by Hansen and Dick in which computer assisted instructed (CAI) systems show effectiveness equal to or greater than classroom instruction, and by Hansen, that shows that CIA plus multimedia produces higher performance than a traditional course.

Majer also reports a study involving a CAI/ Multi-Media Introductory Physics Course. The course was altered from a completely self-paced computer managed format to one involving a recitation section with a professor. The participants were volunteers. The scales in the Omnibus Personality Inventory, the College Student Questionnaire, FACT questionnaire, math and science background, and the Florida Twelfth Grade Achievement Test were used in a regression equation. When only the highest R scoring scales were retained in the equations, five scales were unique to each group, CAI/Media and Traditional.

There was consistency between the two groups in that successful students in both groups were skeptical

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and had liberal religious views. They had greater social inclination and were more emotional and trustful. They were not very diverse in artistic matters but were concerned about social injustice.

Successful students in the traditional course were interested in science, were less sociable, were not likely to indulge in fantasies, were not interested in immediate utilitarian outcomes, and were politically, economically, and socially liberal, autonomous, and unconcerned about the appearance of their behavior.

Majer concludes that "mature" students will do better in a traditional course while immature students do better in the CAI/Media course (Majer, '70).

Kipnis, Lane, and Berger report a study of the influence of impulsiveness on achievement in mathematics and the physical sciences. Highly intelligent impulsive students do well in psychology but badly in mathematics. The drop out rate of highly impulsive students from engineering and the arts and sciences is very little different from the drop out rate of the low impulsive students. Intelligence and impulsiveness are not related, either positively or negatively (Kipnis, '67).

Cognitive Style

Coop and Sigel suggest that the construct of cognitive style can contribute to the understanding of individual differences in the processing of information.

Many measures of cognitive style have been developed based on different conceptions of the term. Witkin writes about field independent (analytic) versus field dependent (global) cognitive styles, Broverman about conceptual versus perceptual dominance, Bruner of focusers and scanners, Kagan, Moss and Sigel of descriptive, relational, and categorical styles. There is great confusion in the literature, exemplified by Witkin's use of the word analytic for field independence versus Kagan et. al use of the term for people who categorize on the basis of parts rather than the whole in the environment (Coop, '71; Witkin, '62; Broverman, '60; Kagan, '60; '63).

Witkin measures the ability of individuals to disengage a component from its surroundings. Bruner observes strategies of response that are used consistently in attaining concepts. Kagan, Moss, and Sigel ask subjects their preferences for grouping common environmental objects.

Witkin, Bruner, and Kagan, Moss, and Sigel all defined aspects of individuals that are persistent and appear to have effects on the ability to learn various kinds of behaviors. The effects vary with age, some appearing among elementary school children but not among college students.

The existing research in the area should sensitize teachers to different individual approaches adopted by the

various students in their classes. Some students may be unable to break away from their preferred mode of perception. Differences in the conceptual tempo of students, or the interaction of an impulsive teacher with a reflective student may produce serious effects (Coop, '71).

Hester and Tagatz investigated the interaction of analytic and global cognitive styles determined by the Tagatz Information Processing Test (TIPT) with conservative or commonality instruction. The concept attainment task was finding an embedded figure in a complex drawing. The "commonality" instructional group was shown a "focus" card of the figure and three other cards, each showing a complex drawing. They were instructed to find the common attribute among the cards. The conservative instruction group was told to compare the complex picture to the focus card and to find the similar figure. Subjects with the analytic style were equally efficient in both modes, while subjects with the global style did much better with the conservative mode than with the commonality mode (Hester, '71).

Learner Control

Students who feel that they are in control of their fate (the definition of "internal control") perform better when they have control of their learning activities (Mathis, '69).

Mager and Clark report that allowing students to develop their own instructional design and to decide what they need to learn results in unique sequences and content of instruction, better performance, and requires less instructor and training time (Mager, '63).

The effect of learner control versus program control on achievement has been studied by Campbell and Chapman. Learner control subjects were given a file containing course objectives, study guides, practice problems, and tests for the course, and allowed to do anything they wished.

Program control (PC) subjects were given the same material in a prescribed sequence, although still self-paced. The performance of the learner control (LC) group slowly improved as the program continued, and the groups were nearly equivalent on the course tests. The significant factors were the same in each group: clear objectives, study guides, self-evaluative problems, self-pacing. The students liked the learner control mode more and might be expected to become more highly motivated to learn for that reason (Campbell, '67).

Fallers objects strongly to learner control and to too much choice in high school. The purposes of high school education should be to pass on the cultural heritage and the skills necessary to keep the society going. The society is encouraging individualized education

because of a fear of mass society and of inequality or ranking. We want to maintain individuality and the equality of men, so we treat all equally by individualizing. But society must socialize students, must teach them to accept restriction (Fallers, '70).

Polly Chico Gross, a high school student, warns against individualization in favor of "basic learning" (Gross, '70).

However, the problems of a mass technological society which values freedom and democracy require an education that accustoms students to change and to rational self-selection of goals and activities, according to Bernstein. Students must be taught to be critical, rational, to respect the rights of others, and to be analytical about society and social change. Students taught to do these things will be independent. Their independence must be recognized, tolerated, and encouraged through individualized instruction and individual choice of goals (Bernstein, '70).

Relevance

The strongest reasons reported by freshmen for going to college are, among men:

1. degree necessary for work
2. prepare to be a success
3. prepare for specialization
4. opportunity for advancement
5. satisfaction from field.

Dole reports that, as seniors, these students still remembered these reasons as having been most important to them. However, total stability of reasons for going to college was small. The list of reasons given as freshmen was much longer and most reasons were of a different rank than the seniors remembered giving them as freshmen. Students do not remember why they came to college (Dole, '70).

Reynolds suggests that only information that is subjected to the personalizing process of the individual learner is learned. The information must be relevant to that person at that time (Reynolds, '71). Newton observes that "relevance" has become the rallying cry of contemporary education and that a subject seems to be "relevant" if it has an immediate and useful bearing on the individual's personal everyday life. He asks if science can have that kind of relevance, pointing out that science owes much of its success to selectively ignoring parts of reality. He questions whether science education should attempt to be "relevant" (Newton, '71).

Wood also stresses the importance of the kind of basic science that is not relevant in the sense Newton observed. "Basic" science is the basis of relevant science and proves useful in unpredictable, unexpected ways. Perhaps the immediate "relevance" of science is the satisfying security of the rational approach as a way of life, the

delight in the way our observations all fit together to make sense (Wood, '72).

Trigrams (1) that subjects liked and thought were words, (2) that subjects disliked and thought were words, (3) that subjects liked and thought were not words, and (4) that subjects disliked and thought were not words, were used as material for paired associate learning. O'Leary found that the performance of low ability white students was significantly better on trigrams they thought were words than on trigrams they thought were not words. Negro students performed significantly better on trigrams that they liked than on trigrams they disliked. This indicates that perceived relevance improves or is associated with better performance and that there are two types of relevance, cognitive and affective (O'Leary, '71).

Klopfer discusses relevance and individualized science: "Relevance" refers to how well an educational program or a course of study is matched to the needs, interests, and circumstances of the student. Individualization of instruction suggests a practicable way to increase the relevance of the student's learning in the school.

Klopfer predicts incredible changes in technology and society that we are not ready for but for which we must prepare the next generation. Students could be in deep trouble if they were to be as innocent about science

as many adults are now. The best preparation the school can offer is to help the student to become an effective independent learner. He must be able to select and use a learning environment and instructional material that will carry him toward his goals. He must have well informed positive attitudes toward science and accept the processes of scientific inquiry as a valid way to conduct his thinking. Honesty, openmindedness, suspended judgement, self-criticism, commitment to accuracy, and a knowledge of the basic facts discovered by science are essential.

In the Individualized Science program of the Learning Research and Development Center of the University of Pittsburgh, prescriptions for study are at first made out by instructors, but students are encouraged to start writing their own. Students progress at their own rate and have the opportunity to take alternate pathways to their goals. By providing alternate pathways the system allows the student to make the program more relevant to his own goals (Klopfer, '71).

Dogmatism

Ehrlich used the Rokeach Dogmatism Scale to examine the relationship of dogmatism to classroom grades. Major area and sex determined the predictive efficiency of dogmatism scores. He hypothesized that grades would be more important to males than to females because of their greater vocational interest. This led to a prediction

of an interactive effect with major area and sex, which was confirmed (Ehrlich, '71).

Rokeach and Norrell had found that close-minded subjects are less able to learn new beliefs (not accept new beliefs), than open-minded subjects (Ehrlich, '71).

Low academic achievers score high on the Dogmatism Scale and high academic achievers score low on the Dogmatism Scale, regardless of grade level. Russo found that low academic achievers remain conventional and rely heavily on authority. Rather than exhibit flexibility and open-mindedness in a classroom situation, the more dogmatic individual tends to prefer structured situations (Russo, '70).

Weiss, Sales, and Bode used IQ scores, English grades, and the California F Scale by Athanasion and Ezekiel, with a sample of thirty six students to determine the effect of authoritarian and non-authoritarian teachers on the performance of authoritarian and non-authoritarian students. Authoritarian students did best with authoritarian teachers and non-authoritarian students with non-authoritarian teachers (Weiss, '70).

Goals and Proposals in Individualized Instruction

Paul Douglas lays the blame for the growing popularity of individualized instruction on the administrative search for a cheap escape from the costs of a staggering

increase in enrollments. But curricular reform has been a subject in education for a century. Eliot at Harvard claimed that a student's will to learn must come from his own inner motivation. A boy of 18 or 19, he said, should study what he likes best and what he is best suited for. But Harvard students, in the eyes of their professors, dissipated their energies in too many fields or concentrated too narrowly, or took "snap" courses. Students did not understand the basic aims of general education.

Douglas outlines some principles of individualized instruction:

> True intellectual goals should displace time-serving goals.
>
> The mainstream of the student's learning should move in its own broadening channel, independent of courses, teachers, and institutions.
>
> Liberal education is a satisfaction of a sound feeling of the relative values that permanently concern human life wherever they may be found.
>
> A curriculum is nothing more than the actual sequence of mental acquisitions of a given mind as it makes its way through the world of ideas by which it is surrounded.
>
> Since every mind behaves in a different manner, every curriculum is necessarily different for every student.
>
> A curriculum presented to the student as a series of courses is ineffective.
>
> Education is a continuous intellectual voyage to be given direction by measurement of present worth.
>
> The student experiences intellectual momentum when with the acceptance of responsibility

> for self-education he marshals all the emotional and moral qualities of his nature behind his intellectual task.
>
> No educational design can elevate intellectual performance above the level of the flow from a student's mind.
>
> The library is the active intelligence center on the campus.

Douglas adds, "The corollary of the indisputable fact of individual differences is individualized education," and praises the Pittsburgh Curriculum Continuity Demonstration for its emphasis on measuring and managing student progress in terms of what the student knows and is able to do. The perils of individualized education include the student's inability to organize and manage his time, inadequate planning of the student's course, the assumption that all students are equally ready for individualized instruction motivationally and academically, the inadequacy of budgets and of instruments to measure student performance, the rarity of student-faculty contact, and the assumption that all students prefer independence (Douglas, '67).

McClellan also stresses that the fact of individual differences requires individualized instruction. He further justifies individualized instruction as being morally proper in the sense of aiming toward "the release of the full human potential of each individual child and youth."

McClellan claims that programmed instruction was seen as being color and class blind, and that programmed instruction forced consideration of exactly what it was that culturally deprived people lacked, so that it could be provided for them.

He praised Skinner:

> It (the theory of operant conditioning) was radically egalitarian; all men, like all pigeons, are endowed by their Creator with the right and the ability to learn; it was radically individualistic; each man, like each pigeon, must learn at his own rate and with his own style.

And after de-emphasizing programmed instruction, he added:

> Surely it is not ignoble to affirm that everyone can learn. Nor is it irrelevant to insist that educational research focus on the individual learner to discover how he can be helped to learn better (McClellan, '72).

Kieffer complains that students do not get what they expect at small liberal arts colleges. He blames this largely on the mass lecture method of instruction. Lectures emphasize constant attention and do not allow for a moments consideration of what has been said. Learning should emphasize thought progressions, reflections on relationships, and free association.

Lectures also assume that all students are alike, that they know the same things, and learn at the same rate. Lectures are wastefully used to transmit information that can be read. They fragment the student's time, exposing him repeatedly to a series of unrelated presentations and

preventing him from integrating a subject into a whole. Lectures force the professor to use multiple choice questions on his exams and the student to "cram" knowledge and then go on, whether he understood or not.

> It is a ruthless and incredibly inefficient system that permits and almost forces weaknesses to go undetected or uncorrected, that piles weakness upon weakness, that shoves students on to ever more complex educational content without real information on their mastery of prior foundation content.

Kieffer recommends these objectives:

1. Mastery of educational content rather than steady progress over a series of arbitrarily established time hurdles.

2. Movement of students through educational content on an individual basis at their own best pace.

3. More emphasis on integrative rather than disintegrative learning experiences and learning environments.

4. More efficient use of student and teacher time.

5. Wide options in teaching methods to accomplish specific tasks.

6. Enlarged and more efficient opportunities for students to work with their professors and to seek their help.

7. More efficient use of college facilities.

8. Constant validation of teaching methods and educational content as reflected in the ability of each student to demonstrate mastery of desired content (Kieffer, '70).

"Individualized instruction is quickly being established as a routine teaching procedure in many classrooms." Students react quickly and positively to the

release from the lockstep of group instruction and, perhaps for the first time, learn for the sake of learning in a world of realistic learning. Teachers perform as diagnosticians and prescribers, and have greater opportunity for personal contact with students (McBurney, '69).

Gnagey warns that technological progress may create a society where the individual will be "lost." "The main requirement for man's supremacy as a personal entity is intellectual freedom. Upon freedom of thought depends his political, economic, and all his other, freedoms." He suggests that men must learn to adapt to change and to enjoy learning for its own sake (Gnagey, '64).

An effort to help students in the complex task of planning their educational development led to project TALENT in 1957. Flanagan describes the motivation for and essentials of a model of an educational system developed by the Center for Research and Evaluation in Application of Technology in Education (CREATE), of the American Institute for Research in Behavioral Sciences, Palo Alto, California.

There is presently inadequate provision for the very large individual differences found in any age group. Schools do not develop in the student a sense of his own responsibility for educational, personal, and social development and for making his own realistic educational decisions. There is not enough emphasis on learning how

to learn, to think, and to make decisions. Instruction does not have the efficiency and flexibility necessary to enable the student to plan and select the education that will prepare him for the roles he selects.

The plan (CREATE) requires modules, modular segments with specific objectives, and measures to determine when the objectives have been met. It uses a computer to process, store, and make information available. It requires guidance procedures for planning individual programs (Flanagan, '67).

Hug reports that students pursuing curricular objectives by independent study had better attitudes than other students. Students in independent study were provided with programs of instruction, discussion questions, a room for discussion, and a quiet room. A small group discussion section with teacher made questions and a lecture-demonstration section were compared to the independent study section. No differences in achievement were found, but independent study students believed that they had learned more, improved their study habits more, and that their work was more interesting than in their other classes (Hug, '70).

Programs of individualized study at Indiana University have also developed improved attitudes toward science. One program involved a list of objectives and resources for a block of study, with the student left to

decide how he would proceed to attain the objectives. A date was given for completion of the block and for an examination. Only a few students complained, and they didn't complain about the subject matter. They wanted more structure, a more authoritarian teacher.

Anderson suggests that few people would argue with the statement that schools at their best have been benevolent dictatorships. The idea that students have civil rights is just now being established by court rulings.

The need for student freedom is based on civil rights and the meaning of "science." Science requires the freedom to inquire. But we have to teach students to use freedom by forcing them to operate under fewer and fewer constraints. That is, specify objectives and their priorities, then leave the student to decide his own fate. Extrinsic rewards may be used to get a student involved in science, since without some contact with science no interest in science will ever develop (Anderson, '71).

Education is a purposeful, non-random event. Bloom suggests that the normal curve, describing random events, should not be used to evaluate achievement in education (Bloom, '68). Marso contends that classroom tests should be less difficult than the 50% difficulty level. He found that students exposed to less difficult tests studied more and achieved more on a final

examination. The increased study time suggests a better attitude toward science (Marso, '70).

Glass and Yager also suggest that individualized instruction improves student understanding of science. They allowed students to read portions of the text on their own and at their own rate. No classes as such were held. The student performance in this class was compared to the performance of the students in the previous year, using the Test on Understanding Science and the Facts About Science test. Students in the self-paced course gained a significantly better understanding of the scientific enterprise (Glass, '70).

Troyer quotes Mannello and immediately agrees, "'If grades must go,' as indeed they must, what will take their place?" He describes an evaluation system at the National College of Education, Evanston, Illinois. The system is criterion referenced instead of norm referenced. The student record is a list of competencies. A student is no longer allowed to "pass" a course by doing well on parts of it and badly on other parts.

"Passing" a course is seen to have little meaning by the Council on Academic Standards at National. The letter grades are empty of meaning, relating to achievement in later courses but not to professional or vocational achievement. The GPA and the normal curve do not reflect reality. Grades do not really tell a student where he

stands. The emphasis on comparisons between students rather than on intrinsic factors of achievement is unacceptable. The pursuit of grades has a negative effect on the mental health of the student, especially on self-esteem and openness to further learning. Grades provide no adequate system of self-appraisal and encourage a morality of "getting by."

At National the student is provided with a competency list at registration. The instructors evaluate the student on each competency item and sign a form when competence is demonstrated. There is no self-pacing inherent in the system, however. Instructors may require attendance in class and may set times when competency may be demonstrated. The plan also specifies matching learning units (modules) to student learning styles as expressed by variables such as abstractness vs. concreteness, amount of practice, reading vs. listening, and observation vs. manipulation (Troyer, '70).

Dunn states that individualization is necessary:

> Recently we have begun to recognize that each youngster learns in a manner which is uniquely his or her own, through perceptual strengths that either fortify or discourage the acquisition of knowledge and skills, and with a learning style that tends to dominate his or her every effort to achieve. . . . Drastic instructional and organizational change is needed to revise and improve the teaching-learning process to permit students to strive for, and reach, self-fulfillment.

He then lists what he believes to be the basic elements of individualization:

> Teacher and student diagnosis.
> Teacher and student prescription.
> Student selection of goals, learning materials and activities, and instructional techniques.
> Self-pacing.
> Self-assessment followed by cooperative assessment.
> Self-selection of modus operandi determined by learning styles.
> Objectives and prescriptions based on student interests.
> Student creativity incorporated into self-selection aspects (Dunn, '72).

The above models require some kind of competency statements. Barton cautions that competency statements are useful for instruction or training. They should not be used in situations that require original thinking, value commitments, creative solutions to problems, and self-discovery or self-understanding (Barton, '72).

Bolvin and Glaser reiterate the absurdity of expecting and educating for uniformity, and espouse the moral value of individual performance versus group performance.

> The principle goal of education is to create men who are capable of doing new things, not simply of repeating what other generations have done--men who are creative, inventive, and discoverers. The second goal of education is to form minds which can be critical, can verify, and not accept everything they are offered.

Creativity and originality can be brought about by freedom in the classroom, by freedom that assures that

the students' behavior is shaped by his own productivity and not by group norms. A critical approach is encouraged by the ability of the individual to challenge opinion, which can best be done on the basis of information the individual acquires himself.

With these values, the members of the Learning Research and Development Center of the University of Pittsburgh developed the Individually Prescribed Instruction program. The program keeps track of competencies, is self-paced, provides for differences in learning styles, and for different goals for each child. It is assumed that each child can master all of his subjects (Bolvin, '68).

Ubben reviews self-pacing, observing that group instruction cannot cope with individual differences and that teachers should become instructional managers. Ubben, Liberman, and Schwen refer to Individually Prescribed Instruction (IPI), Learning Activity Packages (LAP), Program for Learning in Accordance with Needs (PLAN), and UNIPAC, all of which either are or involve instructional modules based on behavioral objectives, instructional activities, and diagnostic tests (Ubben, '70; Liberman, '70; Schwen, '70).

The advantages and disadvantages to breaking a course up into instructional packages are listed by Johnson. The packages are portable, exchangeable between

courses, replicable, modifiable, feasible, applicable to any field. The student can go anywhere to learn, learn at his own rate, repeat material whenever he wishes, study topics in any sequence, get assistance whenever he needs it, and complete the course whenever he is ready. The limitations include lack of time to prepare materials and the antagonism of other faculty and administration. There is a tendency to use low-level cognitive objectives and to fail to use as large a variety of instructional methods as possible. More measures of attitudinal response should be included in the packages (Johnson, '71).

Programs to Individualize Instruction

Fred S. Keller developed a plan for self-paced learning based on his observations of training programs in the Signal Corps during World War II, in cooperation with J. G. Sherman. The plan involves dividing the course into roughly 30 units of content and writing a study guide with clearly stated behavioral objectives, a variety of learning activities, practice problems, and a self-evaluative quiz. Finally mastery tests are written in several versions for each unit.

Students may study the units at their own pace. There are student tutors available if the student needs help, and he may see the professor. When he feels ready for a mastery test he goes to a testing center, picks up

the test, completes it, and sees it graded immediately by a student tutor. If he does not demonstrate essentially total mastery of the test material he does more problems, completes other study activities, and returns a day or more later to take another version of the same test. He may repeat this procedure until he finally demonstrates mastery and continues to another unit.

Course grades are determined by the number of units in which mastery is demonstrated, and by a final examination. The student may complete the course well before the semester is over, or he may continue well into the next semester, with no effect on his grade.

Lectures are given, but they are "enrichment" material. The material covered in the lecture is not tested, and attendance at lectures is a privilege that must be earned by demonstration of mastery of specified units.

Student comments about Keller Plan courses indicate that students attained much greater mastery, and a greater feeling of achievement, felt more recognized as a person, enjoyed the course, improved their study habits, acquired better attitudes towards tests, worried less about grades, and became more interested in hearing lectures, in Keller Plan courses.

The distribution of grades in Keller Plan courses is skewed, with a high percentage of A's and B's.

Withdrawals and incompletes are more common than E, C, or D grades (Keller, '68).

Green reports the use of the Keller Plan in a physics course at the Massachusetts Institute of Technology. He used 18 units of course material. He notes that Keller Plan courses are highly structured, and that students tend to put off doing work in the course in favor of doing work in courses with deadlines.

Grading in the freshman course was based on a midterm and final examination, and was Pass-Fail. Grades in the sophomore course were based solely on the number of units completed, with no midterm or final examination (Green, '71).

Successful use of the Keller Plan is reported from numerous schools, including:

Lowell State College, Lowell, Massachusetts,
Dr. Paul Protopapae
Georgetown University, Washington, D.C.,
Dr. Sue Clark
Monterrey Institute of Technology, Mexico,
Ing. Horacio Gomez Junco
Universidade Brasilia, Brasilia DF 70.000 Brazil,
Professor Paulo Cesar Bezarra
University of Michigan, Ann Arbor, Michigan,
Dr. Donald E. DeGraaf
Staten Island Community College, New York, New York,
Helen B. Siner
Victoria University of Wellington, Wellington,
New Zealand, Dr. B. A. Ryan
Rutgers University, New Brunswick, NJ,
Dr. Emil Heitner
Gordon Institute of Technology, Geelong, Victoria,
Australia, Dr. Gerald King
Florida State University, Tallahassee, Florida,
Dr. Leila R. Cohen

Henry Ford Community College, Dearborn, Michigan, M. F. Read
Ohio University, Ada, Ohio, Donald C. Milks
Boston University Medical School, Boston, Massachusetts, Dr. Allen J. Cohen (Sherman, '72).

Green reports that his friend, Fred Keller, is "running scared." The Keller Plan is being adopted with frightening speed by all sorts of people (Green, '71).

Nunney and Hill describe a program at Oakland Community College, Michigan, that is based on the prescription of instruction by means of cognitive style mapping. Tests are given which probe questions such as how the student uses his senses, how he searches for meaning, whether he prefers to listen or to read, whether he prefers to categorize or to contrast and relate information. Using the map, the teachers choose a set of instructional activities for the student. The programs are self-paced, with traditional classroom experiences kept available (Nunney, '72).

All of the programs involve self-pacing, mastery tests, and learning packages or modules containing behavioral objectives, instructional activities, and self-evaluative tests.

Postlethwait and Husband describe the Audio or Auto Tutorial System at Purdue University. The system involves an Independent Study Session involving the use of multimedia in carrells, with activities determined by behavioral objectives, a General Assembly Session where

the instructor attempts to integrate and orient the subject material and gives major exams, and an Integrated Quiz Session where the student is quizzed orally about items covered in the last week. In this session students are handed an item and must then discourse on it, or "teach" it (Postlethwait, '70; Husband, '70).

Edling reviews a number of programs of individualized instruction in which students proceed at their own pace and achieve self-evaluated and self-satisfying goals. These include the Continuous Progress Plan of Edwin Reid at the University of Utah, and at the Meadow Moor School in Salt Lake City; the Duluth experiment; the programs at Melbourne High School in Florida; Matzke Elementary School at Cypress, Texas; NOVA Schools, in Fort Lauderdale, Florida; the UCLA Laboratory School, Los Angeles, California; Janesville Public Schools, Janesville, Wisconsin; the Tutorial Community of the System Development Corporation, Santa Monica, California; Dekalb County Schools, Decatur, Georgia; and others in Haxtun, Colorado; Hagerman, Idaho; Pendleton, Oregon; and Temple City, California (Edling, '70).

Steffen describes project SPOKE in Norton, Massachusetts (Steffen, '71). Wedemeyer and Ghatala describe the Wisconsin "Open" school (Wedemeyer, '72). Hunt describes an individualized program at Northpoint High School, New York (Hunt, '66). Reports of other programs

of individualized instruction include Kallenback and Carmichael, '71, Bertrand, '72, Shanberg, '71, Stoltz, '71, Briley, '71, Rogers, '73, Payne, '72, McCurdy and Fisher, '71, Krockover, '70, Frantz and McConeghy, '72, Hensley, '71, Lunetta and Dyrli, '71, and May, '72.

Effects of Individualization on Achievement

Poppen and Thompson used a grade contract approach which allowed the student to select suggested grade level requirements or to substitute individual or independent study activities for an or all of the suggested course activities in an educational psychology course. If the student exceeded his contract or didn't complete it his grade was determined by his actual performance.

No significant differences in achievement between the experimental course and a course ran in a traditional manner were detected, using examination grades and quality of papers and child case studies reports as measures of achievement. Subjective evaluation by the instructors indicates that those students opting for independent study projects in place of the examinations became more involved in "relevant" learning (Poppen, '71).

Hastings divided a required graduate course in educational research into six units and wrote behavioral objectives for each unit. Reading references, learning materials, and exercises were included in each unit.

After the fifth class session there were no further class meetings held. Mastery was defined as 50% on the early units and up to 68% on the later units.

Scores on the first form of each unit test taken by each student were used to compare the performance of the students in the experimental section with the traditionally run class, which used the same division of the course material. There were no significant differences between the groups on IQ, critical thinking, previous achievement, sex, age, years since bachelor's, number who had completed the master's degree, years since completion of the master's degree, semester hours completed since completion of last degree, or undergraduate and graduate majors and minors.

The experimental group performed significantly better than the traditional class group on four of the six unit exams.

Students asked why it was necessary to learn certain of the behavioral objectives, which led the author to suggest that a rationale for each objective be included in the behavioral objectives (Hastings, '72).

An individualized self-paced instruction system and laboratory with small group discussion was developed by Shavelson and Munger. They compared its effectiveness against a traditional course in high school biology.

The experimental, self-paced group did as well as the traditional group on the first quiz and completed the material in less time. The experimental group did significantly better than the traditional group on the second quiz and completed the material in less time. The experimental group also did significantly better than the traditional group on a post test. The students in the experimental group felt that they had received a better "education" than in other courses (Shavelson, '70).

Hartnett and Stewart, at the College of Basic Studies, University of South Florida, divided their students into two groups, one to take the regular courses and the other to take the same courses by independent study. The latter group attended no classes but took a common final examination, with the first group. These students were matched to the students in the regular course using their Florida Twelfth Grade Test scores, with no pair differing by more than three points. In two of the six courses the independent study students performed significantly better on the final examinations than the regular course students. The mean performance of the independent study students in the other four courses was slightly but not significantly higher than that of the regular course students (Hartnett, '66).

Born, Gledhill, and Davis distributed the students enrolled in a psychology of learning course according to

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cumulative GPA into one of four course sections in order to obtain similar distributions of GPA in each section. The sections were: a lecture-discussion section, two Keller Plan sections, and a "rotating" section in which instruction was switched from traditional to Keller Plan after the first midterm exam.

The Keller Plan sections were provided with module study guides, tutoring, and tests, upon request, at one hour "class" meetings held three days a week. The course was divided into 16 study units, one per textbook chapter. Students were not quite self-paced because they were required to pass all units covered by a midterm examination before the midterm, which was given on the same day for all sections.

Students in the two Keller Plan sections and in the rotating section earned a mean grade significantly higher than the students in the lecture discussion section. The differences occurred in fill in the blank and essay questions, but not in multiple choice questions.

All students who dropped out of the Keller Plan sections had a previous GPA of 2.24 or less. The student with the previous GPA of 2.24 transferred to the regular section, earned a low C on the midterm, and finally withdrew from the course. Another student who insisted on transferring to the regular section completed the course with a grade of E.

In the rotating section the top five students and the bottom five students on the first midterm were determined. Then instruction was switched from regular to Keller Plan. The performance of the top five students was not changed significantly on succeeding examinations, but the performance of the bottom five was significantly improved. Poor to mediocre students were most helped by the Keller Plan method, but withdrawing students in the Keller Plan section were all poor to mediocre students (Born, '72).

Bybee gave one section of an Earth Science class three lectures a week, with films and lecture outlines. A second class was given one hour lecture a week and required to attend a two hour laboratory. Three quarters of the laboratory time was left to the individual, with access to an auto-tutorial (multimedia) center. He found no significant differences in examination performance of the two sections on a Comprehensive Earth Science Examination. The group in the experimental section preferred the treatment they had received more than the group in the regular section had preferred their treatment (Bybee, '70).

After briefly reviewing several studies that indicated that individual study without formal class attendance results in achievement as high or higher than achievement associated with attending class, Himmel selected 39 subjects from a general psychology course and gave them a

careful orientation to the self-directed study technique, passed out course material, and let them go. They attended class only for the examinations.

The final examination scores of the students who were freed of class attendance were significantly higher than the final examination scores of those students that were required to attend class (Himmel, '72).

James used the ISCS materials in a course for seventh grade science. In an experimental section he allowed faster students to go beyond the core and permitted slower students not to complete the core. Students were assigned to the regular and experimental sections so that there were equivalent distributions of scores on tests of science achievement and understanding in each section. No differences were found in the post course performance on these tests (James, '72).

Crist observes that students do not pay much attention to programmed texts, but that projecting the frames on a screen in class and requiring the students to respond aloud in turn did not produce any higher performance than allowing the student to proceed through the text alone and at his own pace (Crist, '66).

Menges arranged a self-directed study course in the psychology of learning. Attendance was required only at the first five class meetings. The student was required to write behavioral objectives for his plan of

study, meet personally with the instructor at least three times, submit a journal of learning experiences, and assign himself a course grade.

Course achievement of the experimental group and a group receiving traditional instruction was compared using an 80 item multiple choice test. No significant differences in performance were found. The students in the self-directed study group had consistently better attitudes toward the course than the students in the traditional sections (Menges, '72).

A programmed science sequence of 100 frames was used by Gropper and Kress to measure the typical work rate or "pace" of each student in an eighth grade class. Fast workers made more errors and scored lower on post-tests than slow workers, but only among low IQ students.

Work rate was found to be a stable characteristic of individuals, but many fast workers had low IQ and did poorly in terms of errors rate and on post-tests. Typically slow working low IQ students did well at their own rate but did poorly when forced to work at a fast rate.

High IQ students who were typically slow workers did <u>not</u> suffer significant deterioration in performance when forced to work at a faster rate, but fast working high IQ students performed less well when forced to work slowly. The goal of efficiency would seem to require

some control of pacing, rather than allowing students to pace themselves (Gropper, '65).

Goldman, Wade, and Zegar constructed a self-paced course in Economics involving three study units. Most of their students "never even came close to completing the three units of the course." The units were: (1) major concepts, (2) development of analytical skills and (3) research.

The "major concepts" numbered 200, plus unspecified behavioral propositions embedded in the text. The sections on analytical skills and research made no attempt to describe goals in terms of behavioral objectives. The authors claimed that "Most of the disciplines in the behavioral sciences, humanities, and creative arts . . . do not lend themselves to such step-by-step programming."

The authors suggest that a detailed syllabus is apparently not enough structure and that the students seem to need deadlines, classroom activities, and an authoritative instructor. Only 21% of the students expressed any satisfaction with the course (Goldman, '74).

Summary

There seem to be four goals for which individualization of instruction is prescribed: (1) To make instruction more effective and efficient, (2) To provide for the stability of the democracy by training people to be critical, analytical, and rational, (3) To prepare the

individual to adapt in a rapidly changing world through life-long independent study, and (4) To give the student freedom to choose his own goals and activities, as suggested by the democratic ethic.

Individuals differ far more than one would expect on every variable that might be measured. Many of these variables interact with the efficiency and effectiveness of instruction. Adapting the instruction to the learning style of the individual--his pace, his preference for reading or hearing, his method for sorting new information--should increase the total educational level of society as well as maximize individual accomplishment (Newsom, '72).

Anxiety has been found to affect student achievement, in increasing achievement for some and decreasing achievement for others. If an individual suffers test anxiety and takes a test that he considers important, he is likely to do poorly on the test. His performance will be improved if he takes tests frequently, of similar appearance, rather than taking a few highly important tests (Kirkland, '71).

Performance on highly complex tasks is less affected by test anxiety than performance on simple tasks, but becomes poorer as the task becomes more test-like (Carlson, '69).

Test anxiety is a persistent characteristic of students and increases with age and grade level (Kirkland,

'71). Academic failure in adults does not increase test anxiety (White, '66). Recitations in which students are actually called upon to respond increase test anxiety (Schultz, '72).

The need to avoid failure can lead low ability students to choose the most difficult courses and high ability students to choose the easiest courses. Success or failure, respectively, will then cause a switch to a course of the opposite extreme in difficulty (Isaacson, '64).

Authoritarian or dogmatic students prefer highly structured courses and authoritarian instructors, and achieve more in such courses than in less authoritarian, more individualized courses, but do less well in all types of courses than less dogmatic students (Weiss, '70).

Other personality variables interact with achievement. Socialization, achievement via conformity, flexibility, and femininity on the California Psychological Inventory correlate positively with achievement. Successful students are usually skeptical and hold liberal religious views. Less "mature" and less intelligent students are helped more by individualization than are mature intelligent students (Majer, '70).

Giving control of the learning situation to the learner, so that goals, instructional activities, sequencing, and diagnosis are done by the student,

increases achievement. In a sense, such methods increase the relevance of the course. However, problems of motivational readiness, maturity, and preparation appear frequently (Mager, '63).

Frequent claims are made that increasing course relevance increases achievement, although what seems relevant to the instructor is not frequently the relevance that students respond to. Lower ability white students are able to learn pairs of trigrams better if they seem "relevant" in the sense of seeming to be words (O'Leary, '71). Ehrlich predicted an interactive effect of major area and sex on the assumption that grades were more relevant to males, and more relevant in their majors than in their minors (Ehrlich, '71).

The typical program of individualization allows students to progress at their own rate through instructional modules. The modules contain statements of goals in terms of behavioral objectives, a study guide, practice exercises, and self-evaluative tests. The modules contain material that may be completed in one or two weeks. When the student feels ready, he takes an examination and chooses another module (Keller, '68). There are many such programs in operation, most of them producing achievement equal to or greater than achievement in traditional courses, and almost all of them producing better attitudes

toward the subject involved and studying in general (Sherman, '72).

The claims that individualized instruction makes courses more relevant and that increased perceived relevance increases achievement are widely made, but there seem to be no studies directed toward the question of whether perceived relevance in an individualized course does indeed increase achievement or is even associated with higher achievement.

CHAPTER THREE

DESIGN OF THE STUDY

The purpose of this study was stated in Chapter 1; to search for an association of course material, as perceived by the student, with student achievement in a self-paced course in physics. Secondary objectives of this study include a search for an association of perceived relevance with achievement in a traditionally taught course in physics and for interactive effects of perceived relevance and selected variables on both types of course.

In order to accomplish these purposes it was necessary to obtain access to a self-paced course in physics, a comparable traditional course in physics, a measure of perceived relevance, a measure or measures of course achievement, measures of the "other variables," and subjects from the two courses.

Finally, a procedure for handling the data had to be developed.

The interfering variables of sex, test anxiety, dogmatism, and aptitude as measured by the Michigan State University Reading Test were chosen as factors likely to have differential effects on achievement in a self-paced course for the following reasons:

(1) Self-pacing seems to be non-authoritarian and dogmatic personalities do not do well in non-authoritarian learning situations (Weiss, '70); (2) The negative effects of test anxiety seem to be reduced when the anxiety is spread over a course rather than concentrated at a few examinations, and when the student becomes familiar with the form of testing used (Kirkland, '71). In the self-paced section anxiety should be well spread out, since the student takes a great many tests. He may also retake tests as many times as he needs without negatively affecting his grade; (3) High aptitude students are likely to show a ceiling effect where a number of students earn the highest possible grades regardless of other factors; (4) Sex has a reputation for being an interfering variable (Desiderato, '69; Lin, '71; Kirkland, '71).

The Course

A service course offered by the Department of Physics at Michigan State University was taught in two sections: a traditional section and a self-paced section created by Jules Kovacs and Peter Signell. A questionnaire, to be described later in this section, was distributed in the beginning of the Winter quarter of 1974 to all students in the two sections, and scores on examinations and examinations test items were obtained from the instructors, for all students in the course.

The Traditional Section

The traditional section was a lecture recitation course, with two one hour lectures and three recitations a week.

The final grade in the traditional section was obtained from two midterm examinations consisting of four problems each, a final examination consisting of eight problems, and a grade provided by the recitation instructors.

Since the traditional section was given to two lecture groups, the midterms were given in two forms. The scores from these had to be converted to standard form for comparison. The problems were graded by recitation instructors on a partial credit basis. The maximum credit per problem on the midterms was 25 points. The maximum credit on final examination problems was 20 points.

Scores for each problem on each test were obtained for all members of the sample population shortly after the tests were graded, in order to form composite topic area scores.

The Self-Paced Section

The self-paced section began the quarter with one lecture, whose purpose was to introduce the students to the course procedure and to distribute a handbook describing the course.

Two rooms in the physics building were provided for the course. One was a study and help room, manned by graduate assistants, student consultants, and faculty. The second was a testing room.

The course in the self-paced section was organized into modules. Each module incorporated a study guide and a number of forms of a mastery test. The study guides included some instructional prose, references to study activities, practice problems, and a self-evaluative quiz. Students obtained copies of the study guide for the module of their choice in the study room, studied the material until they felt competent, then reported to the testing room for a mastery test.

The mastery test was evaluated immediately, in the presence of the student, by a more advanced student or by a graduate assistant. The grader could ask the student for clarification and could point out arithmetic errors for correction, but could not excuse errors in "real physics." If his performance on the mastery test demonstrated essentially total understanding, the student was awarded a grade of "excellent." Otherwise he was given a "not yet" and required to study at least one more day before being allowed to take another form of the test.

After receiving an "excellent," the student returned to the study room at his convenience to obtain the study guide for another module.

All tests taken were retained by the instructor. A record of the modules passed was kept for grading purposes and for display on a wall chart just outside the study room.

The material was only partially student self-selected. Certain modules were required, although some required modules could be bypassed by passing certain other required modules "up the line." Students were not allowed to retake a test for such a module until they had taken and passed the mastery tests for the modules they would have bypassed.

The basic required course material was divided into 12 modules, with additional modules available. The student had to pass all 12 modules or take a final examination. Passing the 12 modules resulted in a grade of 2.5. For each two additional modules passed, 0.5 was added to the grade.

If the student did not pass all of the required 12 modules a grade was determined from the number of modules he did pass. This grade was then adjusted according to the results of the final examination, as follows:

Final Examination Score	Resulting Change in Final Grade
0 $\leq$ final score < 20%	deduct 1.0
20% $\leq$ final score < 45%	deduct 0.5
45% $\leq$ final score < 90%	deduct 0.0
90% $\leq$ final score <100%	add 0.5

If a student's grade as determined by the number of modules passed was at least 2.0 at the end of the quarter, he was permitted to take an "incomplete" and improve his grade by passing additional modules during the first three weeks of the next quarter.

Students were warned at the beginning of the quarter that procrastination could easily lead to a failing grade. They were advised to establish and maintain a schedule for taking module tests.

Sample Population

The sample population was the group of students in the self-paced and traditional sections of Physics 288 at Michigan State University in the Winter quarter of 1974 who returned usable questionnaires.

One hundred and forty of 286 students in the traditional section and 41 of 104 students in the self-paced section returned usable questionnaires.

These groups included 23 engineering majors, 14 mechanical engineering majors, 11 civil engineering majors, 18 electrical engineering majors, 13 chemical engineering majors, 15 mathematics majors, 16 computer science majors, 10 chemistry majors, 5 physics majors, 2 geology majors, 2 mathematics education majors, 1 planetarium education major, 1 bio-med technician, 1 fish and wildlife major, 13 students in a premedical program (2 of

them in the self-paced section), 1 student in a pre-veterinary program, one in a pre-law program, and five with no major.

There were 8 females and 27 males in the self-paced section and 15 females and 111 males in the traditional section that completed usable questionnaires and did not drop out of the course.

Other demographic data is illustrated in Table 3.1.

Nearly 25 percent of the sample population in the self-paced section is female, while only 13.5 percent of the sample population in the traditional section is female. Otherwise the sample population is typically single sophomores and juniors between 19 and 22 years old from the midwest and northeast sections of the United States. They come from cities of all sizes, with the largest number coming from cities with populations between 10,000 and 50,000.

One student (in 35) in the self-paced section said he felt he would do better in a lecture-recitation course, while 10 of 126 students in the traditional section said they felt they would do better in a self-paced course. Four students in the self-paced section and 28 students in the traditional section did not answer this question.

Two of the 35 students in the self-paced section chose the self-paced section because of scheduling problems or other problems not related to the differences

Table 3.1.--Demographic data.

	Self-Paced		Traditional	
	Male	Female	Male	Female
AGE				
15-18	1	2	3	1
19-22	25	6	97	13
23-26	1	0	7	1
27-30	0	0	2	0
Over 30	0	0	1	0
MARITAL STATUS				
Single	26	8	101	14
Married	1	0	9	1
LEVEL				
Freshman	0	1	2	1
Sophomore	16	4	79	9
Junior	11	2	25	3
Senior	0	1	3	1
Graduate	0	0	1	0
GEOGRAPHICAL ORIGIN				
Northwest	0	0	3	0
Southwest	0	0	0	0
Midwest	22	5	83	11
Northeast	4	3	19	3
Southeast	0	0	3	0
HOMETOWN SIZE				
Country	2	1	19	2
City of population:				
0-10,000	8	1	19	3
10,000-50,000	8	3	31	2
50,000-250,000	6	2	20	2
Over 250,000	3	1	18	5

Table 3.1.--Continued

	Self-Paced		Traditional	
	Male	Female	Male	Female
WORK EXPERIENCE				
Laborer	7	0	46	3
Clerical worker	1	0	6	1
Skilled trades	3	0	13	0
Professional	3	0	13	1
Less than 6 months	13	8	30	10

between the self-paced and traditional methods of instruction, while 24 of the 126 students in the traditional section chose the traditional section because of problems unrelated to the differences between the self-paced and traditional methods of instruction. Seventy-two of the 126 students in the traditional section chose the traditional section over the self-paced section deliberately.

Twenty-seven of 33 students in the self-paced section (two did not respond) chose the self-paced section mainly or totally because of a strong personal preference for self-paced courses. Only 20 students chose the self-paced course because they felt that they would do better in a self-paced course, although 30 of the 35 students did express the feeling that they would do better in a self-paced than in a traditional course.

Forty-seven of 105 students in the traditional section chose the traditional course mainly or totally

because of a strong personal preference for lecture-recitation courses over self-paced courses, while 29 said that their preferences had nothing to do with their choice or that they did not prefer the traditional course.

Sixty-four of the 105 students in the traditional section that responded to this question chose the traditional section mainly or totally because they felt they would do better in the traditional section. Again, more students felt they would do better in the course they chose than chose the course for that reason, when selecting between self-paced and traditional sections of the same course.

Six students in the self-paced section and 14 students in the traditional section, of the initial sample population, dropped out of the course before the end of the quarter, leaving a sample population of 35 students in the self-paced section and 126 students in the traditional section of the course.

Measures of Course Achievement

The final course grade was used as one measure of course achievement in both sections. Other measures of achievement were obtained by classifying examination test items in the traditional section and modules in the self-paced section into the following topic areas:

(1) Thermodynamics and statistical mechanics
(2) Gravity
(3) The electrostatic interaction
(4) The magnetic interaction
(5) Gauss's Law
(6) Ampere's Law
(7) Faraday's Law

Achievement in the Traditional Section

Copies of the midterm and final examinations in the traditional section were obtained after each exam and the test items classified into the topic areas. Each test problem was classified into only one topic area, except for problem seven on the final examination, which was classified into topics three, four, five, six, and seven.

There were two forms of each of the midterm examinations, one for each lecture group. The means and standard deviations of scores on corresponding items on the two forms were not the same. In order to combine these scores, all scores were converted to standard scores with a mean of 40 and a standard deviation of 10. Then the mean of standard scores of examination items classified into each topic was found, yielding a score in each of seven topic areas for each student in the sample population.

Achievement in the Self-Paced Section

Module tests in the self-paced section were graded only "excellent" or "not yet." Regrading a sample of these tests on a 25 point partial credit basis resulted, almost exclusively, in very high scores or very low scores, corresponding to the "excellent" or "not yet" grades. Therefore only the "excellent" and "not yet" grades were used in the study.

The number of times a student had to retake a test of a required module was taken as one measure of achievement in the self-paced section. Each module score was added into one of the five required topic areas.

Another measure of achievement was the number of modules passed in excess of requirements in each topic area. If the student selected modules that he believed were relevant to his goals, this measure would be expected to yield a high correlation with perceived relevance.

Aptitude

One of the "other variables" chosen for this study was aptitude as measured by the Michigan State University Reading Test. The MSU Reading Test and the MSU Arithmetic Test are administered to entering freshmen and transfer students at Michigan State University. These two scores were obtained for most students in the sample population

from the Office of Evaluation Services, Michigan State University.

The MSU Reading Test, Form A, '63, is a fifty item test. The median score of entering freshmen in 1971 was 31.8 and in 1972 was 30.5, for roughly 6500 freshmen in each case. In 1973 the test was shortened and administered to 7947 freshmen and transfer students, and the Kuder-Richardson #20 reliability calculated. The reliability was .84.

The MSU Arithmetic Test is a 70 item test. The median scores of roughly 6500 students in 1971, 1972, and 1973 were: 50.7, 49.0, and 48.3. In 1973 the Kuder-Richardson #20 reliability was calculated for this test and found to be .92.

The Rokeach Dogmatism Scale

A second variable chosen for the study was a personality characteristic that Rokeach called dogmatism. The Dogmatism Scale is a measure of close-mindedness or extremism and has been found to correlate with authoritarianism, political conservatism, and low achievement (Rokeach, '60; Costin, '65).

The Sarason True-False Test Anxiety Scale

The True-False Test Anxiety Scale was first written by Sarason as one scale of a questionnaire designed to test susceptibility to verbal conditioning

Table 3.2.--The Rokeach Dogmatism Scale.

Population

Michigan State University psychology students
Ohio State University students
New York University students
Brooklin College students
Purdue University students
Patients in New York Veterans Administration domiciliary

Reliability

No. cases	r	Mean score	SD	
22	.85	142.6	27.6	
28	.74	143.8	22.1	
21	.74	142.6	23.3	Ohio State University
29	.68	141.5	27.8	
58	.71	141.3	28.2	
89	.78	143.2	27.9	Michigan State University

Scoring

Testees respond to each of 40 statements by writing one of the numbers -3, -2, -1, 1, 2, or 3, indicating strong disagreement to strong agreement. Their score is found by adding 120 to the sum of their responses.

(Sarason, '59). Twenty-one items were obtained by re-writing items from the Mandler-Sarason Test Anxiety Questionnaire.

In 1961 Sarason eliminated four of the items to obtain a test anxiety scale for use in examining the relationship between test anxiety and thirteen measures of achievement:

	Correlation coefficient for: 326 males	412 females
High school English	-.09	-.12
High school mathematics average	-.18	-.12
High school foreign language average	-.09	-.14
High school social studies average	-.17	-.13
High school natural science average	-.15	-.19
High school elective average	-.14	-.06
Guilford-Zimmerman Aptitude Survey: verbal score	-.23	-.22
mechanical score	-.13	-.08
Cooperative English Usage	-.27	-.25
Cooperative English Spelling	-.18	-.16
Cooperative Mathematics I	-.13	-.21
Cooperative Social Studies II	-.28	-.29
1948 ACE Q score	-.30	-.18

Correlations in the first column that are less than -.133 and correlations in the second column that are less than -.098 are significant at the .05 level. The correlations were significant at the .05 level for 11 of the 13 measures (Sarason, '61).

The Test Anxiety Scale (TAS) contains 16 statements. The student or subject is asked to describe each statement as "mostly true" or "mostly false" about

himself. The test is scored as "0" for false and "1" for true, except for two statements.

Swinn found a test-retest reliability for the TAS of .78 (Swinn, '69).

The Relevance Scale

The relevance scale was a simple list of descriptions of the seven topic areas. The subject was asked to read each description and to rate the relevance of each topic to his career goals. Relevance was defined as usefulness in the practicing of the student's future profession or necessary to learning or understanding something useful in his future profession. The subject was asked to indicate "totally irrelevant" by writing "1," "extremely relevant" by writing "5," and intermediate levels of relevance by writing "2," "3," or "4."

A total relevance score was obtained by adding the seven topic relevance scores.

The Questionnaire

The Rokeach Dogmatism Scale, the Sarason Test Anxiety Scale, and the Relevance Scale were bound in a questionnaire with questions regarding sex, age, marital status, academic program, academic level, geographic origin, home town size, work experience, and reasons for selecting the traditional or self-paced option.

Copies of this questionnaire were distributed in the first lecture of the traditional section and in the testing room of the self-paced section for the first two weeks of the quarter.

After two weeks, 88 of the 286 students in the traditional section and 25 of the 104 students in the self-paced section had returned usable questionnaires.

Questionnaires were distributed in the recitation classes of the traditional section in the third week of the winter quarter, and collected before the end of the class meeting. Thirty-three usable questionnaires were collected.

During the third week, students in the self-paced section were asked to complete and return the questionnaire before leaving the testing room. Thirteen usable questionnaires were collected.

During the fourth week of the quarter, short form versions of the questionnaire were delivered to the local addresses of students who still had not returned completed questionnaires. Nineteen of these questionnaires were returned among the traditional course students and three among the self-paced students. The short form questionnaire did not contain the Dogmatism Scale or the Test Anxiety Scale.

The total return rates were:

48.95% traditional,
39.42% self-paced.

Among these students who returned usable questionnaires six in the self-paced and 14 in the traditional section dropped out of the course before the end of the quarter. These numbers were proportionate to the total dropout rate in the two sections of the course.

Statistics

Because of the size of the sample and the lack of identical achievement measures in the two sections, traditional and self-paced, the Office of Research Consultation of the School of Education, Michigan State University, recommended the use of only a few interfering variables and the use of simple correlations within groups including at least six subjects. Scattergrams were highly recommended.

Null Hypothesis

(1) The correlation between perceived relevance of the course and final course grades will be negative or zero, within each of the two methods of instruction, traditional and self-paced, and among subgroups differentiated by sex, MSU Reading score, test anxiety, and dogmatism.

(2) The correlation between the perceived relevance of topic areas in physics and scores on test items in each topic area will be negative or zero, in each topic area within each method of instruction, and among subgroups

differentiated by sex, MSU Reading score, test anxiety, and dogmatism.

(3) The number obtained for the correlation coefficient in the self-paced section will be less than or equal to the corresponding number in the traditional section, for each correlation coefficient calculated for hypothesis one and two.

(4) The grade distribution in the self-paced section will not be skewed with the majority of students earning high grades.

(5) The mean final grade in the self-paced section will be equal to or lower than the mean final grade in the traditional section.

(6) There will be no differences in final grades among groups differentiated by sex, MSU Reading score, test anxiety, and dogmatism, in the two course types.

A computer program was written to select subjects belonging to specified groups. The selection was based on: traditional or self-paced, male or female, high or low dogmatism, high or low test anxious, and high or low aptitude.

High and low categories of each of dogmatism, test anxiety, and aptitude were defined as above or below the median scores of the respective variables of the self-paced students who returned usable questionnaires.

The correlation coefficients and the mean final grade for each group will be calculated and reported. The correlation coefficients will be for: final grade and total relevance, and the seven pairs of topic achievement scores and topic relevance scores.

The correlation coefficients will be converted using the Fisher R to Z transformation and the level at which the Z scores would be different from zero will be reported (hypothesis one and two). The differences in Z scores will be calculated and the level at which these would be significant will be reported (hypothesis three).

The grade distribution in the self-paced section was not expected to be normal. Final grade distributions in this course, created by Kovacs and Signell in 1971, have been skewed in every quarter since its inception. It will be illustrated graphically.

The grades in the traditional section are expected to conform to a normal curve. Differences in grades between subgroups in the traditional section will be examined by planned comparisons. The directions of differences within the self-paced group will be compared to differences in the traditional section for lack of any valid method of comparison. Comparisons between identical subgroups of the two sections will be made by treating the mean subgroup grade in the self-paced section as a

fixed number and examining the mean subgroup grade in the traditional section for differences from that number.

The Within-Line Correlation

A "line" is all the data on one subject. A correlation coefficient of achievement with perceived relevance on the seven topics will be calculated for each subject.

The perceived relevance scores are individualistic in the sense that one subject's highest relevance score might be "3" and yet correspond to another subject's "5." The within-line correlation will indicate whether the subject's achievement correlates with his own relevance scale.

The raw achievement scores data on each of the seven topics are essentially on different scales. The data for the traditional section had been converted to standard scores for other reasons. The achievement scores in the topics in the self-paced section will be converted to standard scores for use in calculating the within-line correlation.

Summary

A questionnaire containing copies of the Rokeach Dogmatism Scale (Rokeach, '60), Sarason's Test Anxiety Scale (Sarason, '71), a relevance scale, and questions concerning demographic data was distributed to the 286

students in the traditional section of an introductory physics course and the 104 students of the self-paced section of the same course. Usable questionnaires were returned by 41 of the students in the self-paced section and 140 students in the traditional section, some lacking the Dogmatism Scale and/or the Test Anxiety Scale.

Examination test items scores were obtained for each item in each of the two forms of the two four item midterm examinations and an eight item final examination. These scores were converted to standard scores with means of 40 and standard deviations of 10. Test items were classified into seven topic areas and a mean score in each topic area calculated for each student.

Modules in the self-paced section of the course were classified into the seven topic areas. The number of modules passed beyond requirements in each topic was used as a measure of achievement. A second measure of achievement was obtained from the number of "not yets" in required modules in each topic.

Final course grades were used as a measure of achievement in both sections.

The relevance scale consisted of a description of the seven topic areas and directions to rate each topic on a five point scale from totally irrelevant to extremely relevant. Relevance was defined as usefulness in the

student's intended career. A total relevance score will be obtained by adding the seven topic relevance scores.

Correlation coefficients will be calculated between final grade and total relevance, and between topic achievement mean scores and topic relevance scores in each of the seven topics, for each of the two sections and for subgroups within them determined by sex, aptitude, dogmatism, and test anxiety. These will be converted by the Fisher R to Z transformation and examined for differences from zero and from one another.

On advice of the Office of Research Consultation, MSU School of Education, correlation coefficients will be used and analysis of variance will not be used in the self-paced section.

A correlation of perceived relevance with achievement through the seven topic areas will be calculated for each student and the mean correlations so obtained will be reported.

CHAPTER FOUR

ANALYSIS OF THE DATA

In Chapter Four scattergrams for each of the groups determined by sex, dogmatism, test anxiety, MSU Reading score, and MSU Mathematics score are presented and briefly commented on. The distribution of final grades in the self-paced course among members of the sample population is illustrated and described, and the distribution in each sub-group is described briefly.

The correlations for each of the traditional and self-paced achievement measures with the measure of perceived relevance, for the total course and each of the topic areas, are illustrated and described and their significance levels are reported. The mean within-line correlation and the mean grade and its standard deviation are also illustrated. Differences between correlations in the traditional and the self-paced sections are reported for the total course and for each topic area.

An analysis of variance for the course grades in the traditional section is reported, followed by planned comparisons between groups. Differences between mean grades in the traditional section and the self-paced section in each group are reported.

Scattergrams

Scattergrams for each group that includes at least six members in the self-paced section are illustrated on the following pages. The seven topic areas and the total course are each represented for the traditional section and for each of the achievement measures in the self-paced section. There are 19 scattergrams on each page, each page representing one group or sub-group.

The horizontal scales are relevance scales while the vertical scales are achievement scales. "SPTWO" refers to the second achievement measure in the self-paced section. The course grade relevance scale shows the numbers 7, 14, 21, 28, and 35, for values equal to or less than these numbers.

The scattergrams for the total course in the self-paced section show an arrow-like appearance. There is a double ceiling effect in that several students earned 4.0 grades no matter what they said about relevance and several others give the course the highest possible relevance rating while earning a variety of grades. There remains a group whose scores fall near a straight line rising from low to high grades with increasing relevance scores. The points near the straight line almost disappear among low dogmatic subjects, reappearing in the high dogmatic group. They also disappear in the high mathematics and reading aptitude subjects. There are no

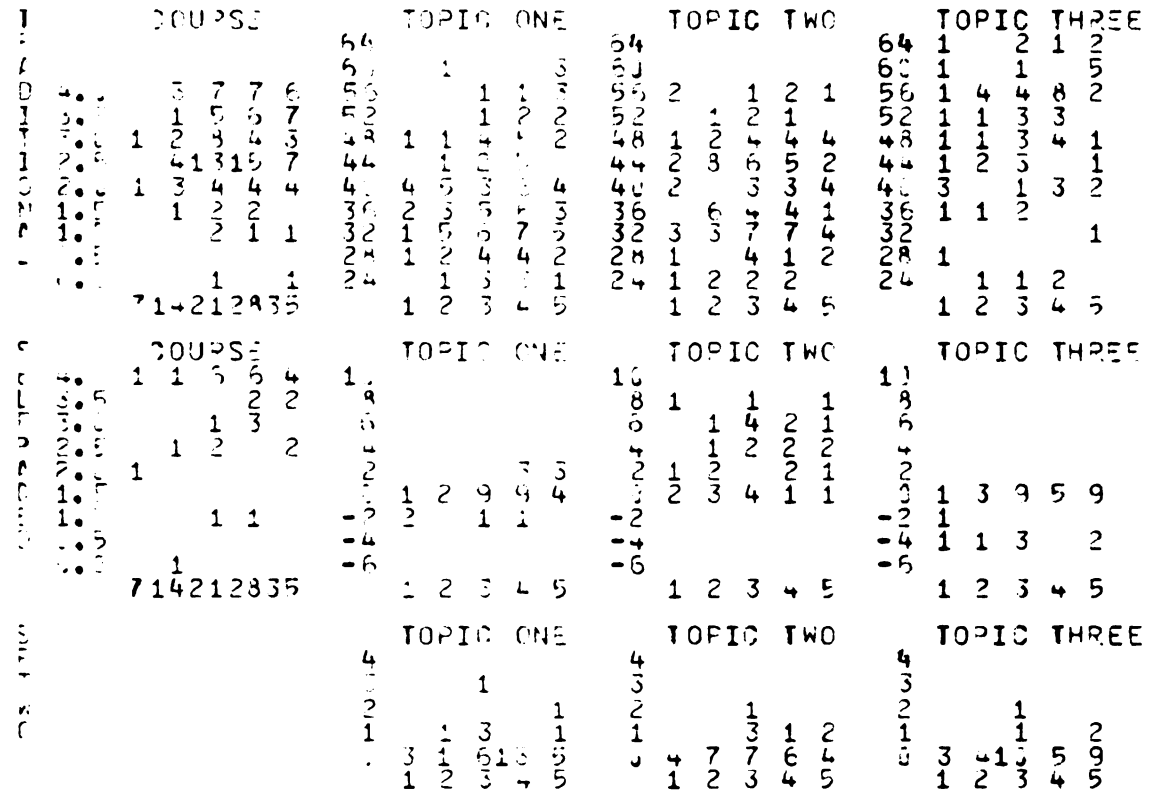
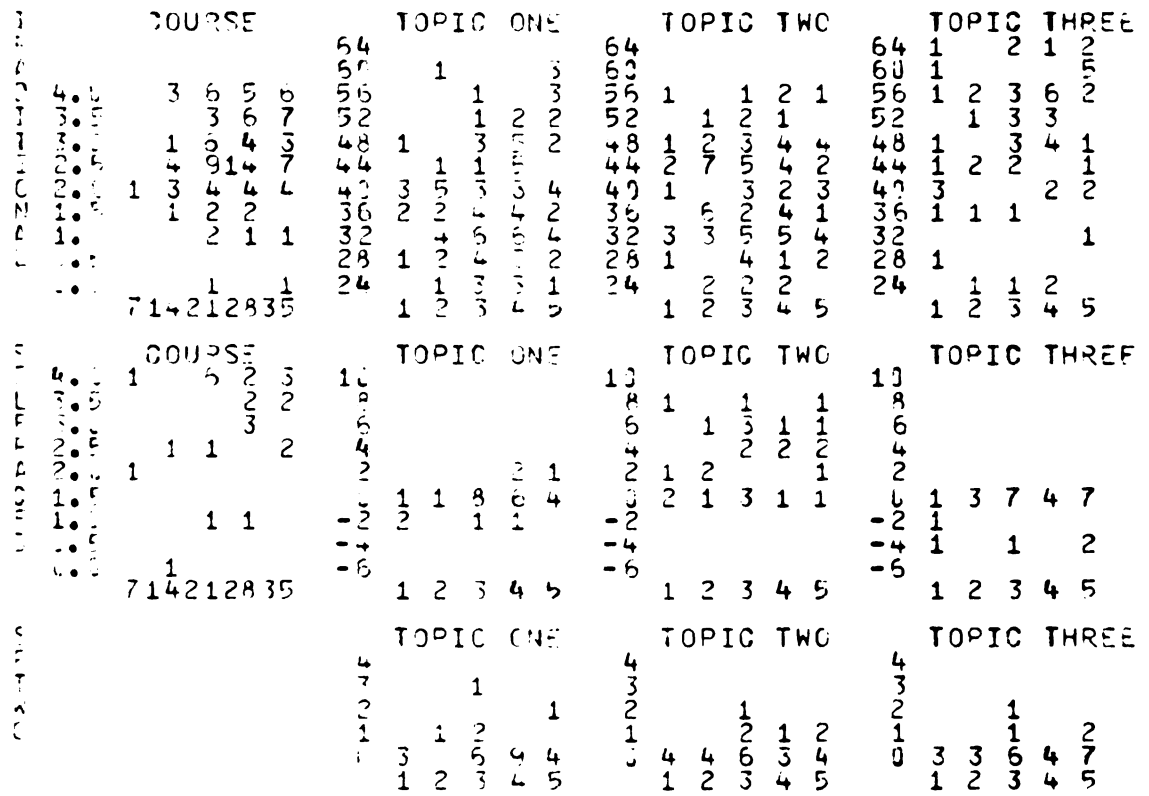


TABLE 4-1A

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG ALL STUDENTS



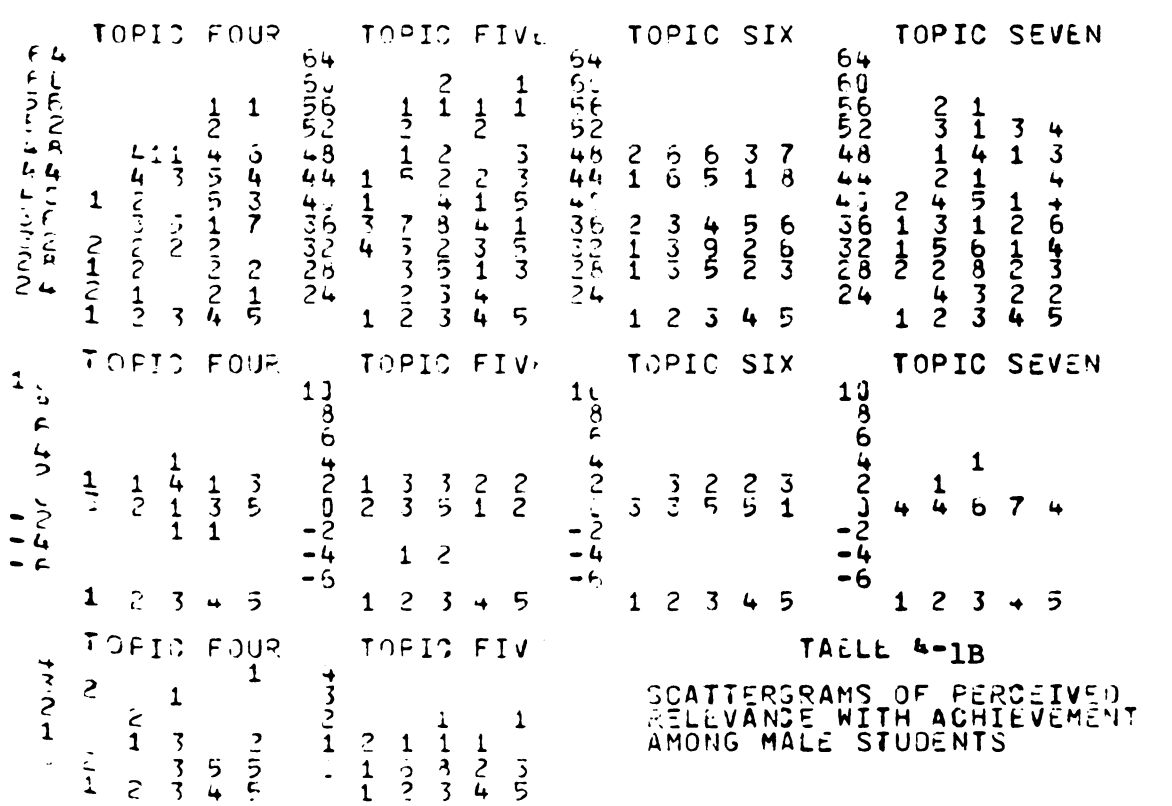
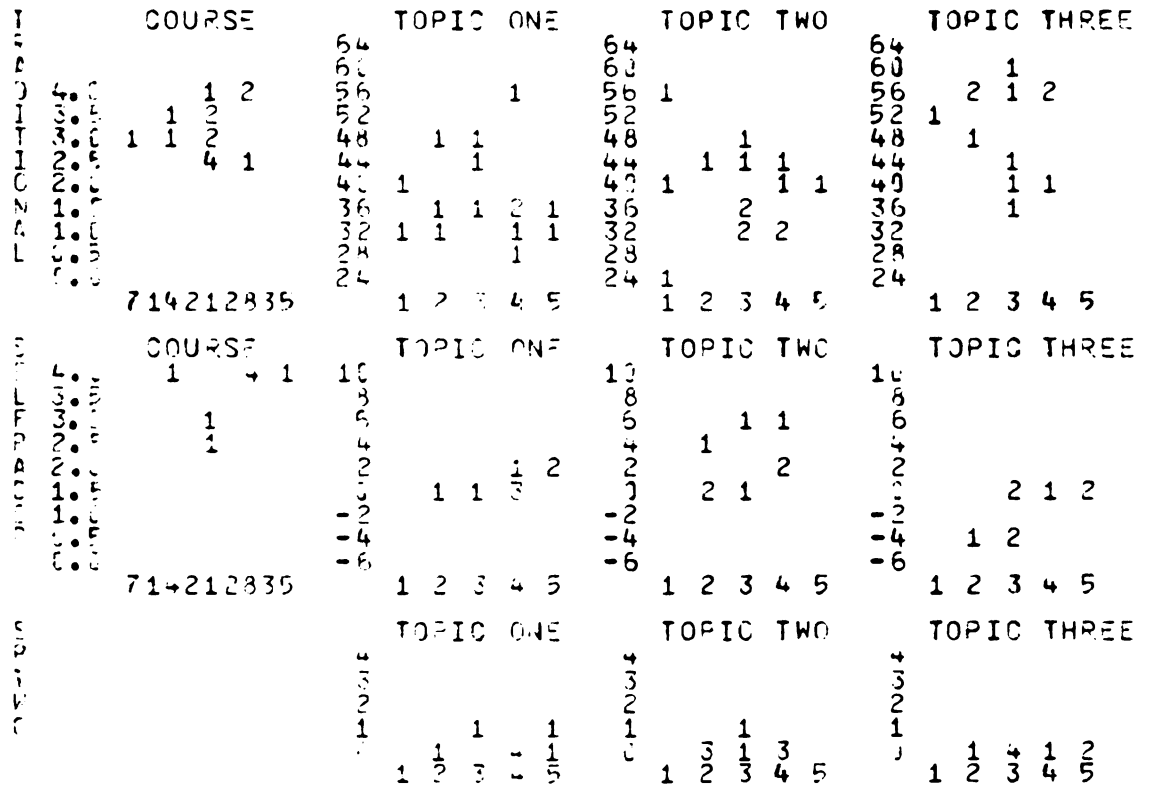


TABLE 4-1B

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG MALE STUDENTS



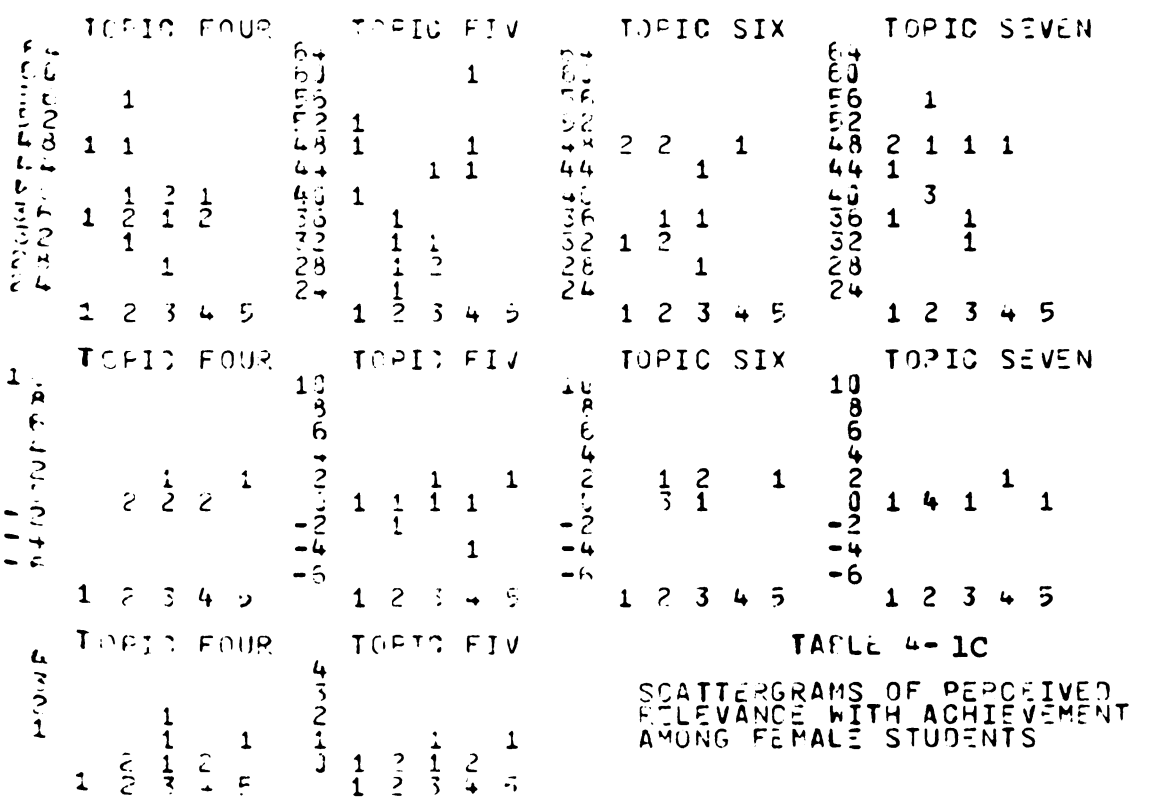
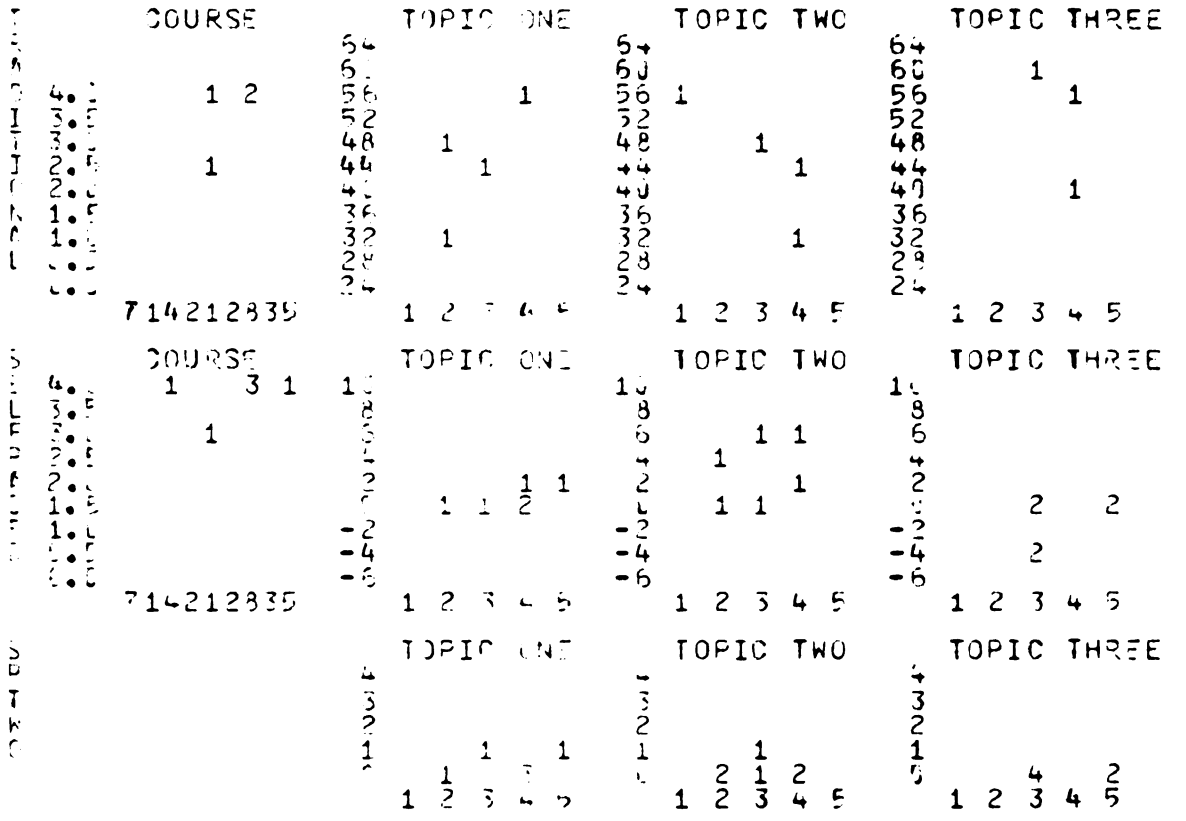
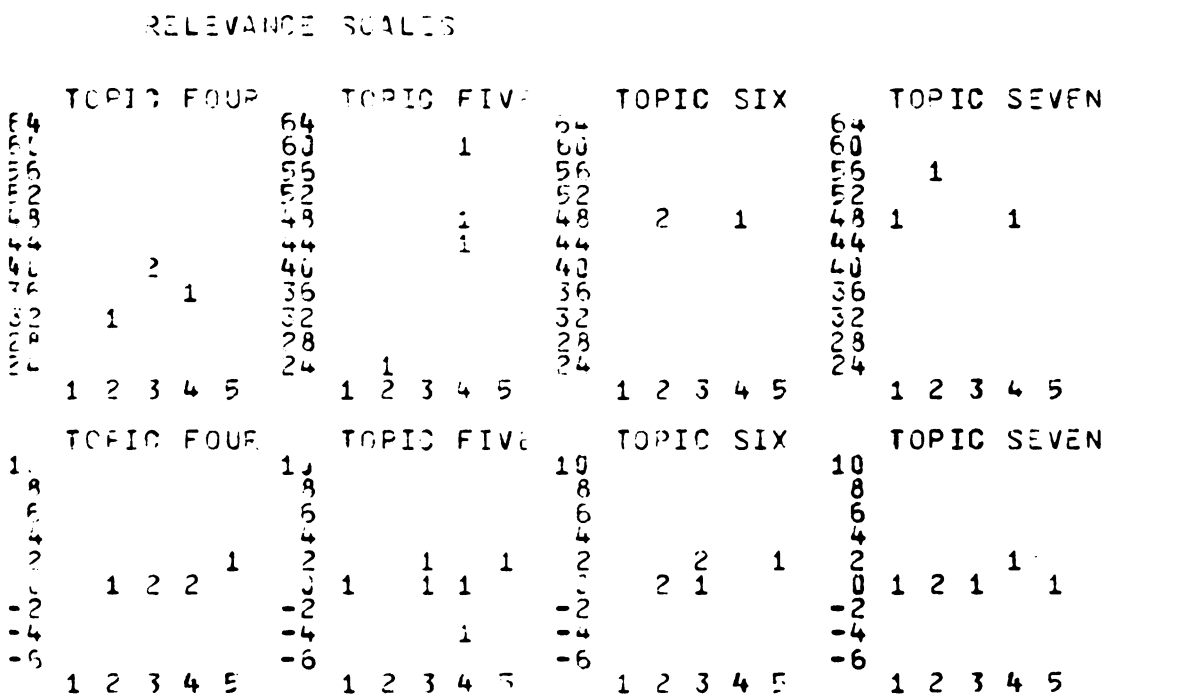


TABLE 4-1C

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG FEMALE STUDENTS





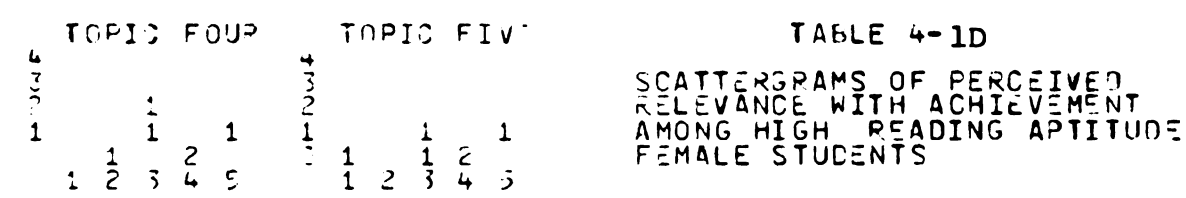


TABLE 4-1D

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH READING APTITUDE FEMALE STUDENTS

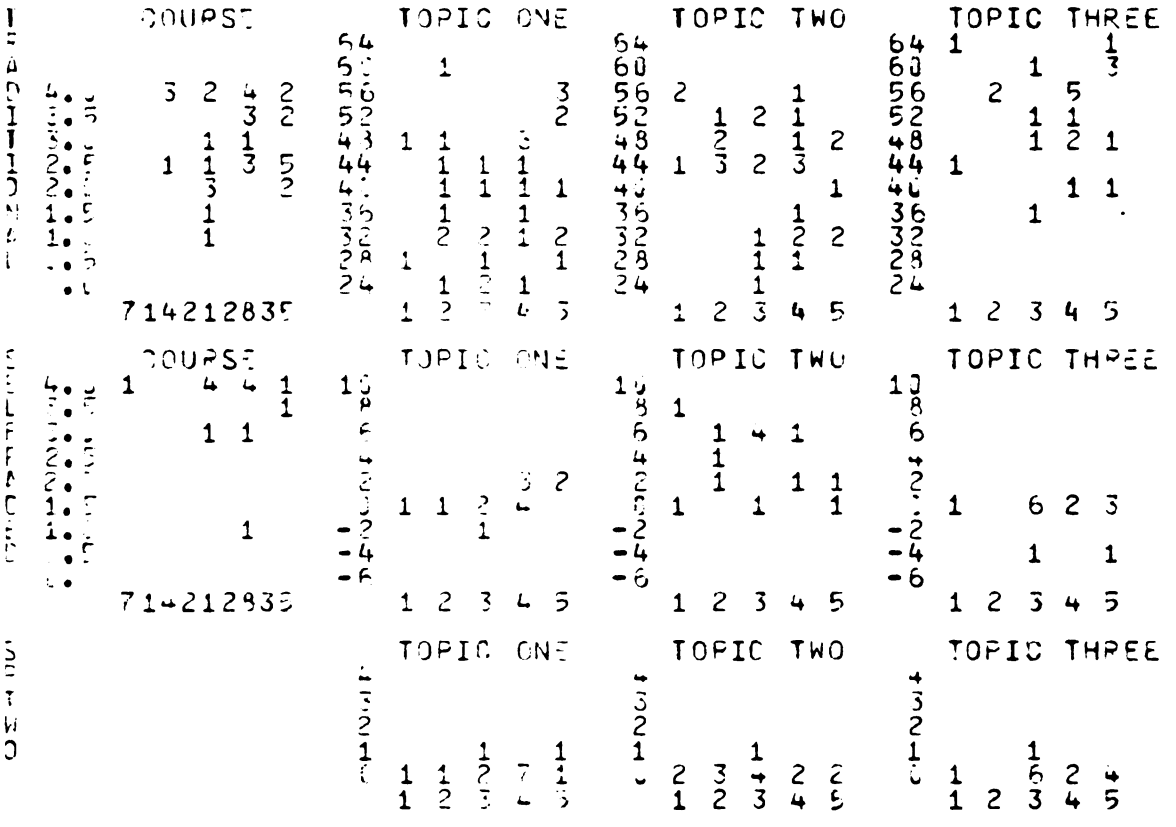
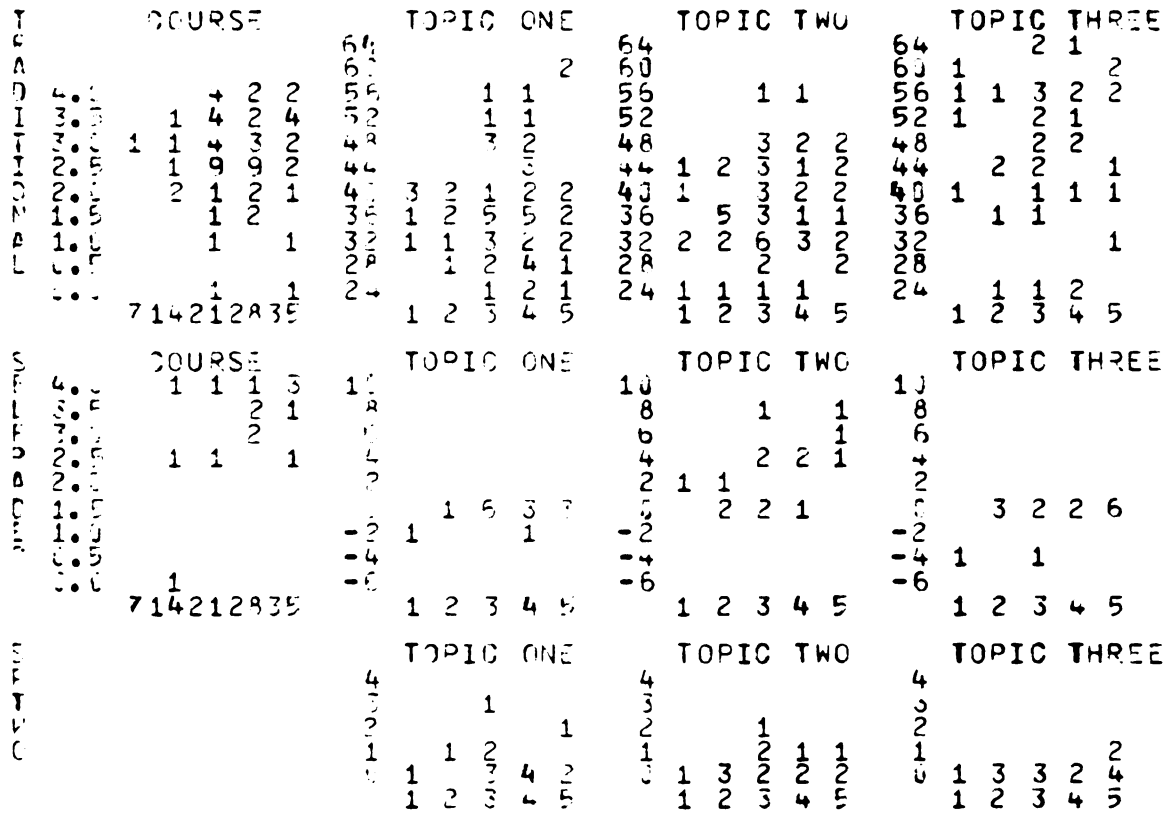


TABLE 4-1E

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH MATH APTITUDE STUDENTS



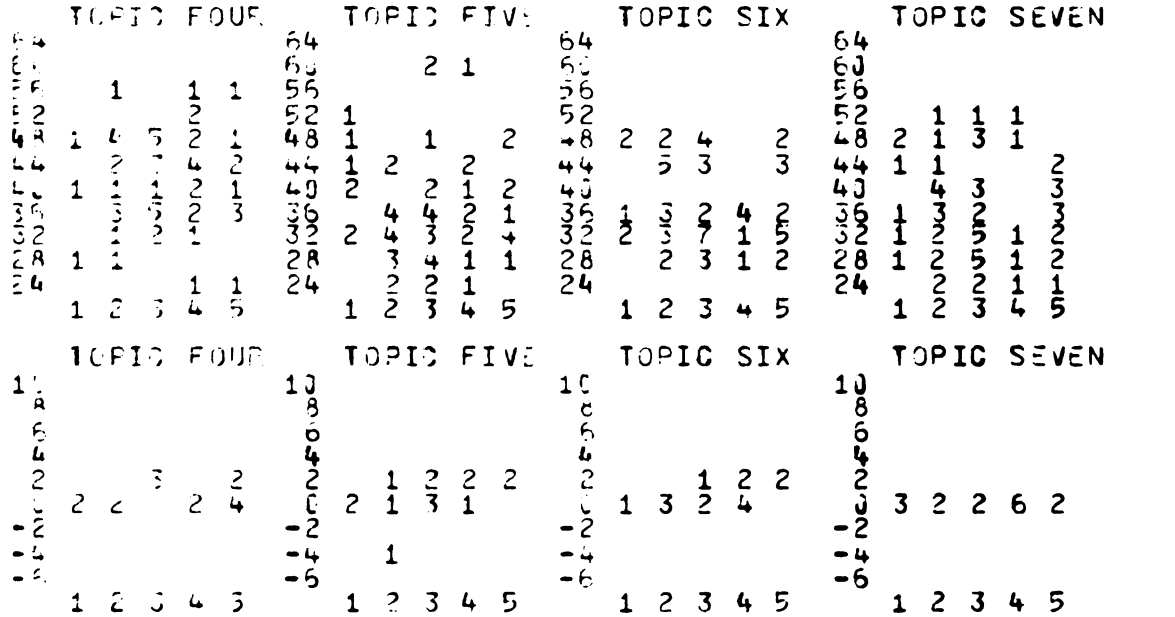


TABLE 4-1F

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW MATH APTITUDE STUDENTS

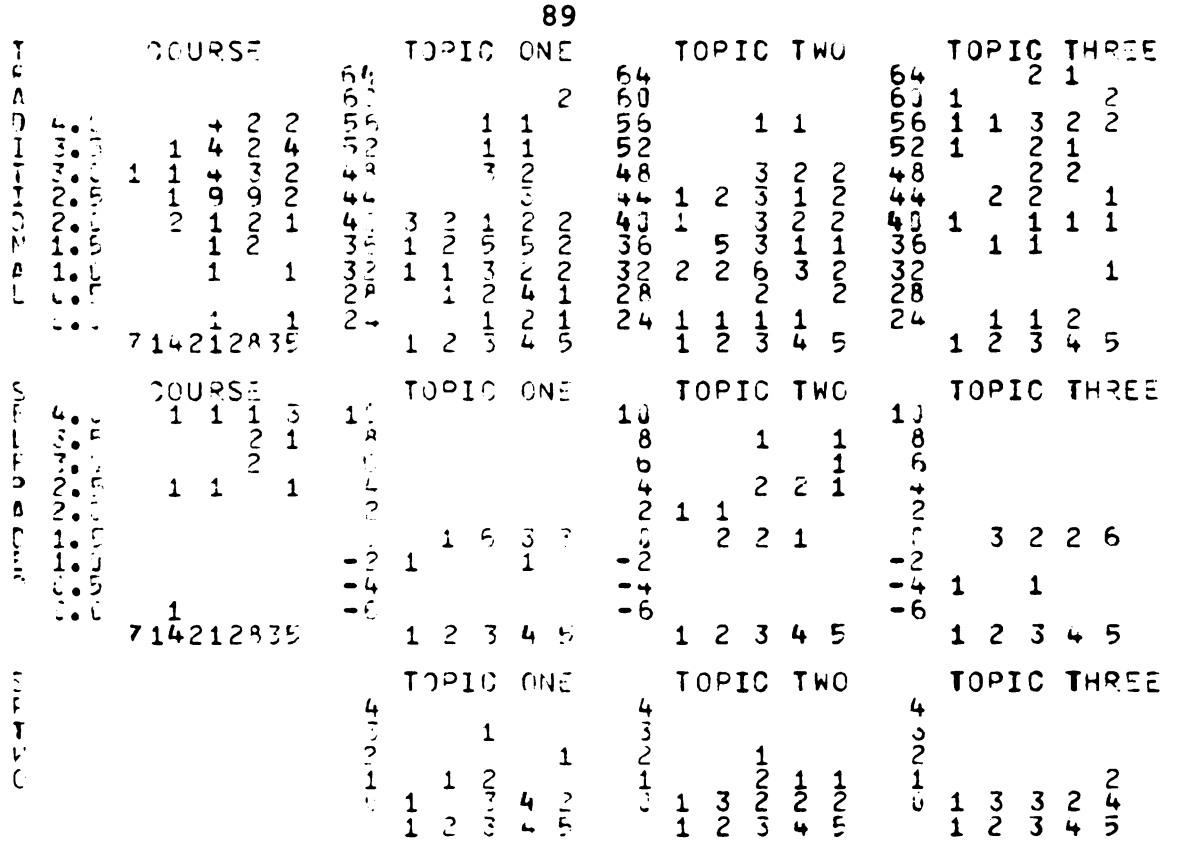
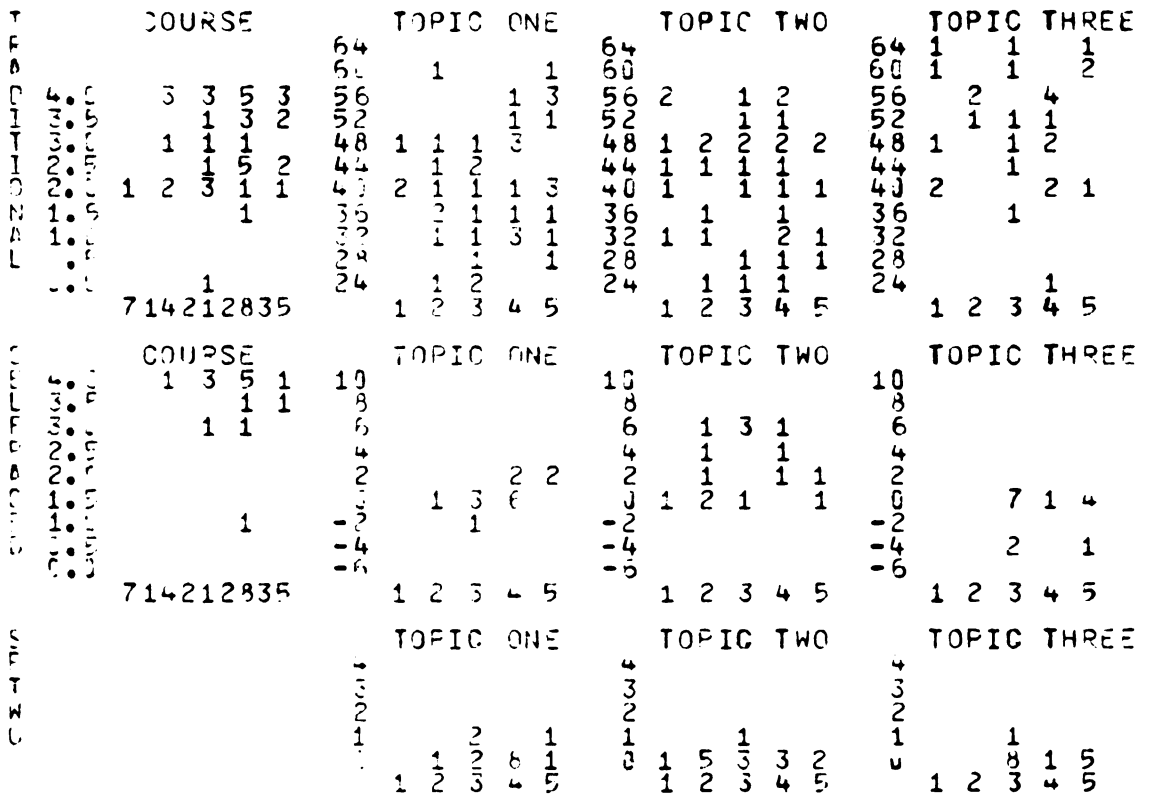
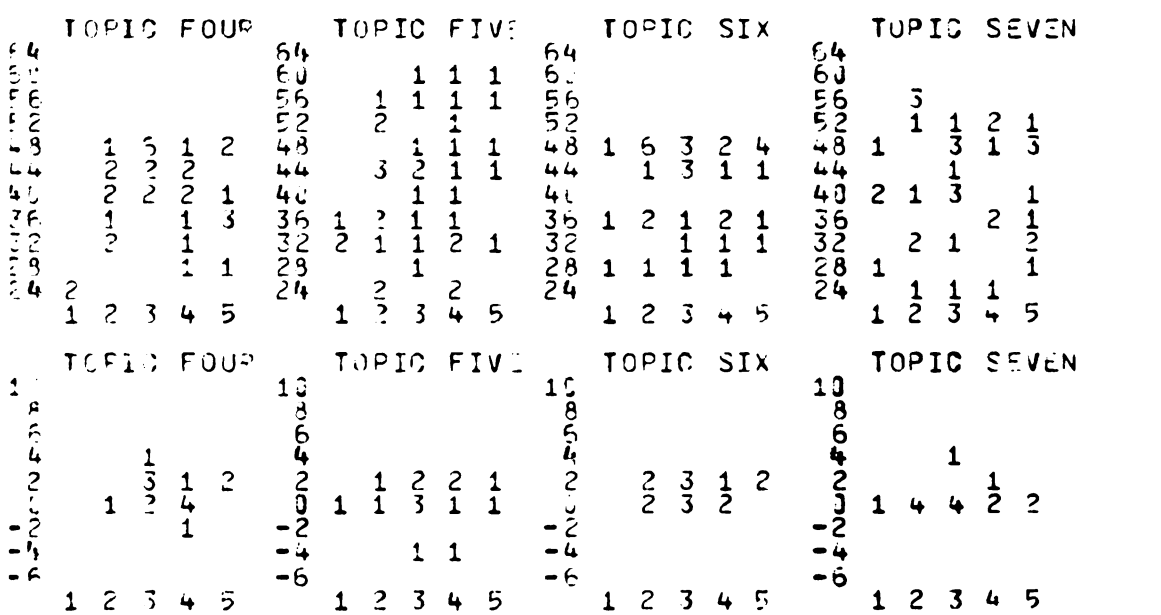


TABLE 4-1F

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW MATH APTITUDE STUDENTS





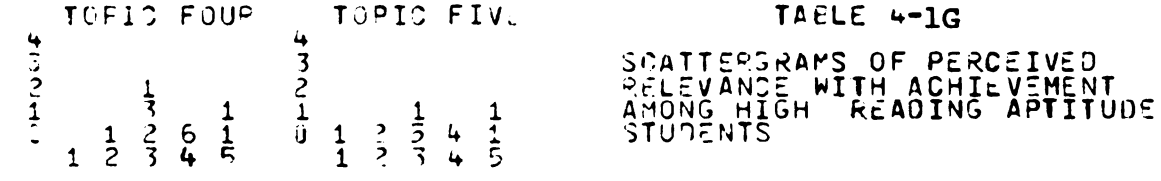
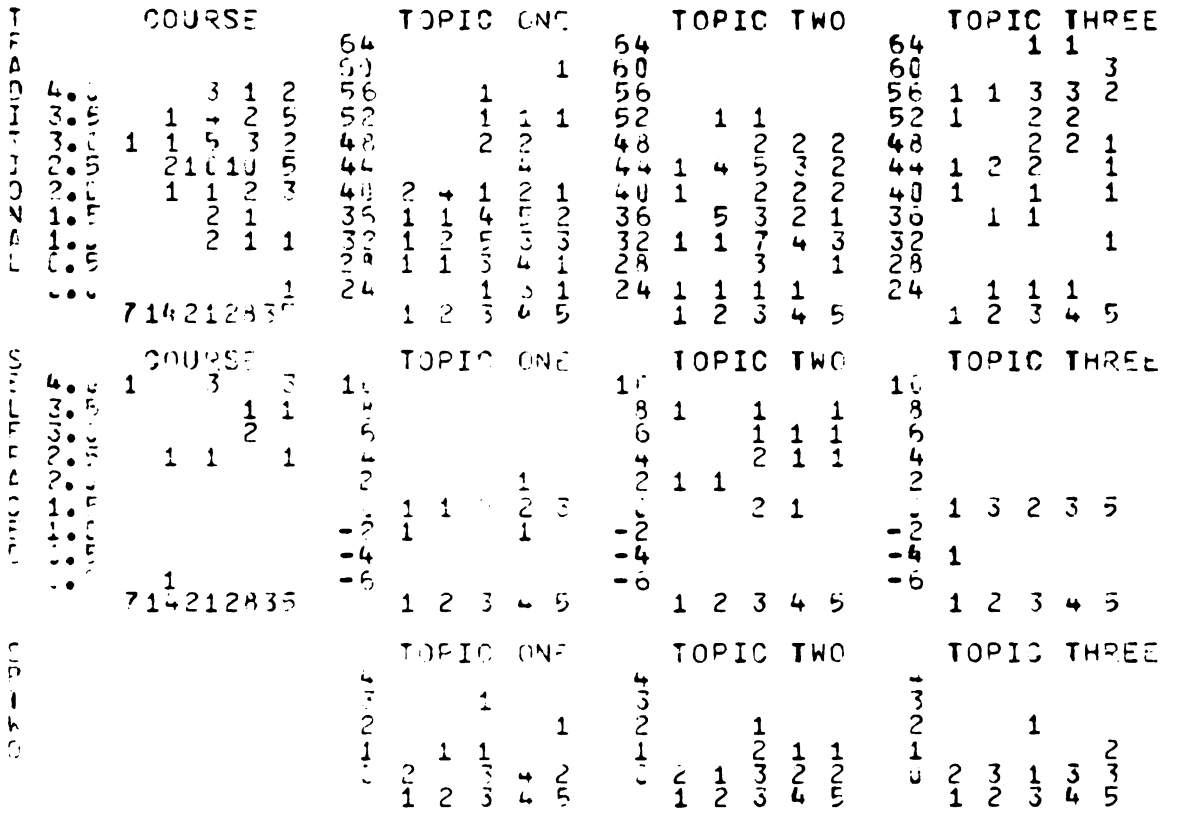


TABLE 4-1G

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH READING APTITUDE STUDENTS



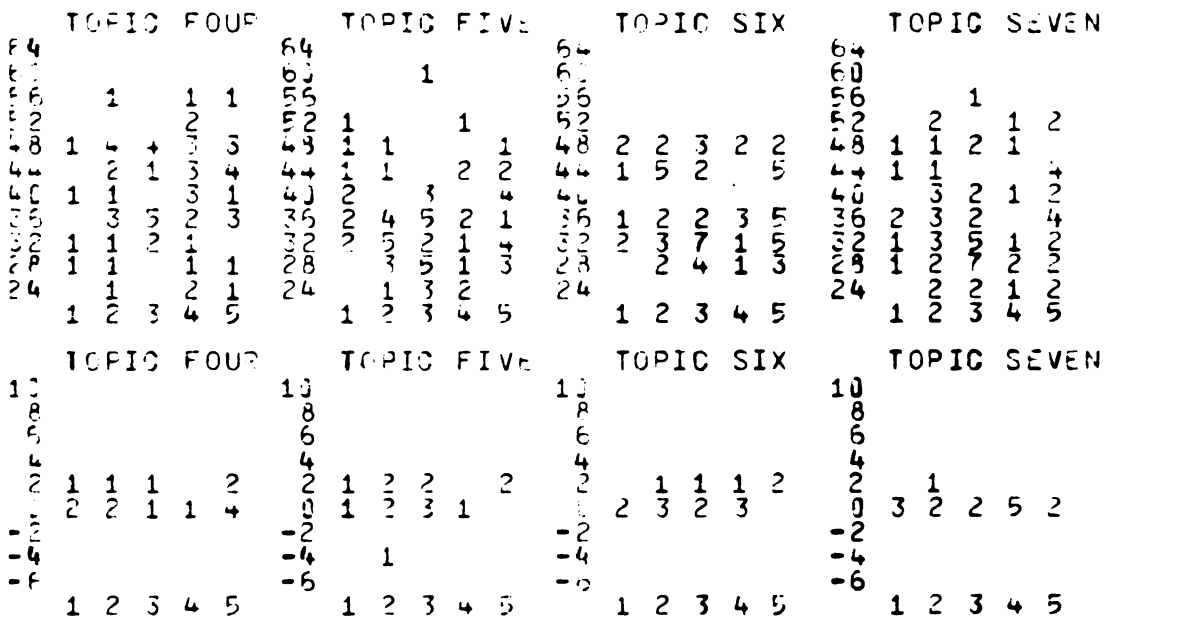
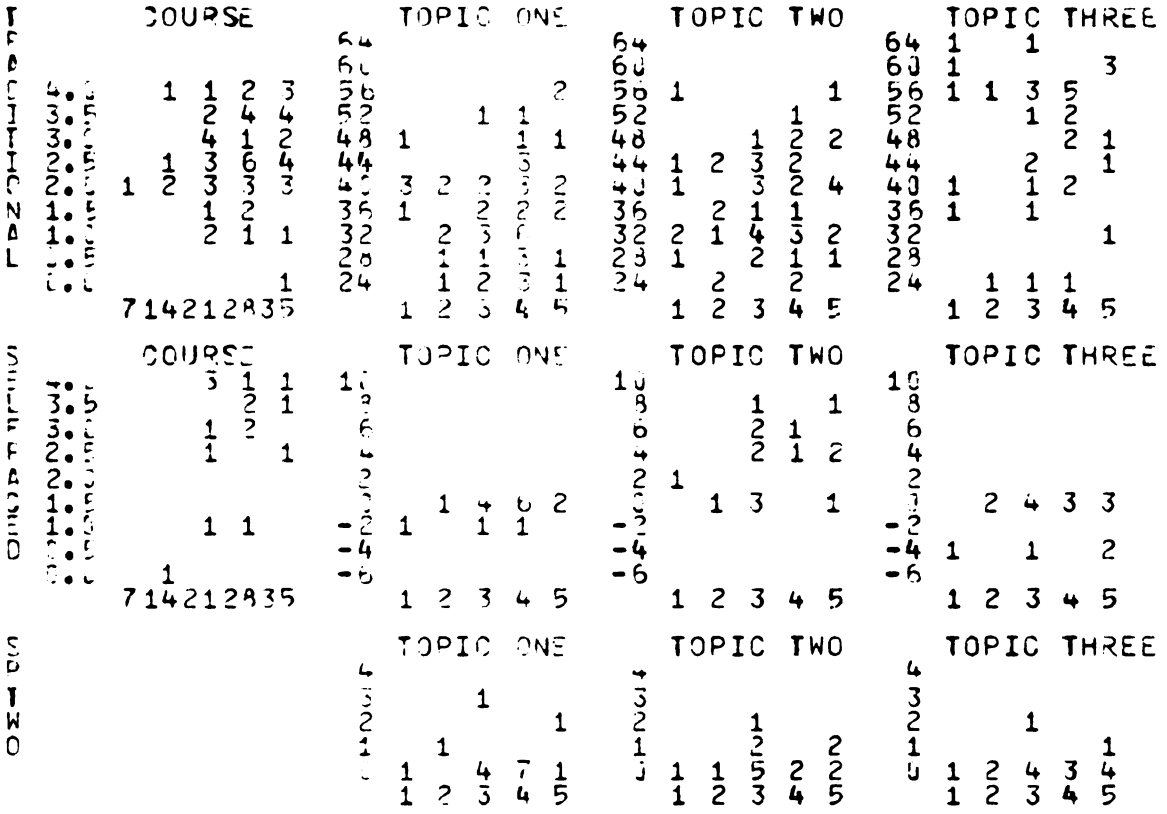
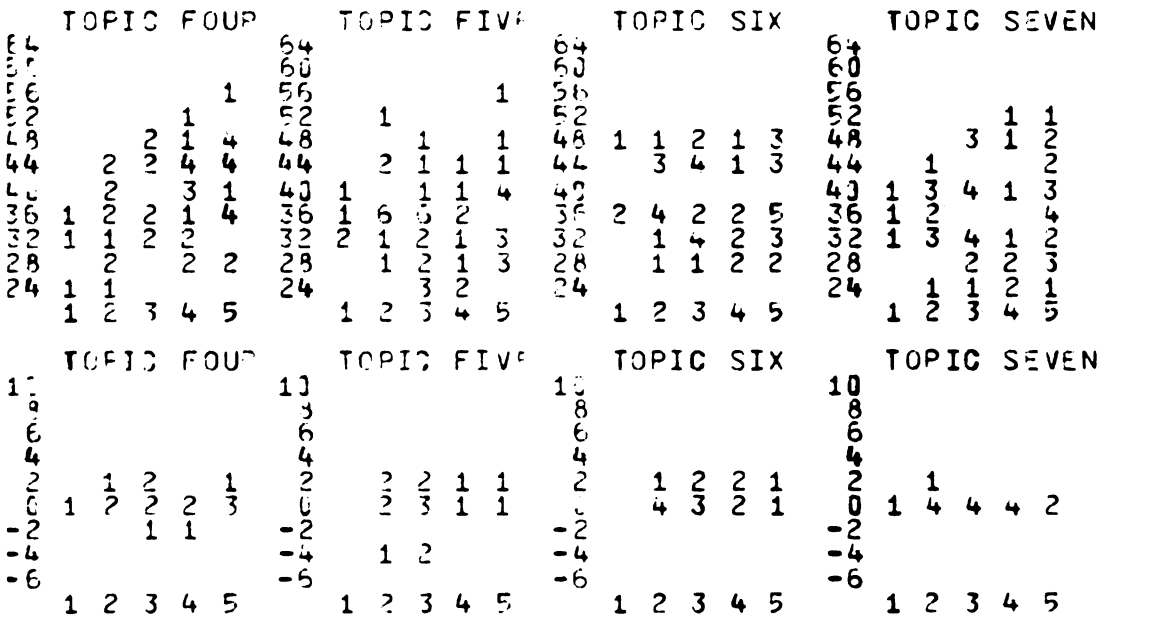


TABLE 4-1H

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW READING APTITUDE STUDENTS





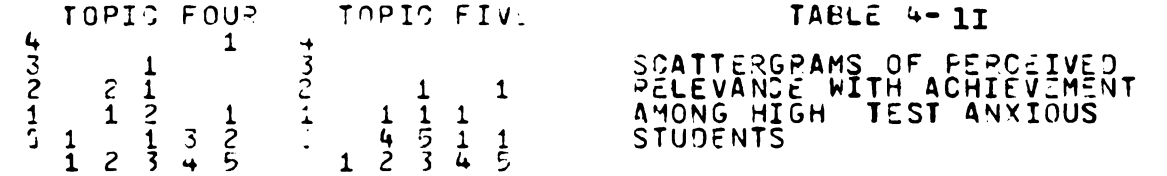
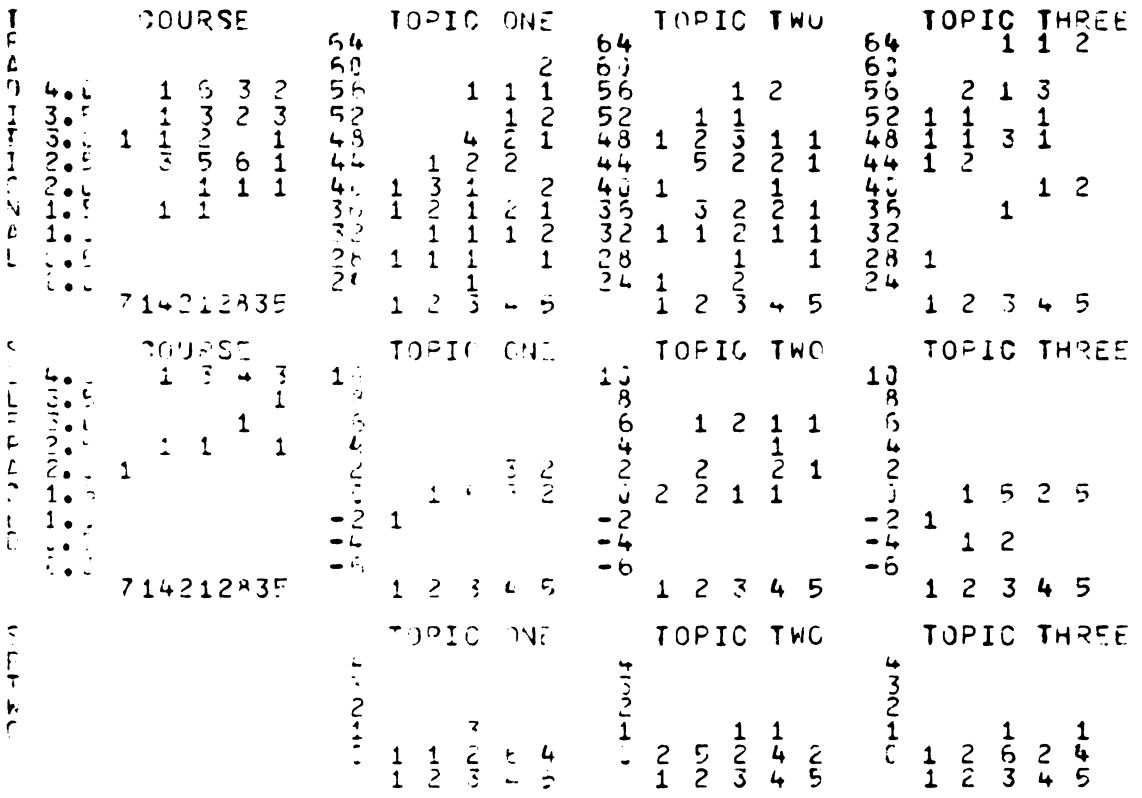
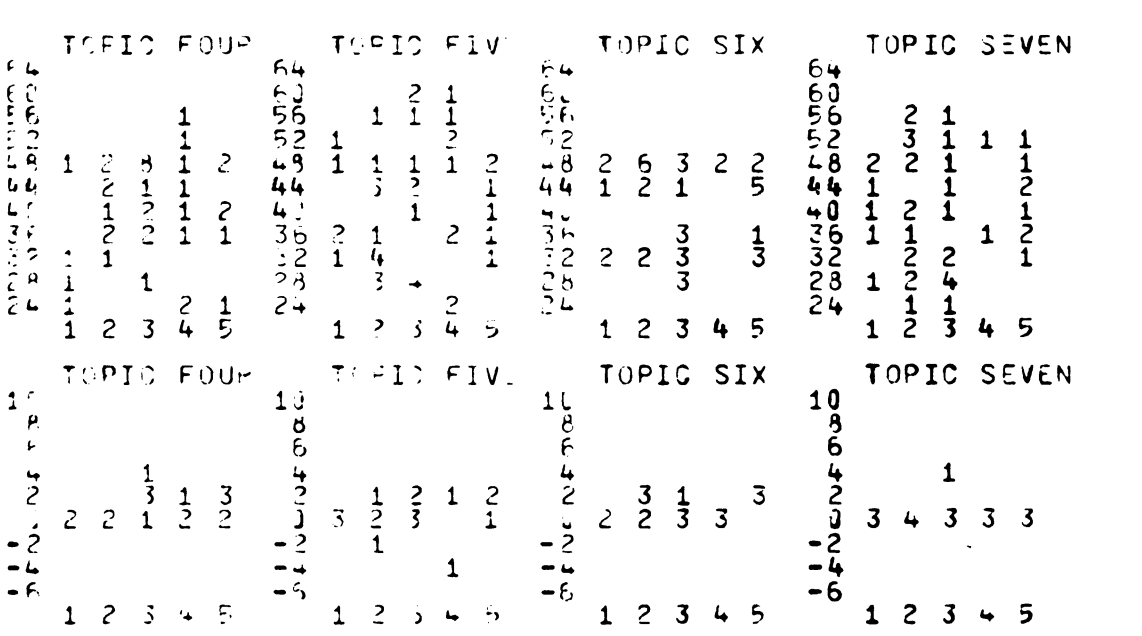


TABLE 4-11

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH TEST ANXIOUS STUDENTS





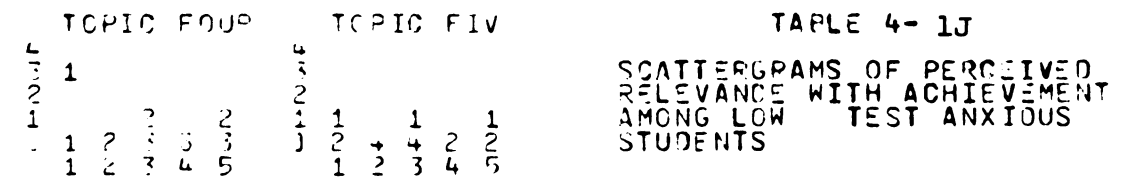
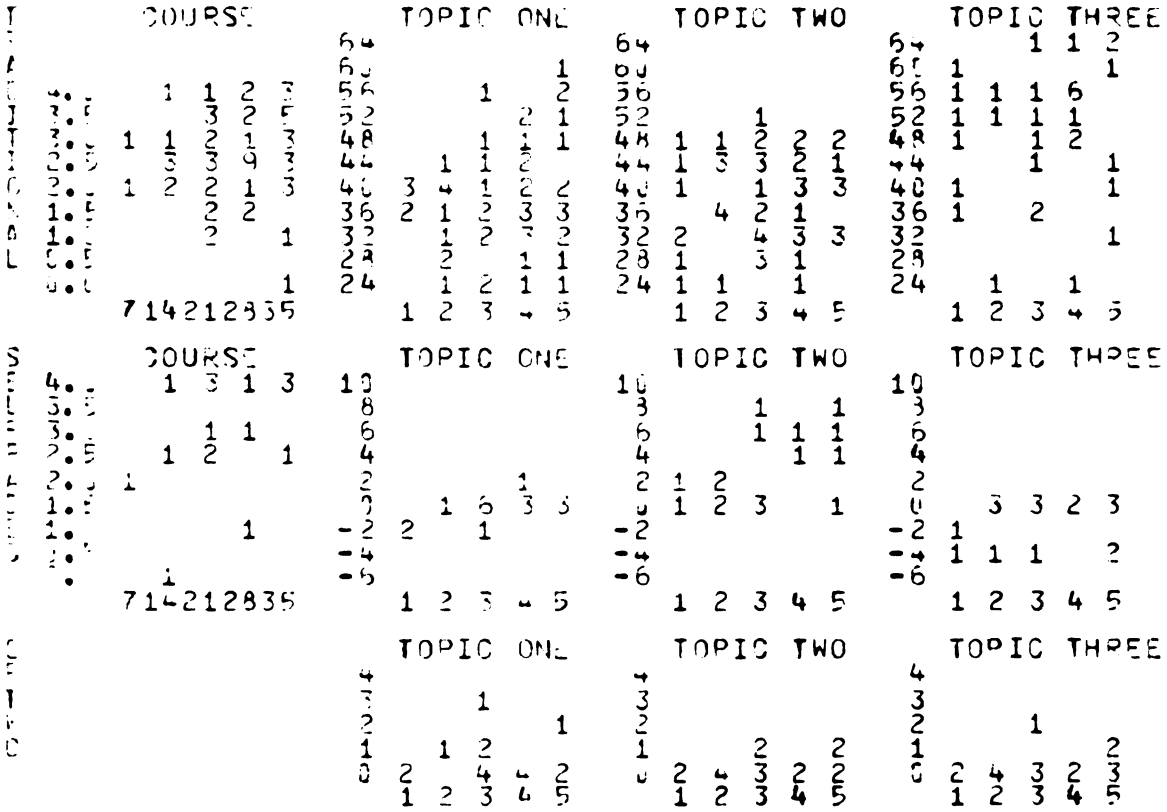


TABLE 4- 1J

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW TEST ANXIOUS STUDENTS



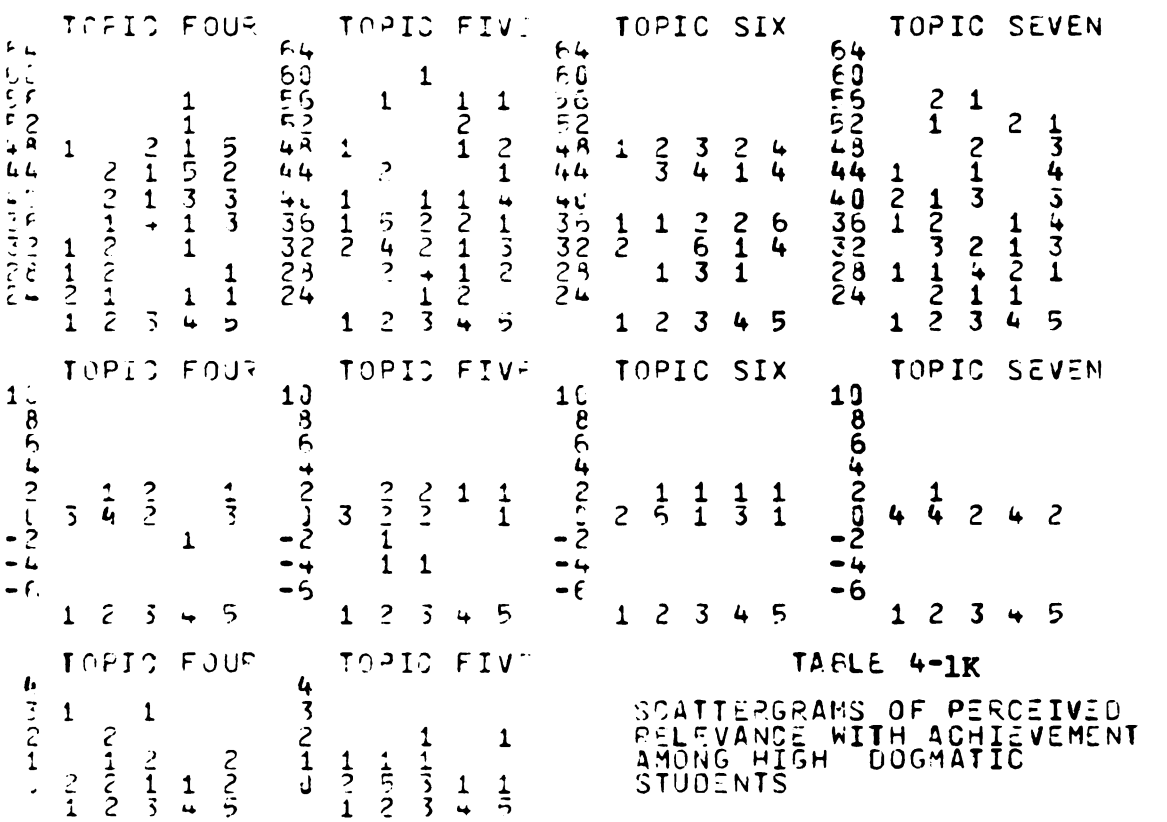
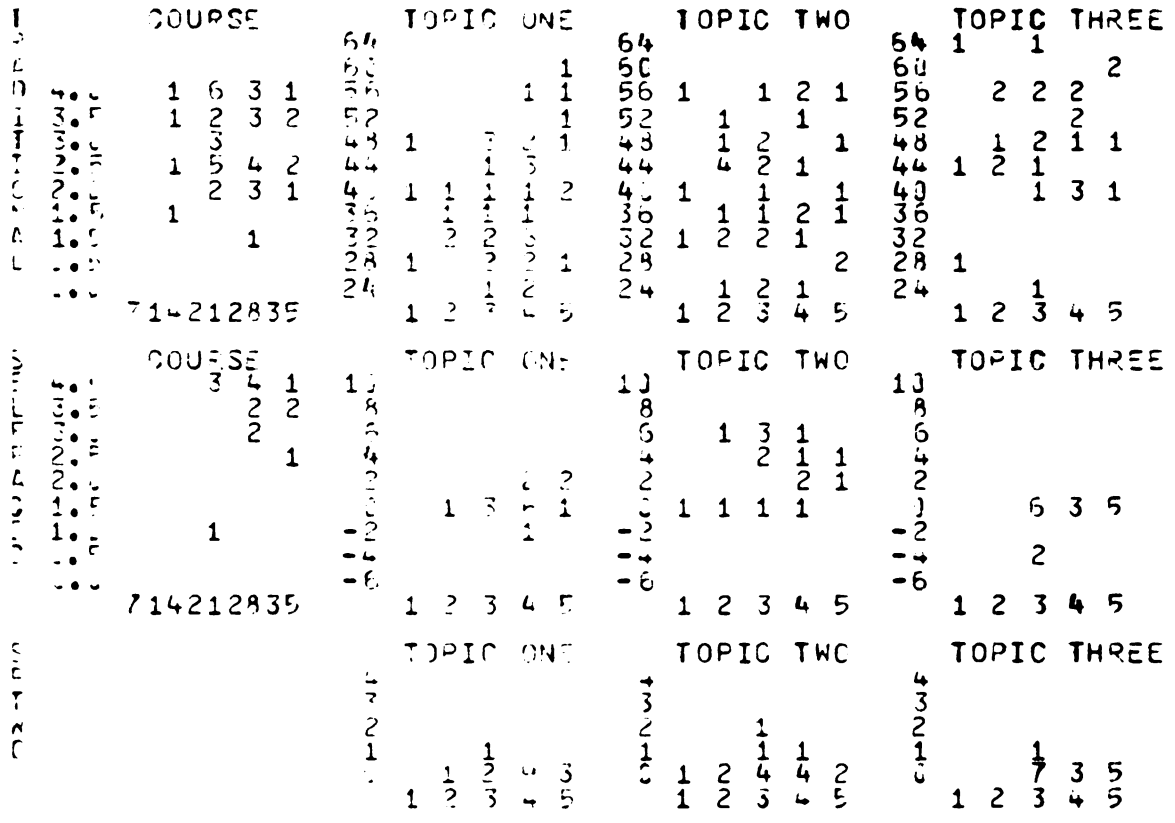
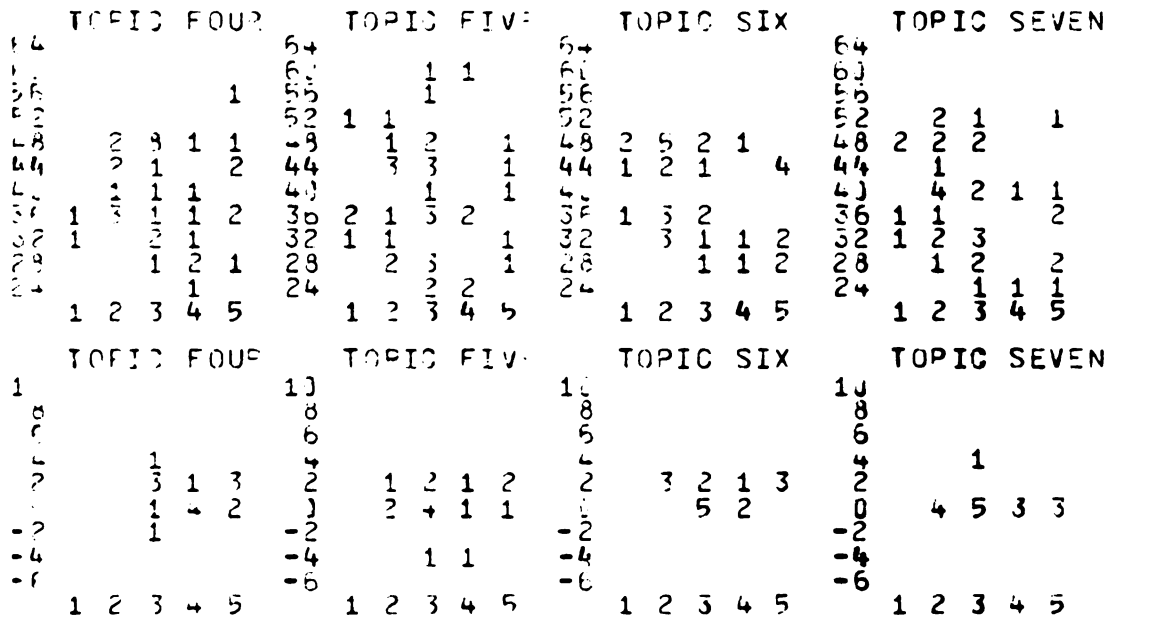


TABLE 4-1K

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH DOGMATIC STUDENTS





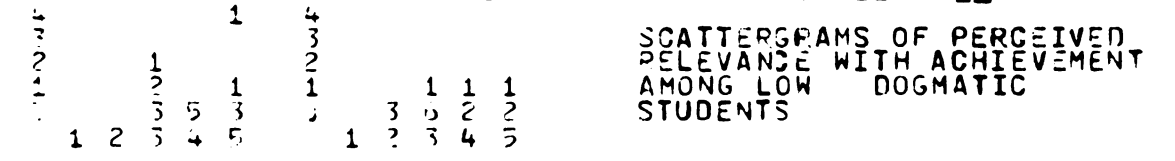
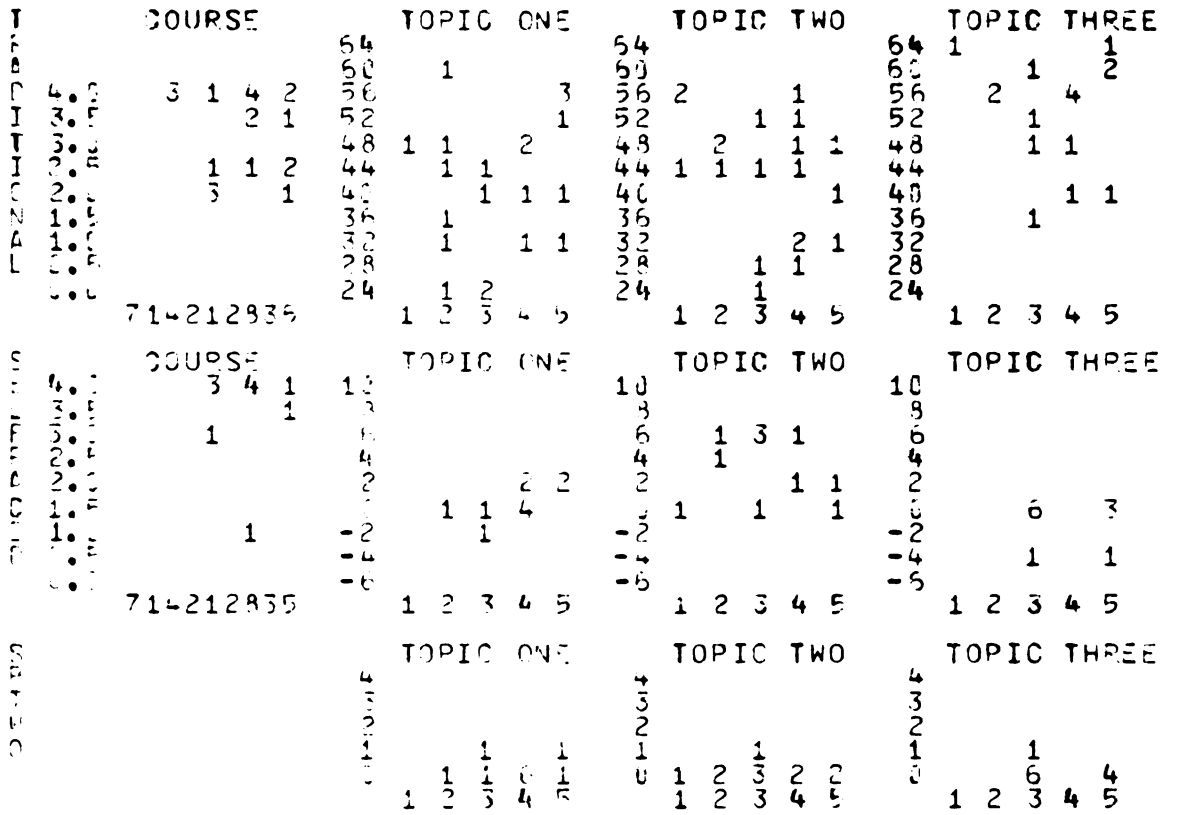
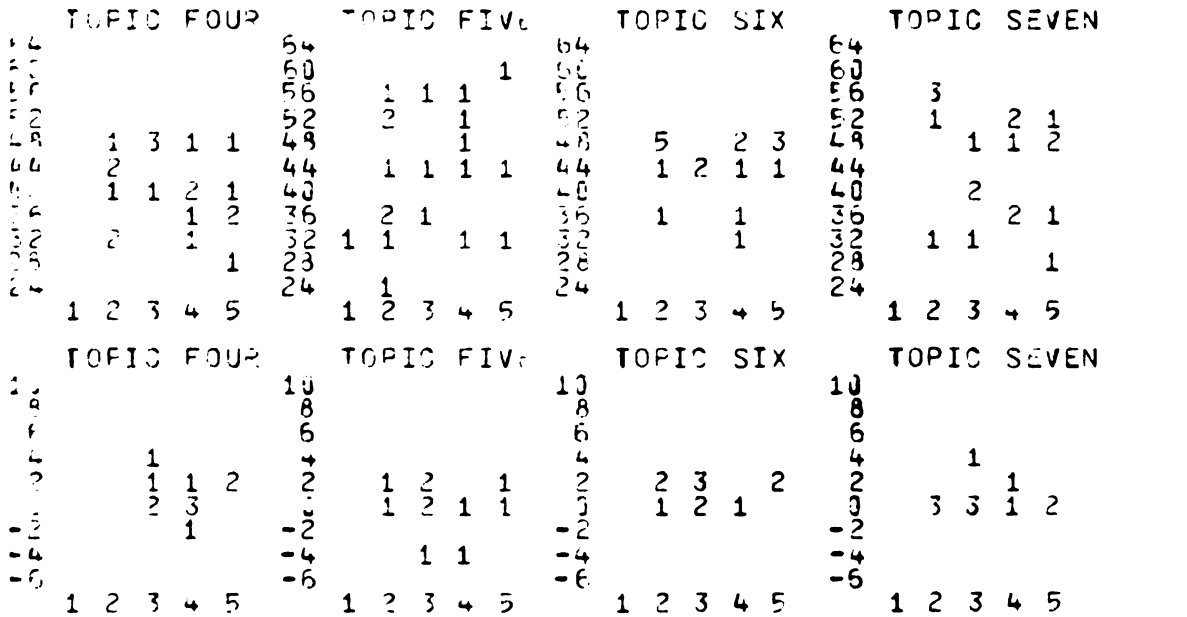


TABLE 4-1L

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW DOGMATIC STUDENTS





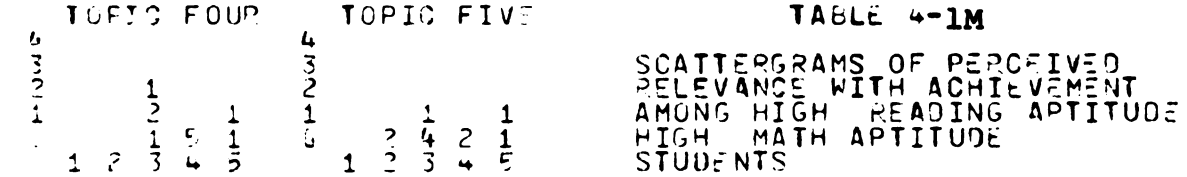
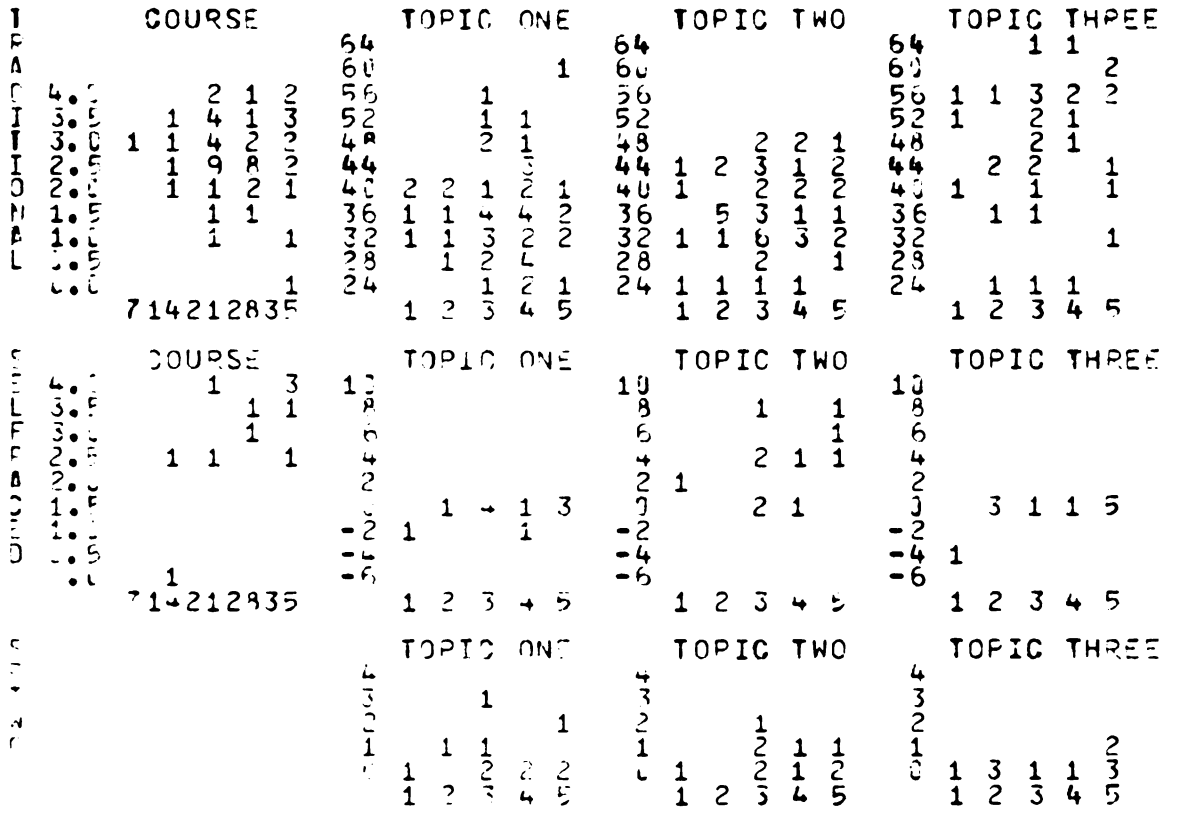
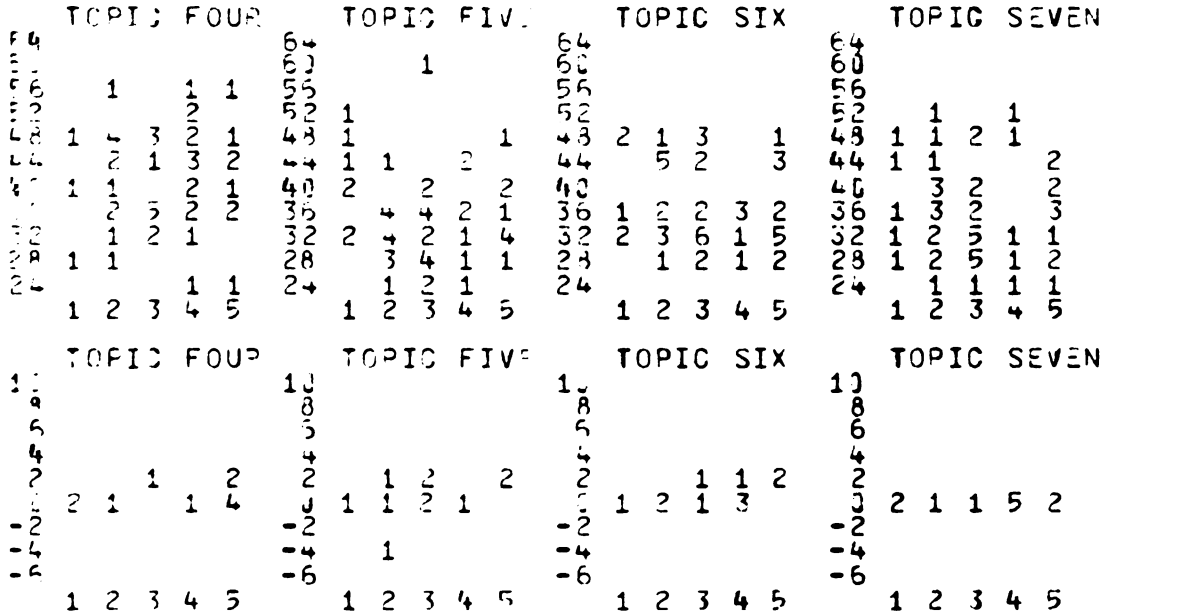


TABLE 4-1M

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH READING APTITUDE HIGH MATH APTITUDE STUDENTS





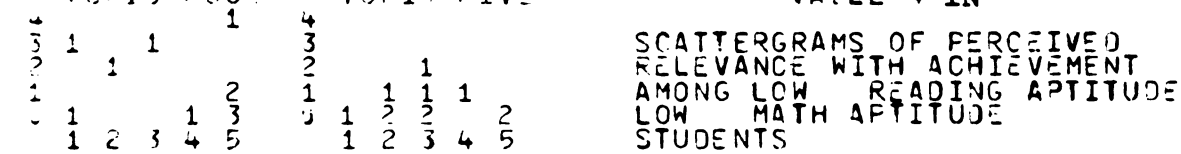
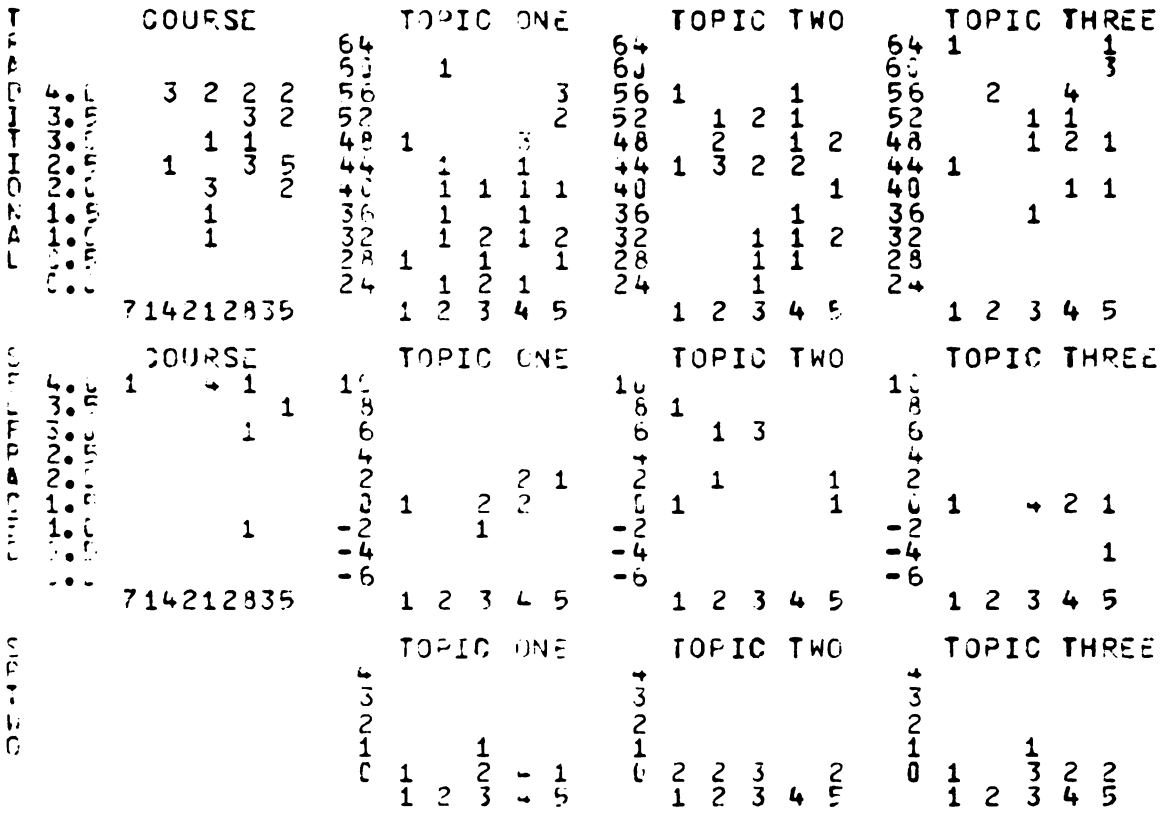


TABLE 4-1N

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW READING APTITUDE LOW MATH APTITUDE STUDENTS



RELEVANCE SCALES

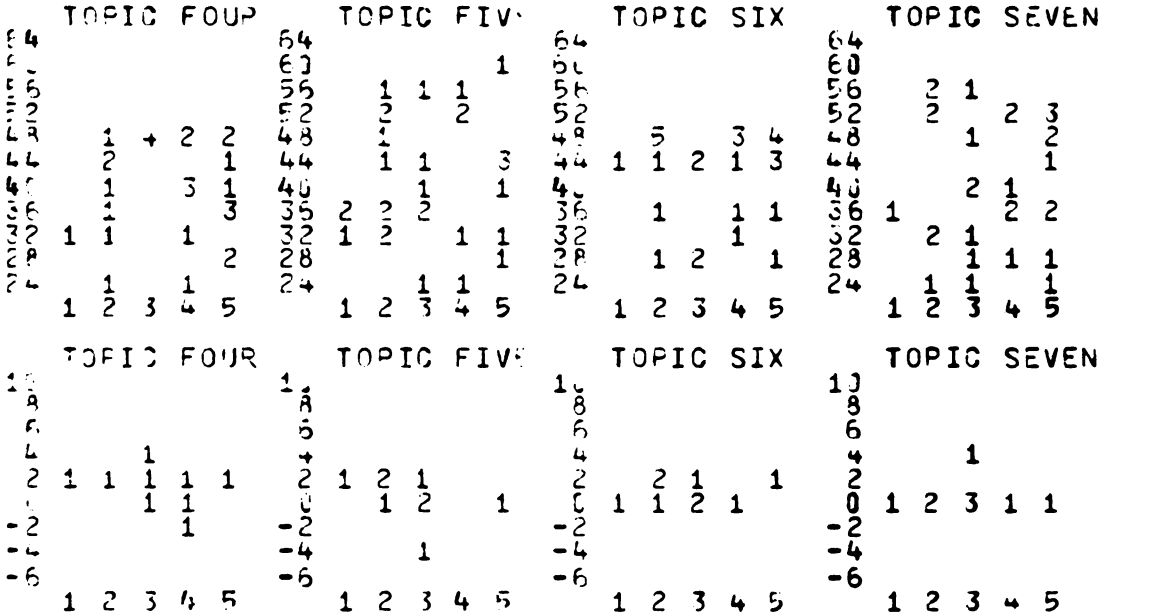
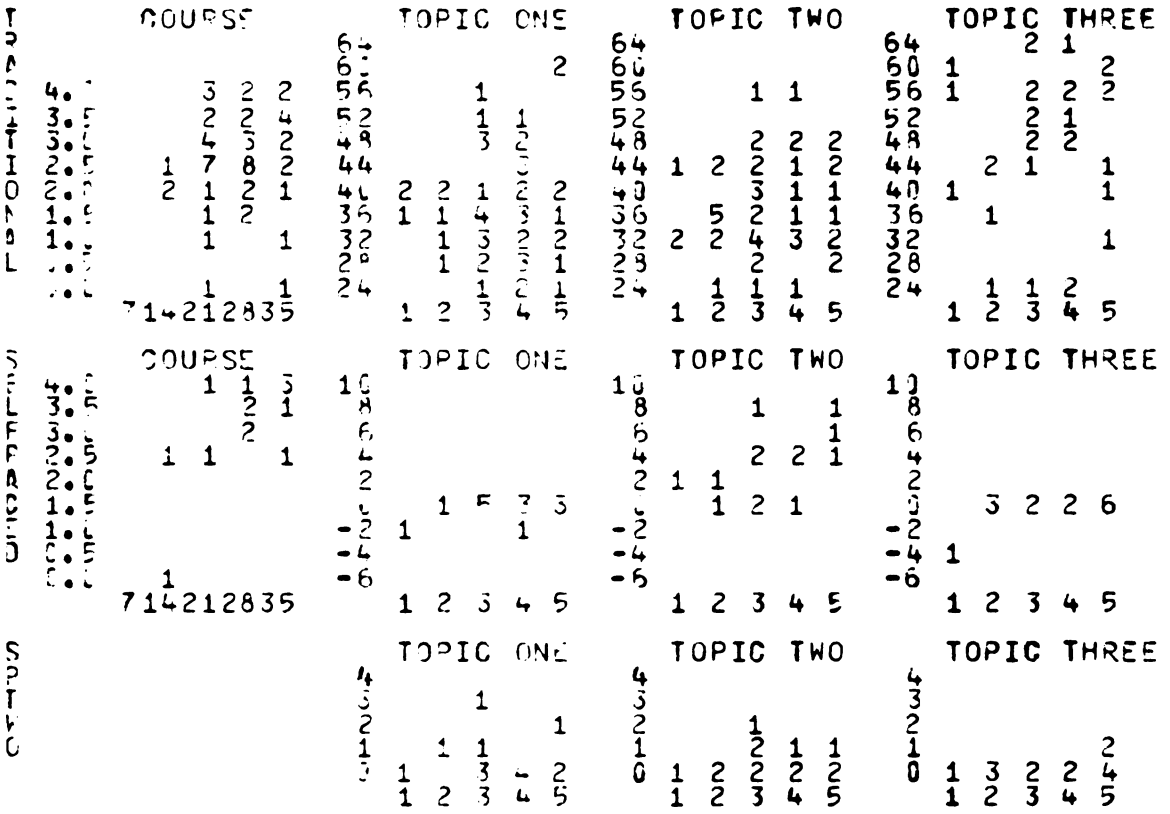
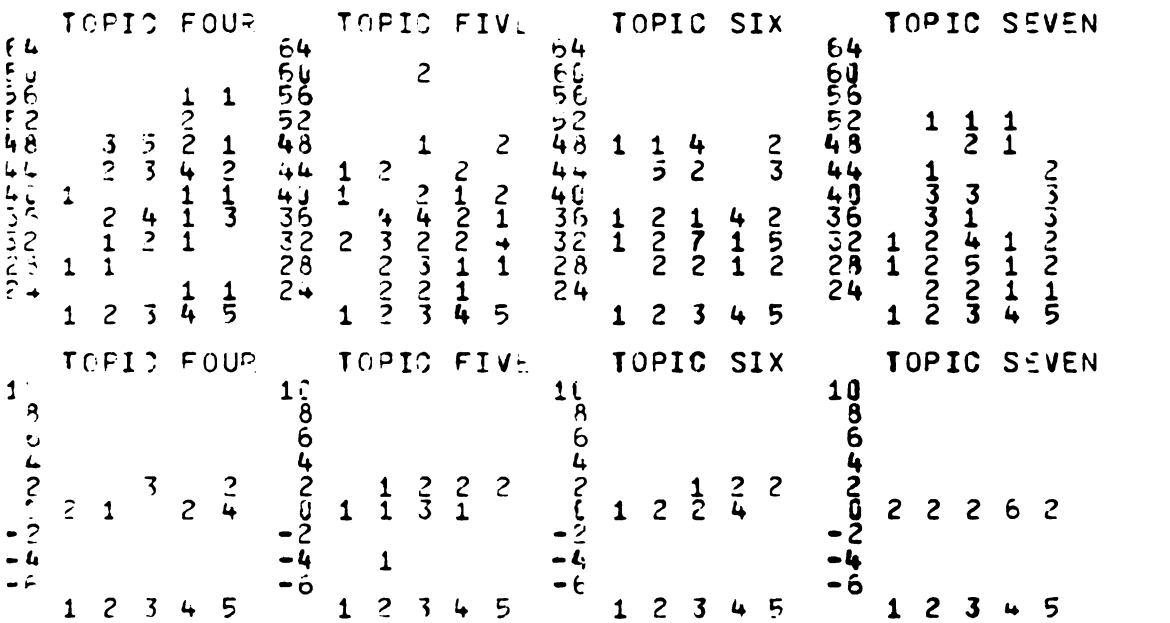


TABLE 4-1P

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH MATH APTITUDE MALE STUDENTS





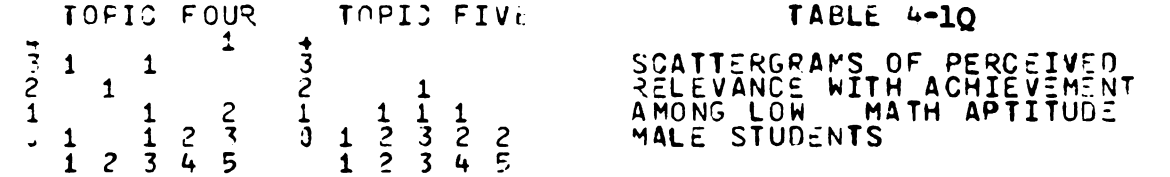
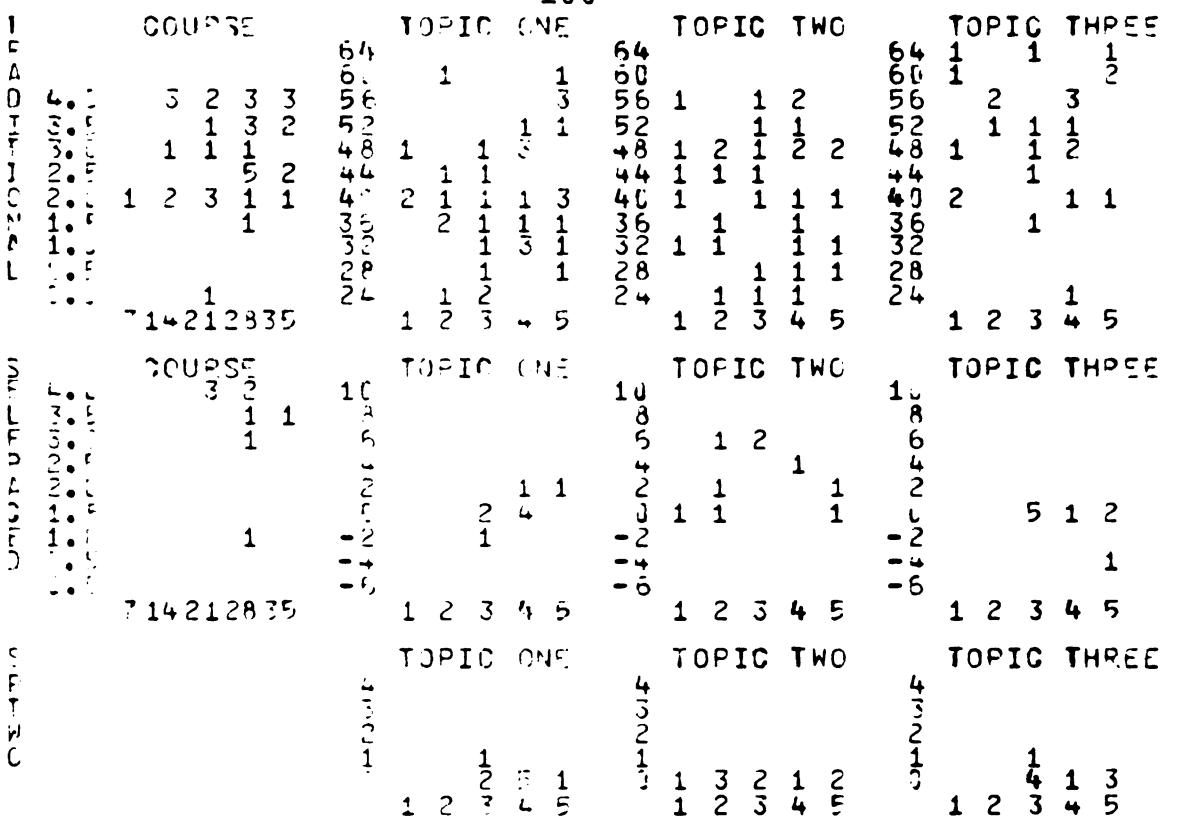


TABLE 4-1Q

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW MATH APTITUDE MALE STUDENTS



RELEVANCE SCALES

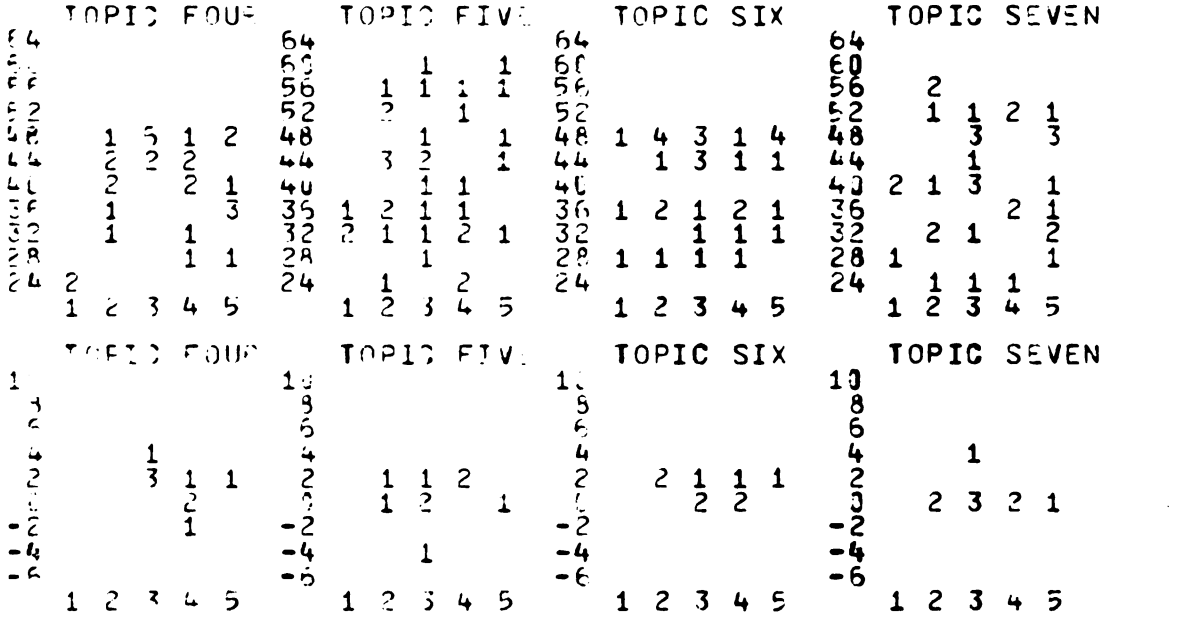
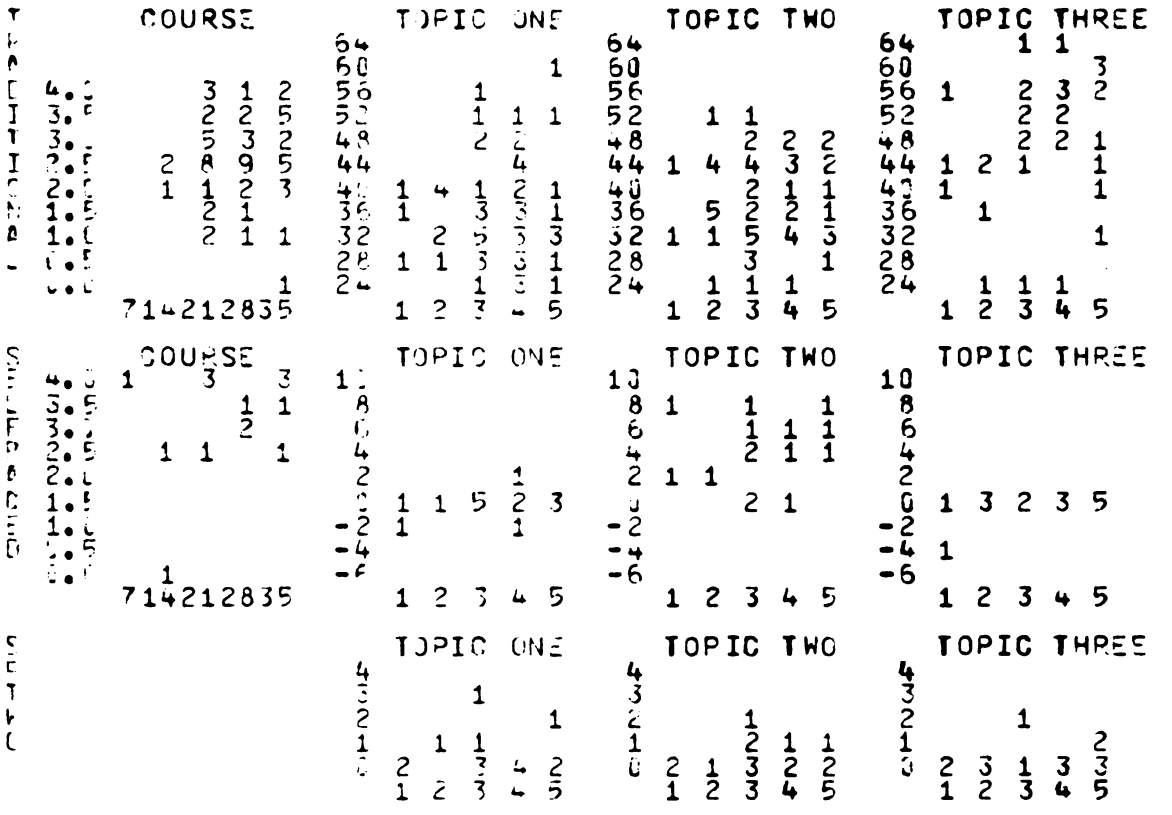


TABLE 4-1R

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH READING APTITUDE MALE STUDENTS



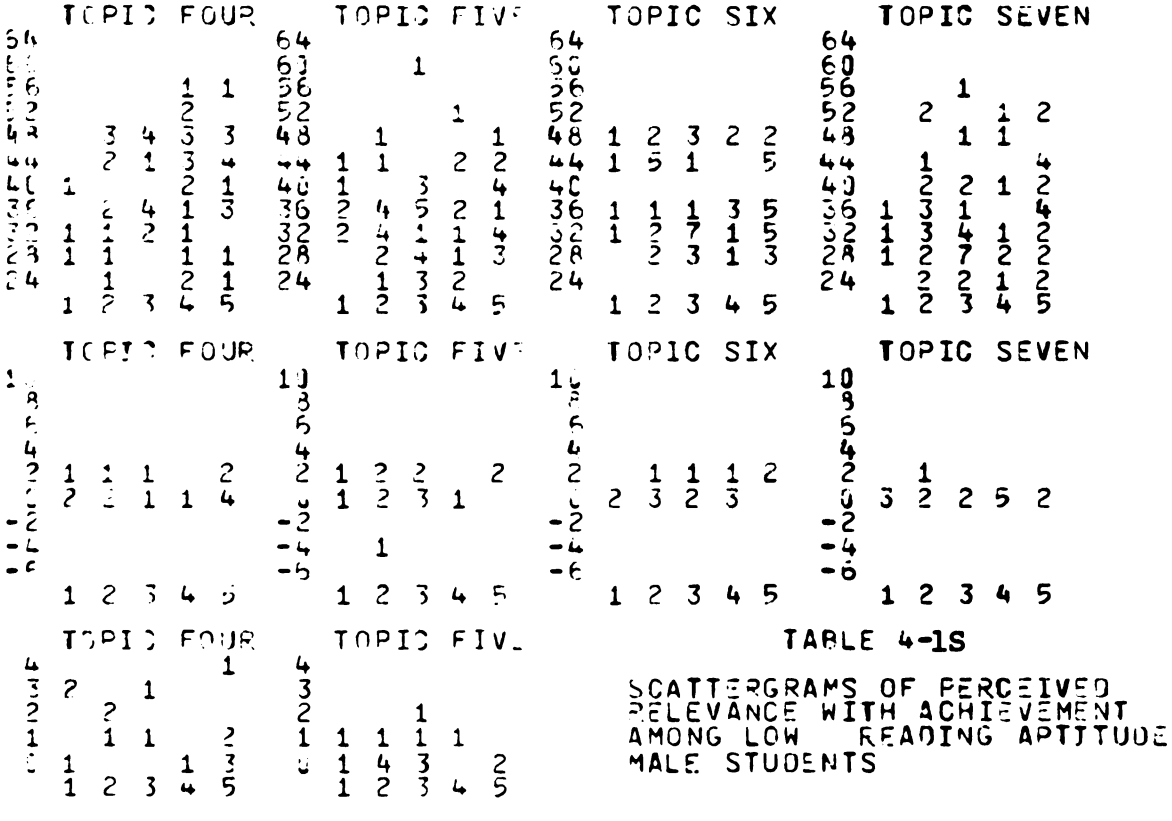
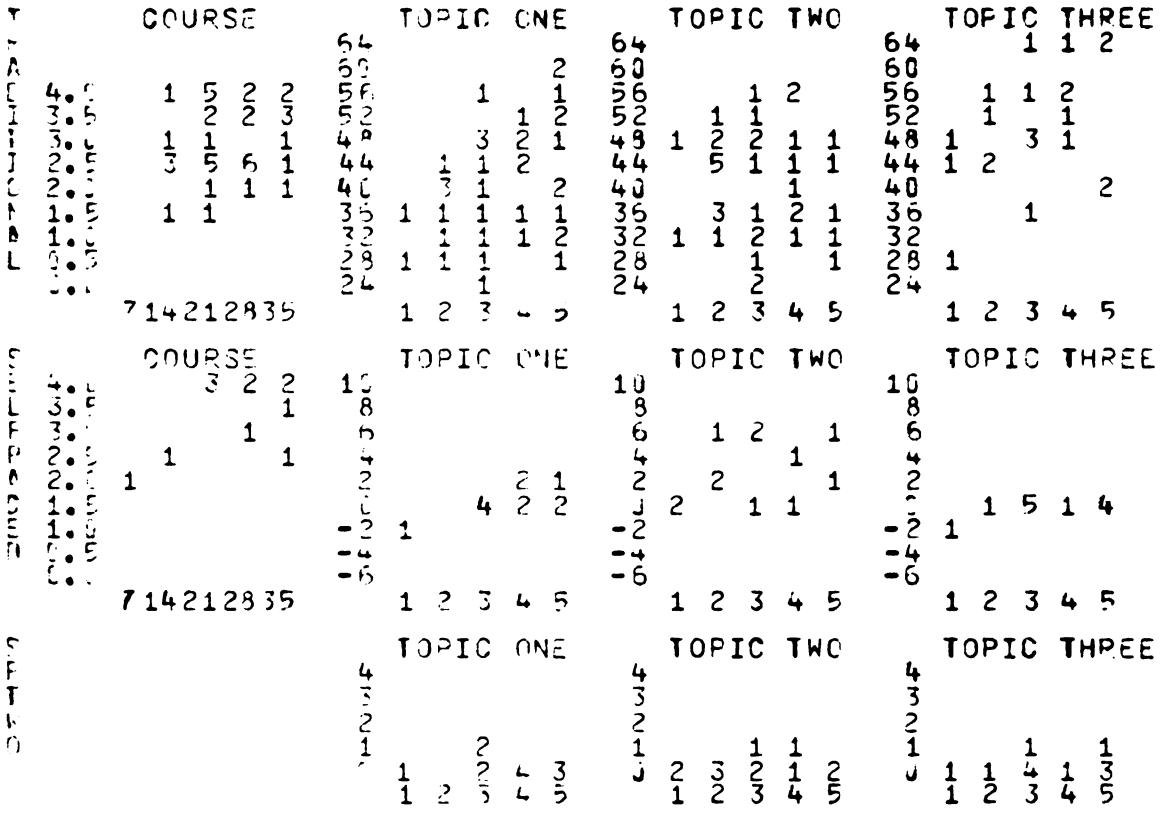


TABLE 4-1S

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW READING APTITUDE MALE STUDENTS



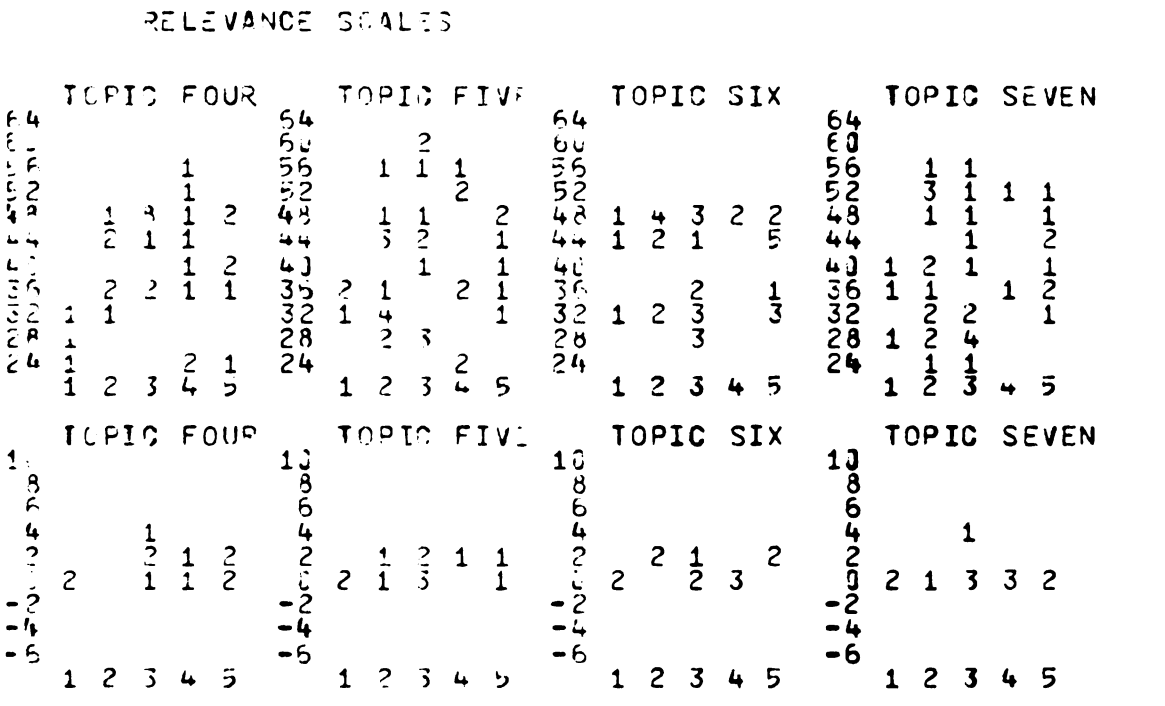
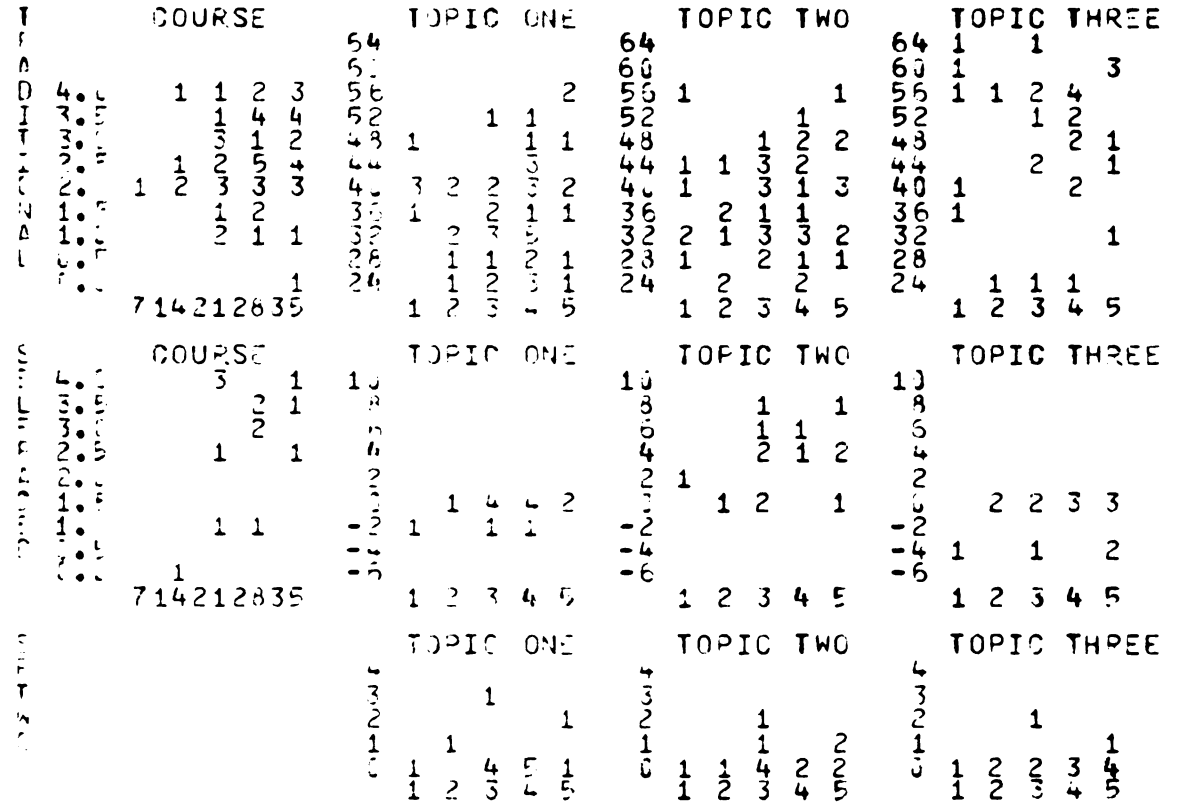


TABLE 4-1T

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW TEST ANXIOUS MALE STUDENTS



RELEVANCE SCALES

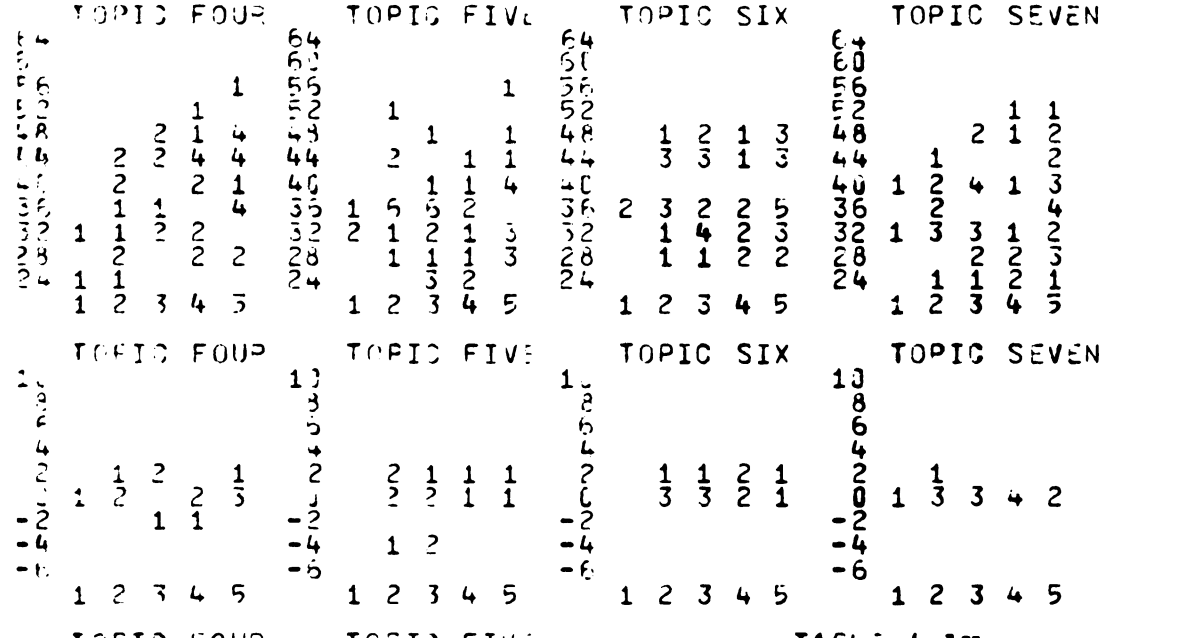
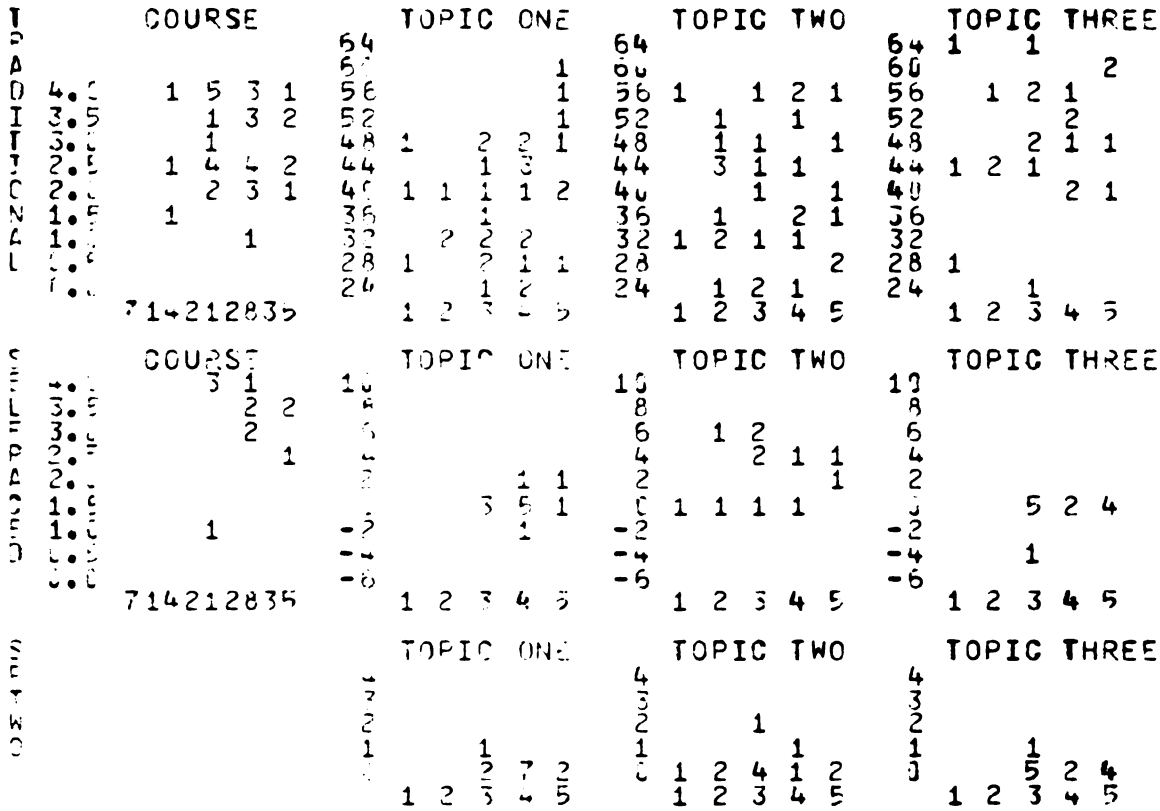
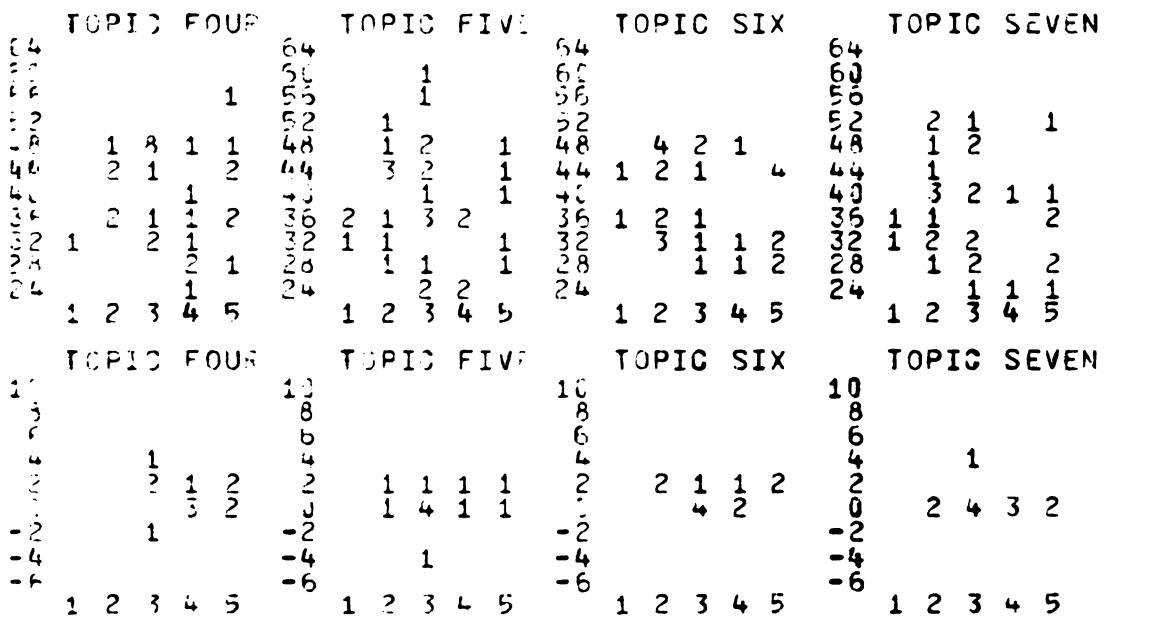


TABLE 4-10

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH TEST ANXIOUS MALE STUDENTS





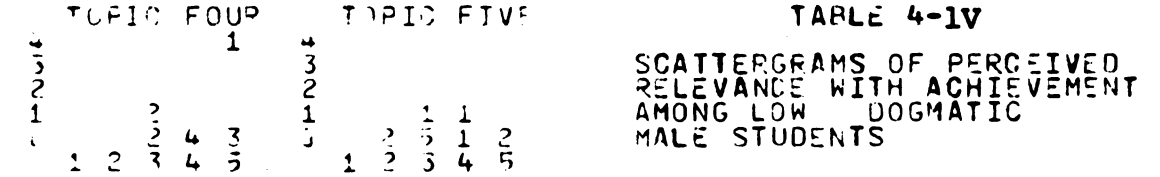
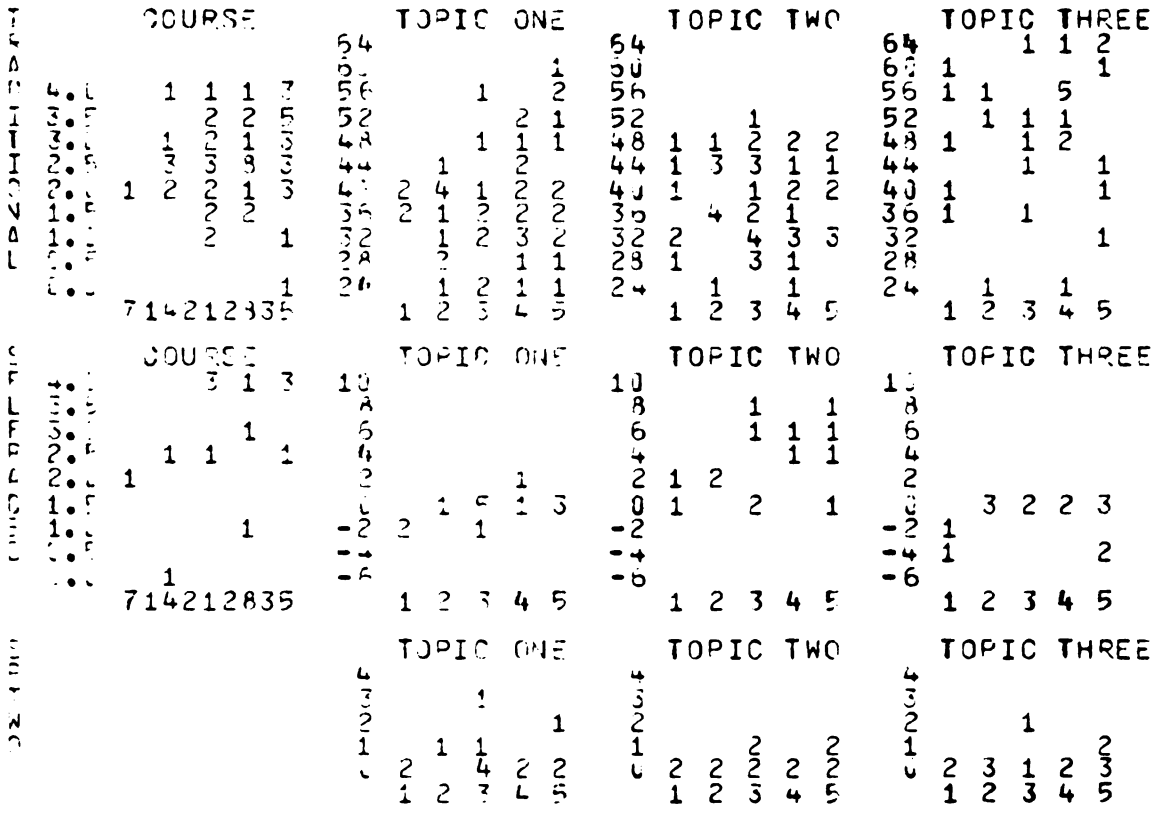
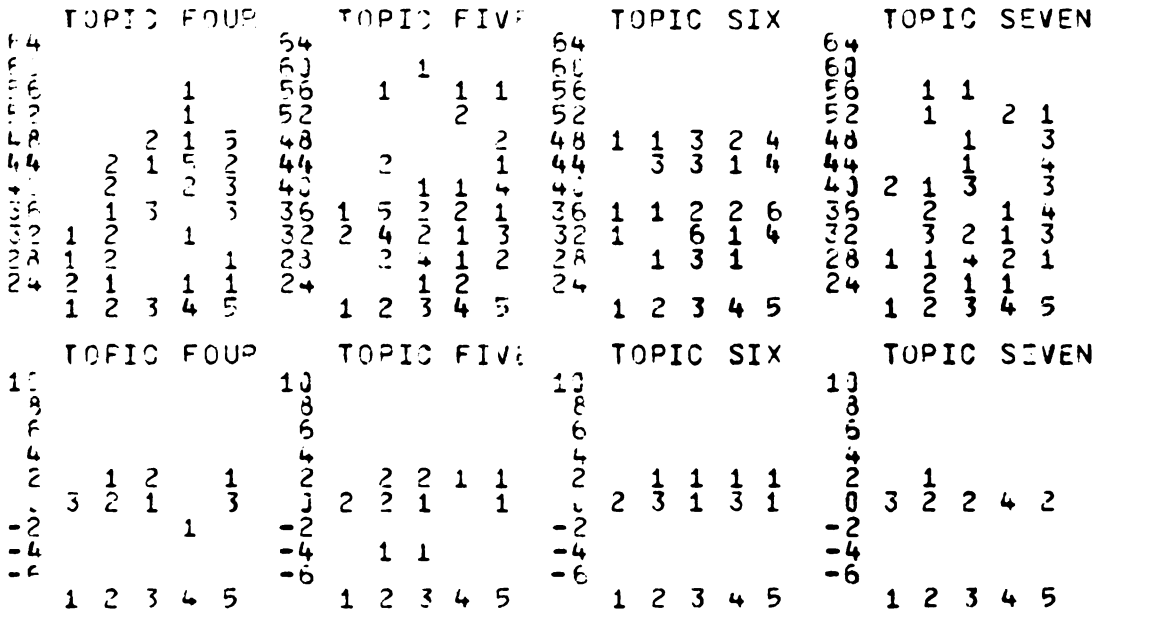


TABLE 4-1V

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW DOGMATIC MALE STUDENTS





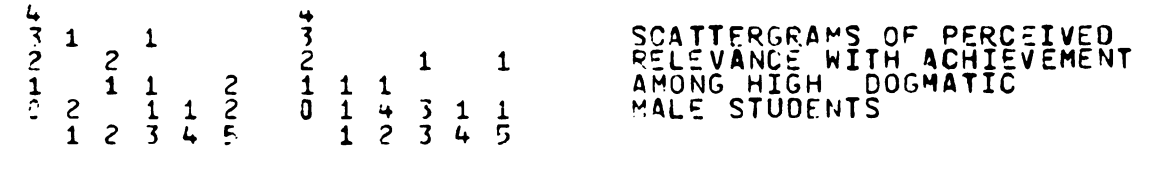
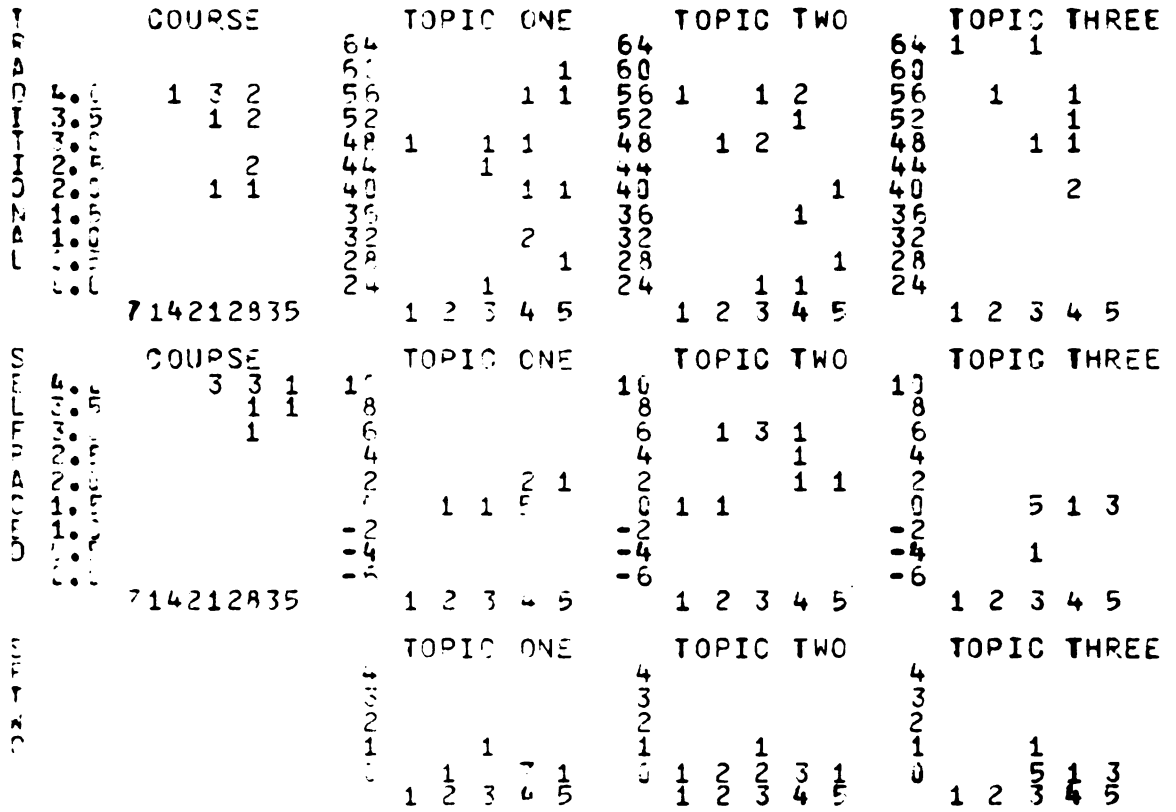


TABLE 4-1W

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH DOGMATIC MALE STUDENTS



RELEVANCE SCALES

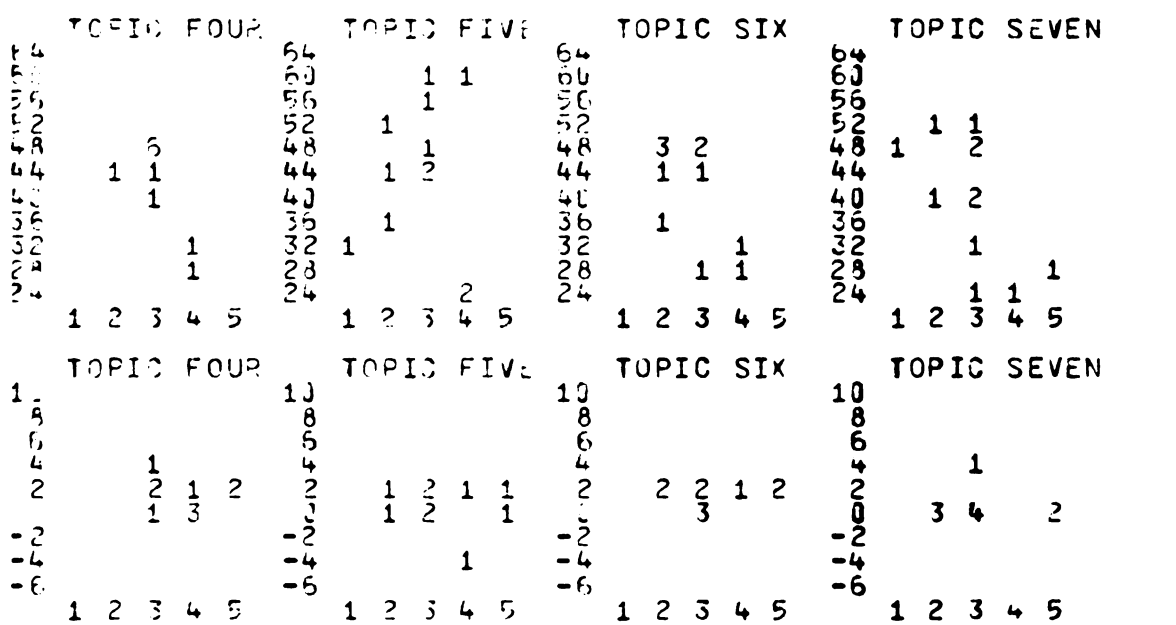


TABLE 4- 1X

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW DOGMATIC HIGH READING APTITUDE STUDENTS

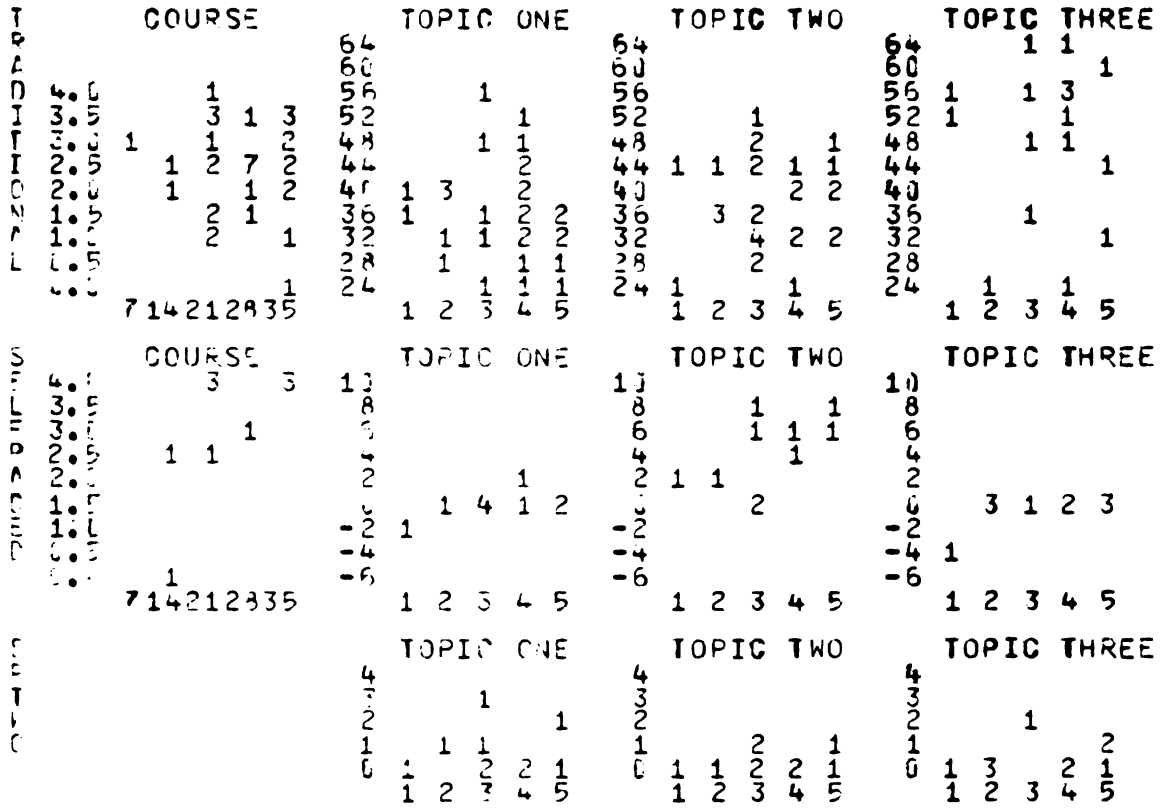
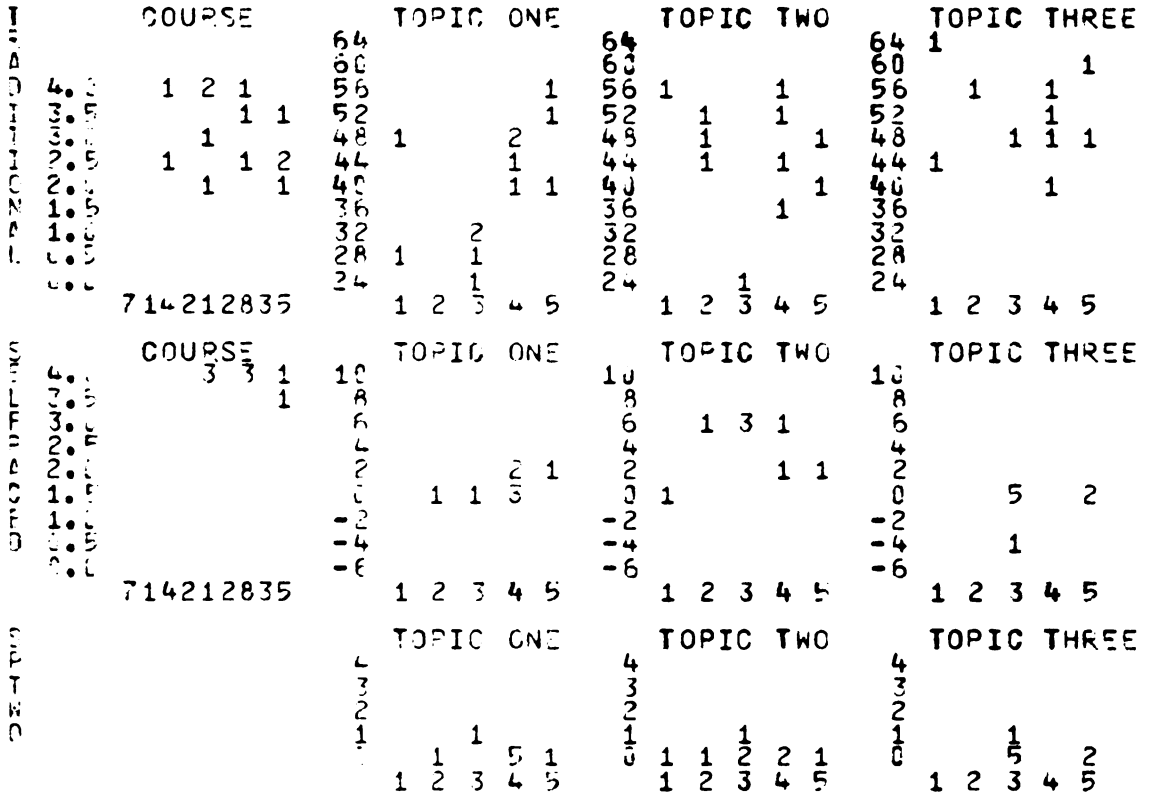


TABLE 4-1Y

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH DOGMATIC LOW READING APTITUDE STUDENTS



RELEVANCE SCALES

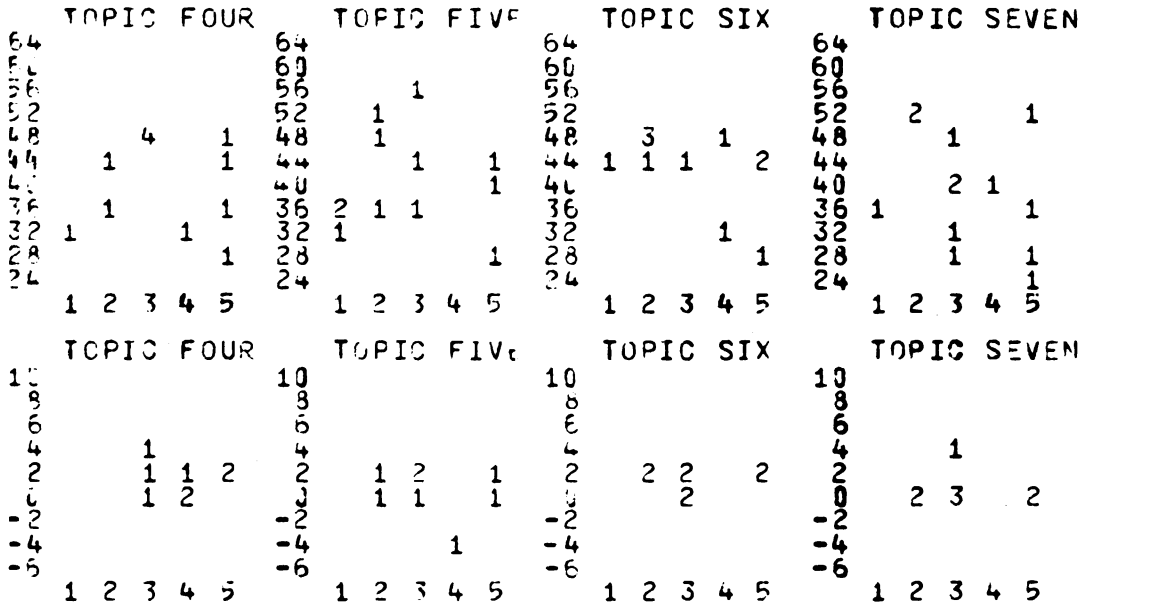
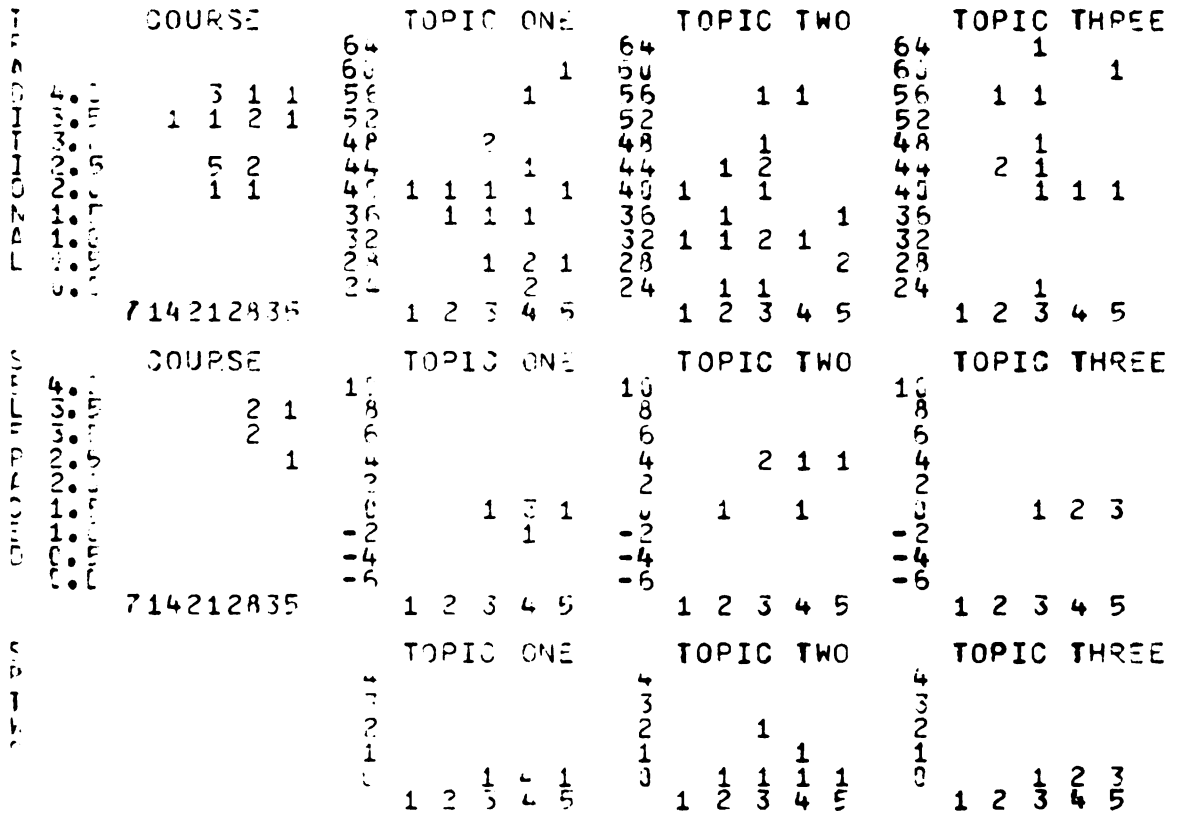
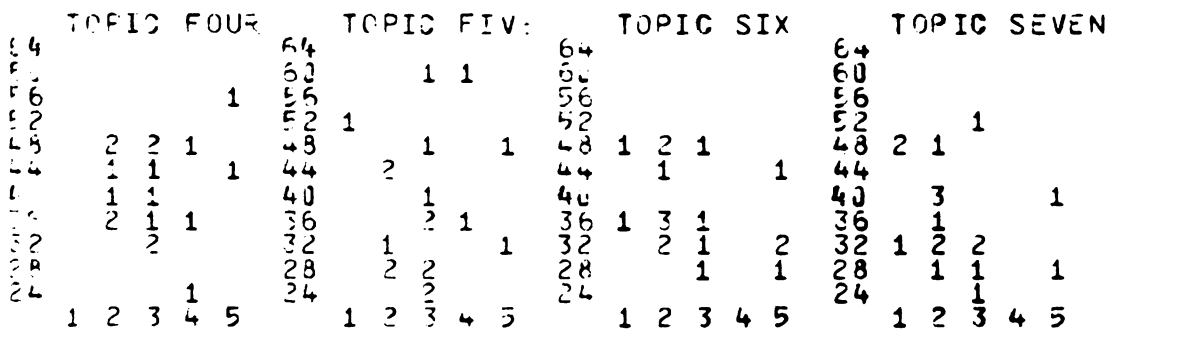


TABLE 4- 12

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW DOGMATIC HIGH MATH APTITUDE STUDENTS



RELEVANCE SCALES



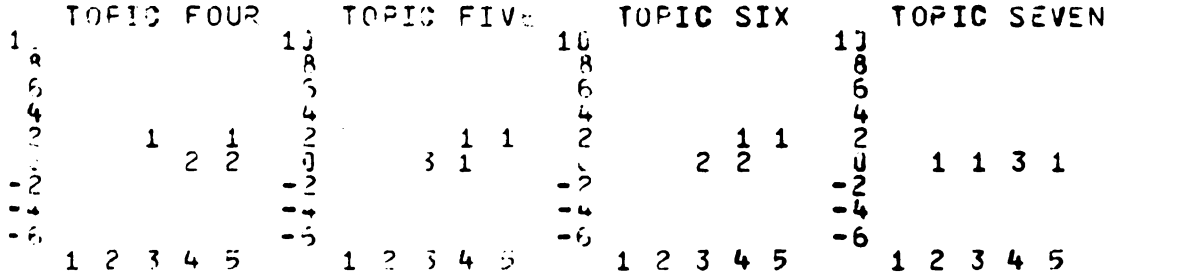
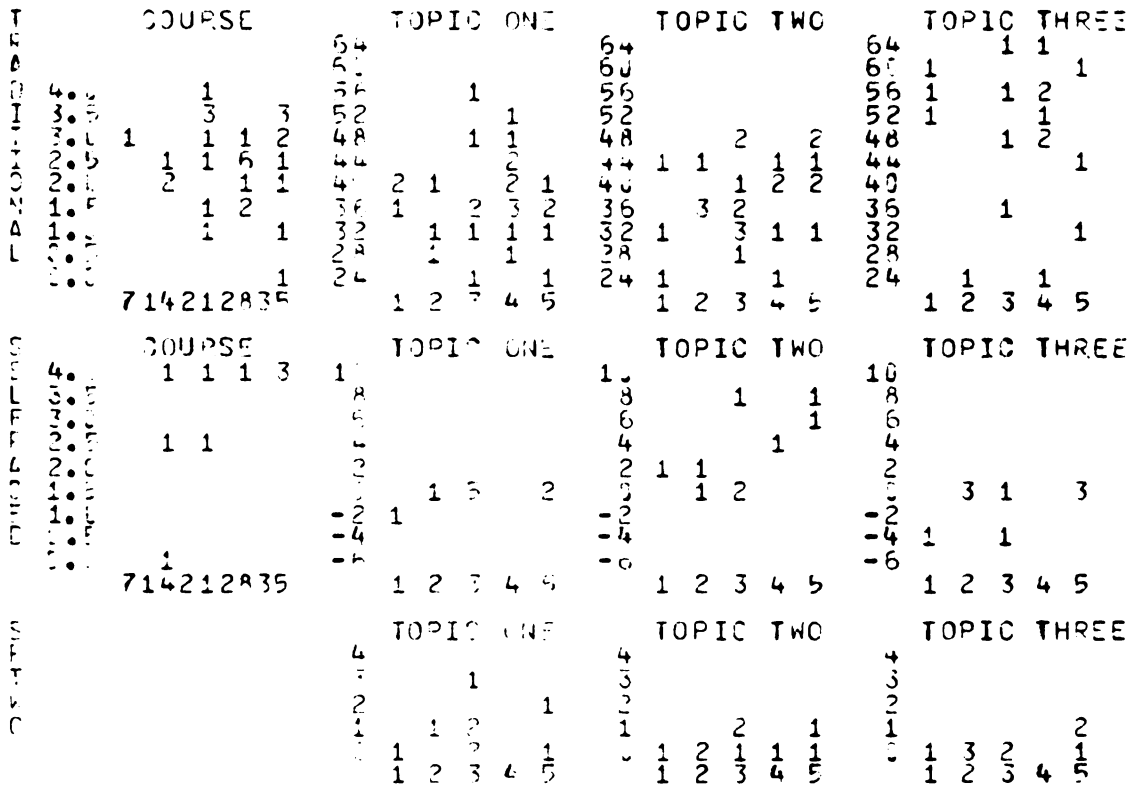


TABLE 4-1AA

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW DOGMATIC LOW MATH APTITUDE STUDENTS



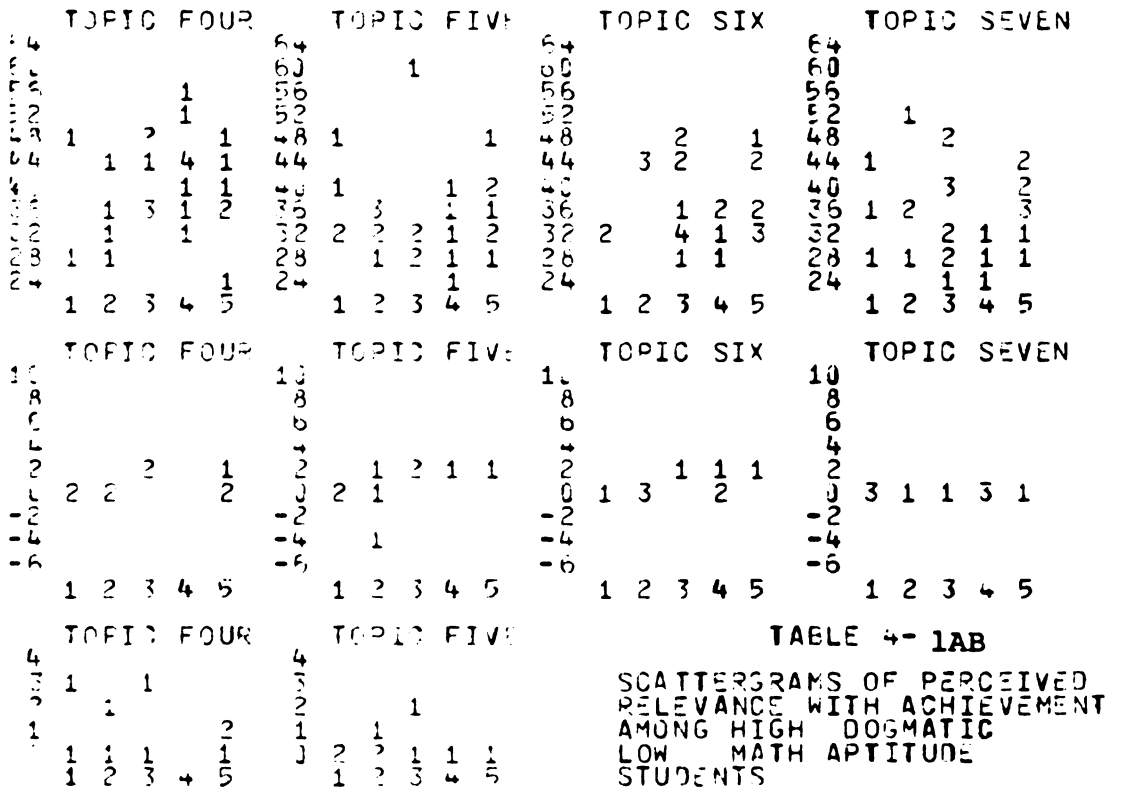
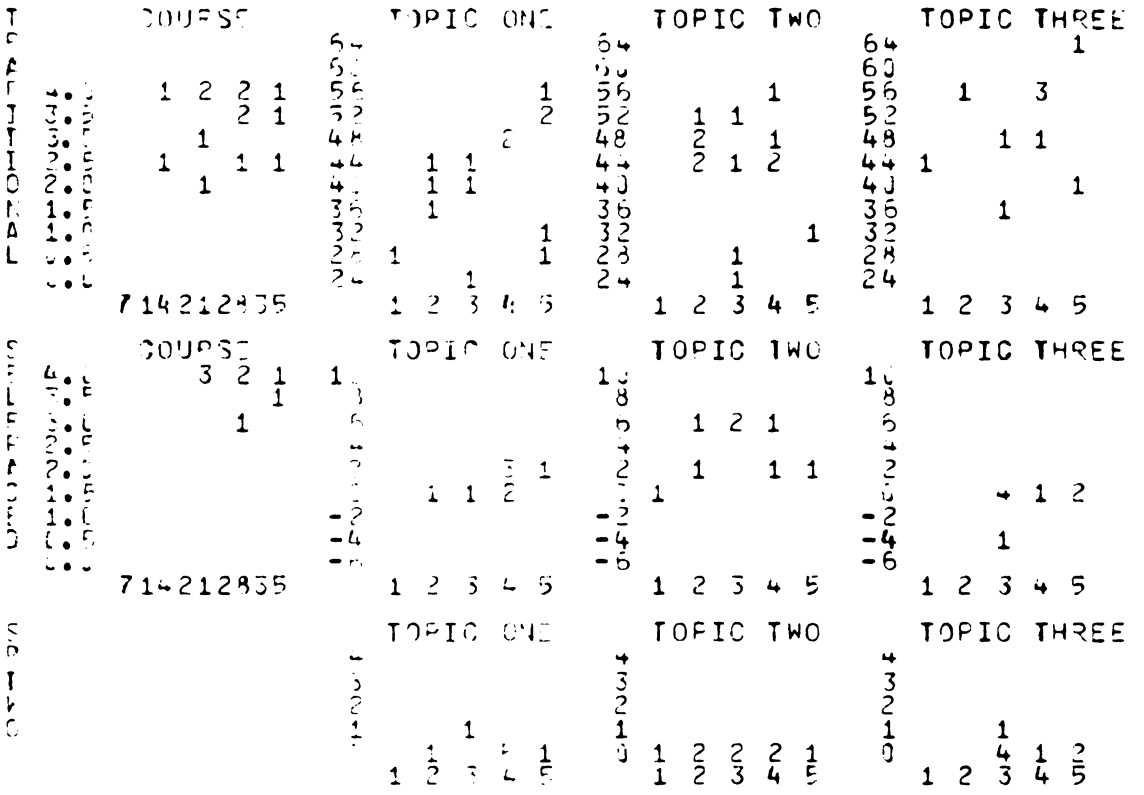


TABLE 4- 1AB

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH DOGMATIC LOW MATH APTITUDE STUDENTS



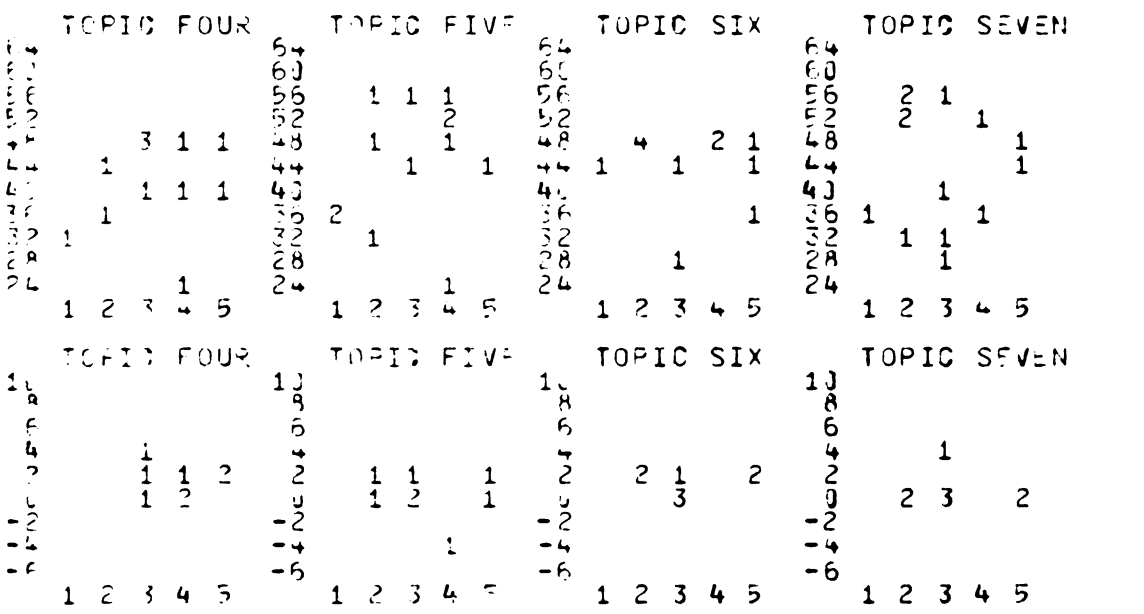
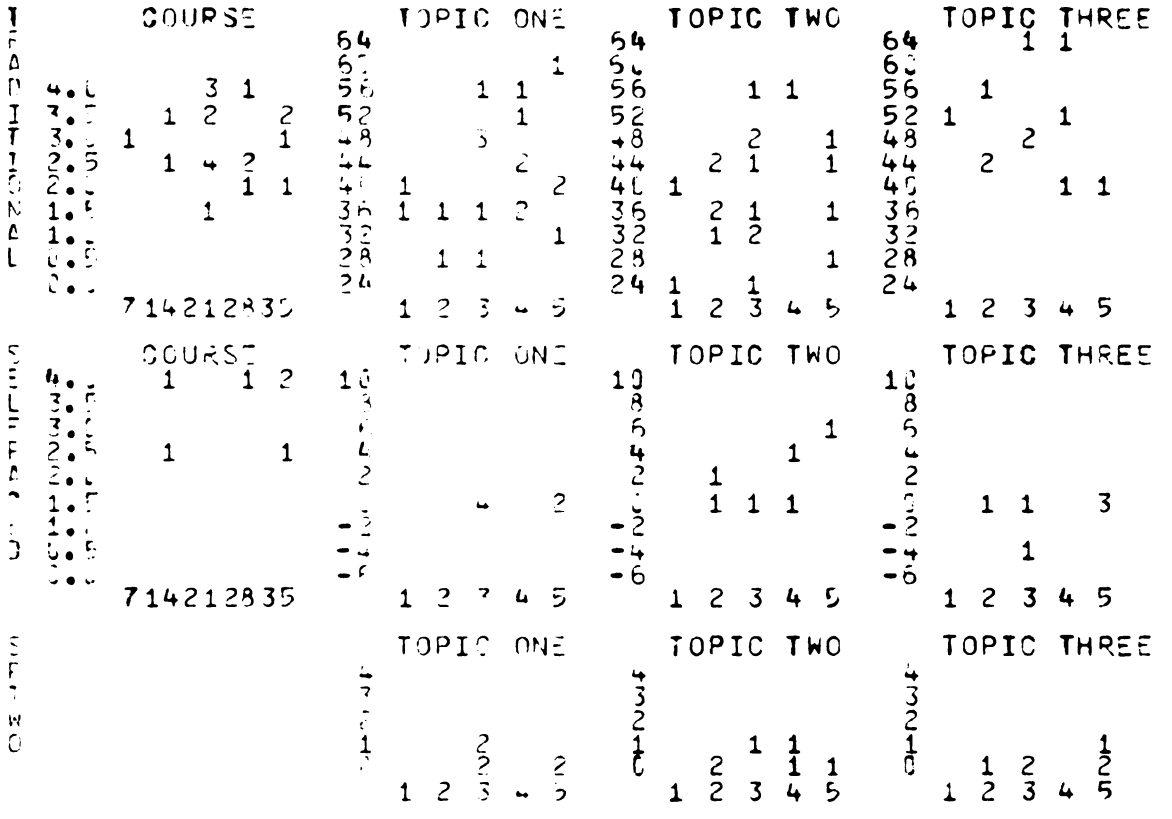
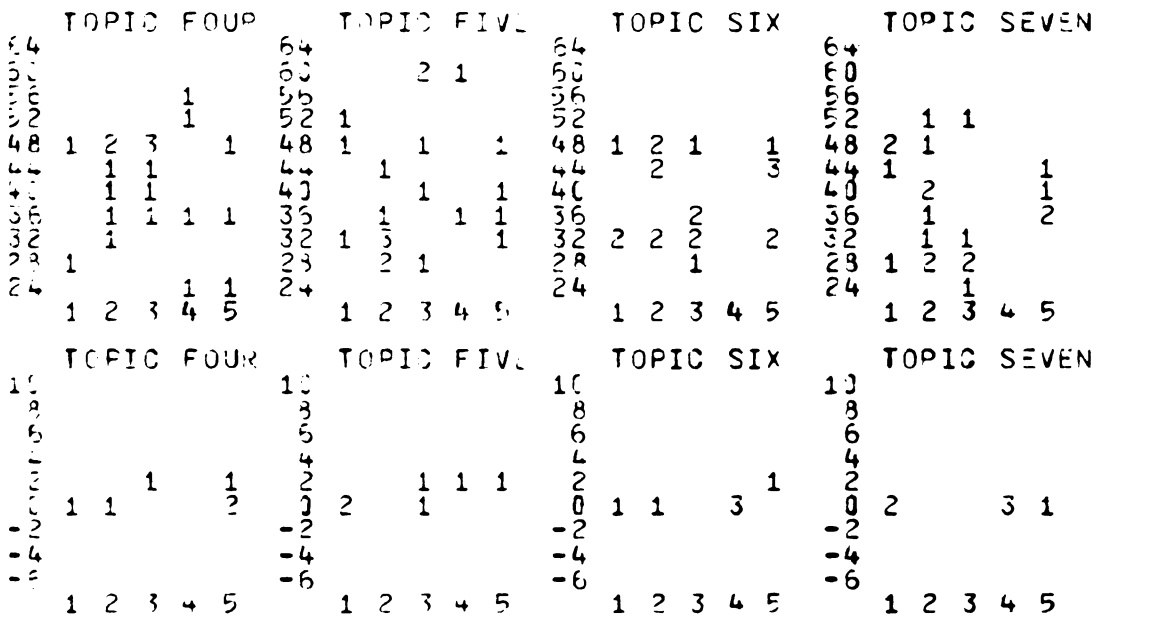


TABLE 4- 1AC

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW TEST ANXIOUS HIGH MATH APTITUDE STUDENTS





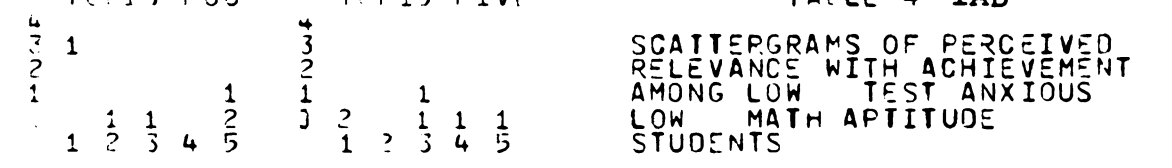
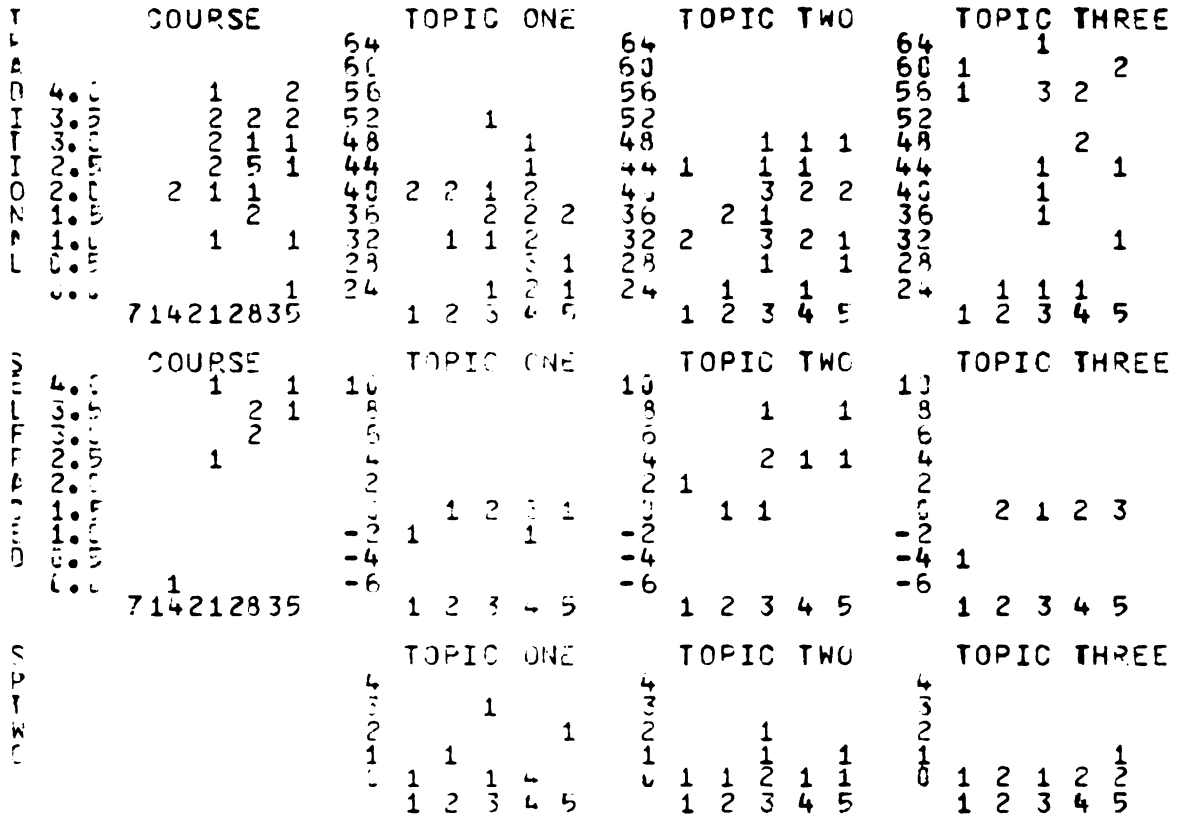


TABLE 4- lAD

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW TEST ANXIOUS LOW MATH APTITUDE STUDENTS



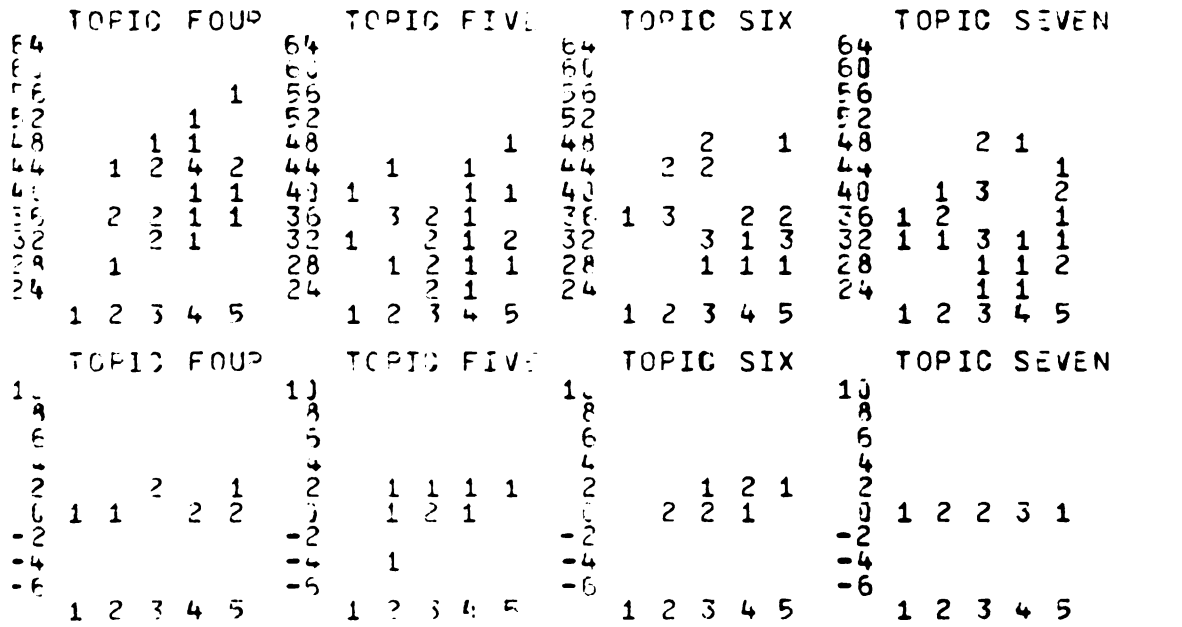
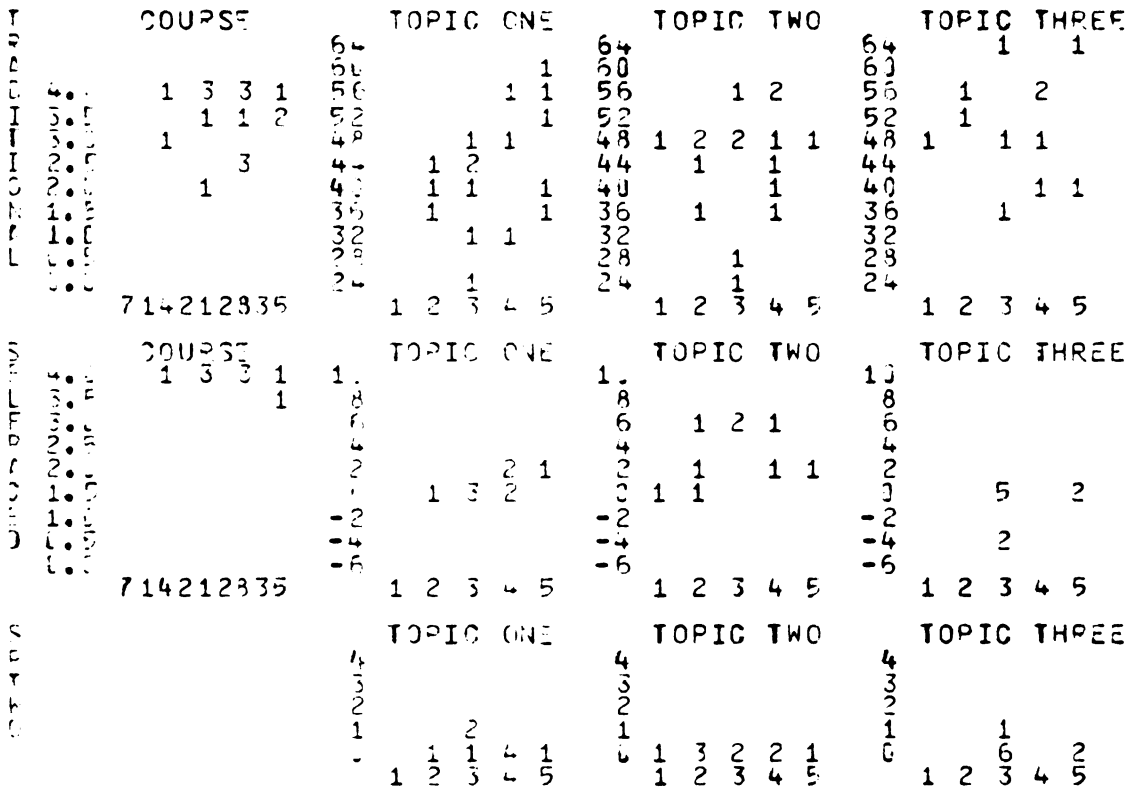
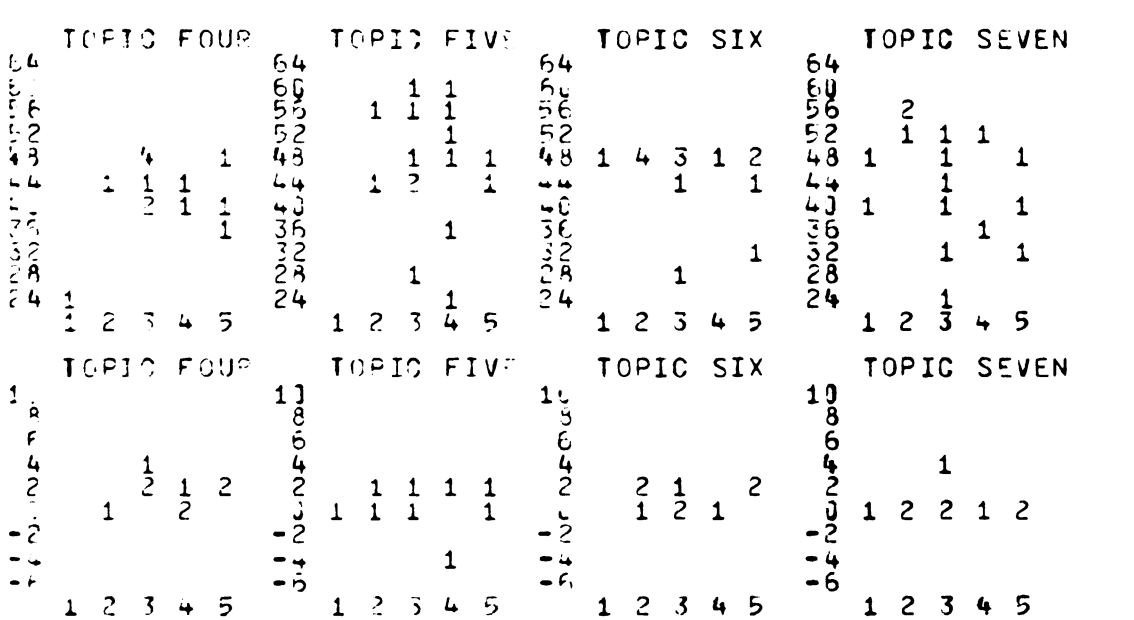


TABLE 4-1AE

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH TEST ANXIOUS LOW MATH APTITUDE STUDENTS





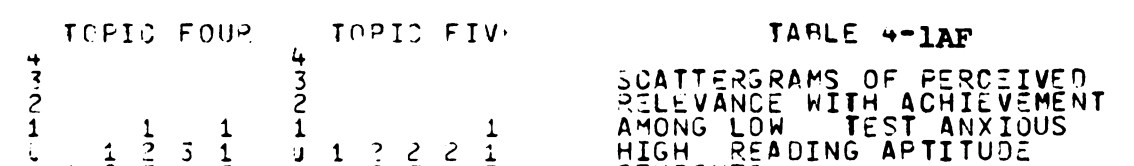
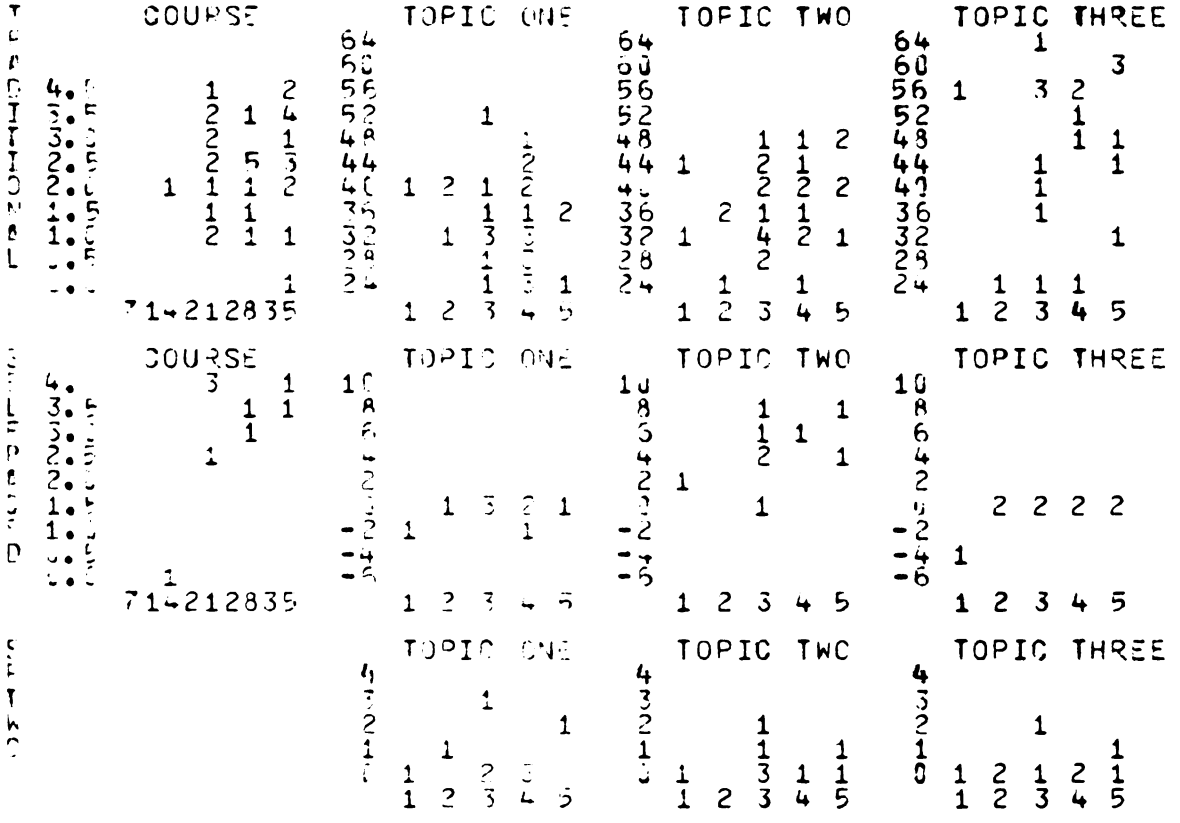


TABLE 4-1AF

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW TEST ANXIOUS HIGH READING APTITUDE STUDENTS



RELEVANCE SCALES

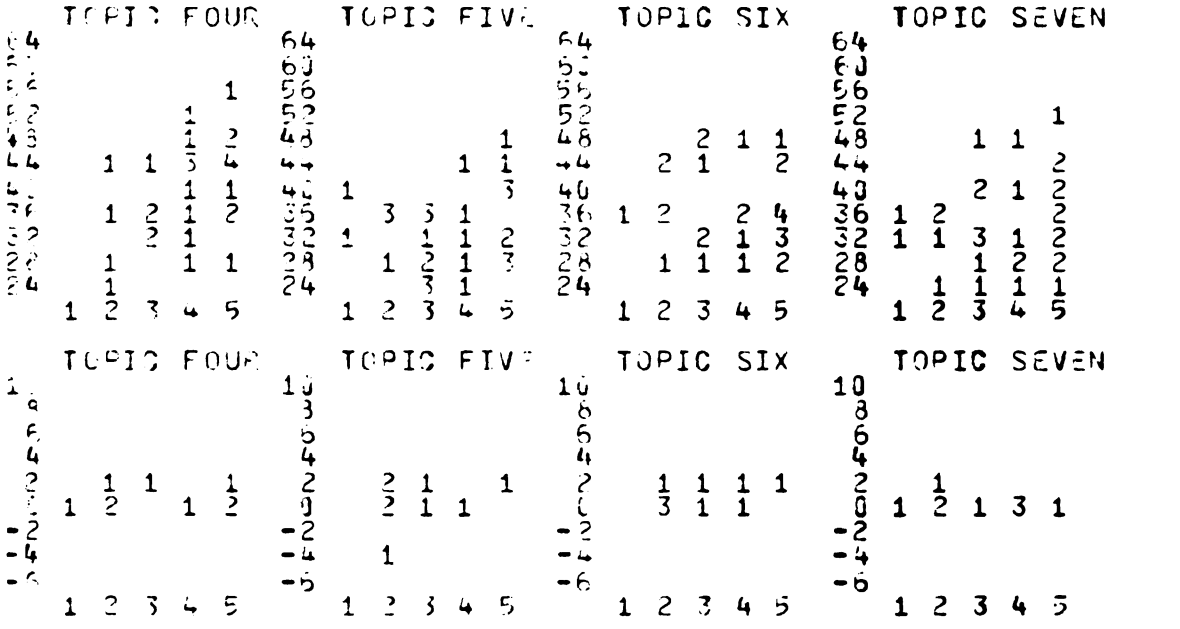
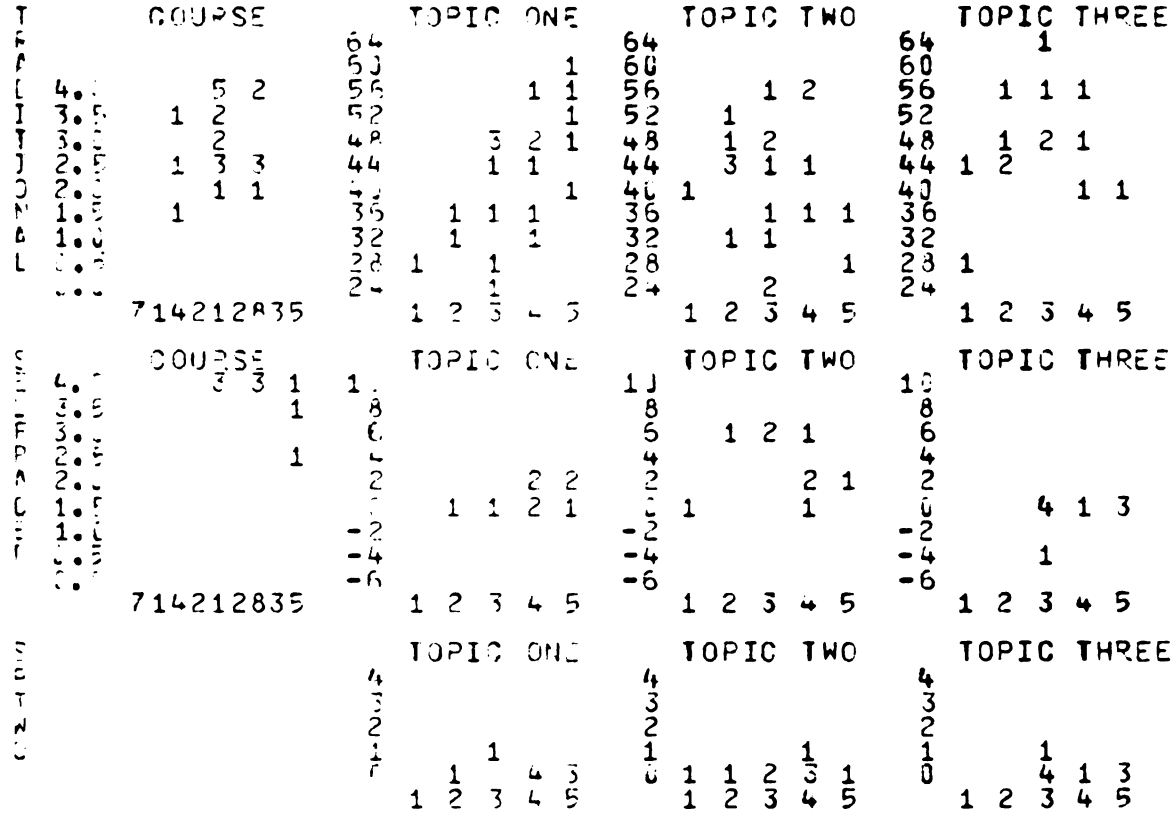


TABLE 4-1AG

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH TEST ANXIOUS LOW READING APTITUDE STUDENTS



RELEVANCE SCALES

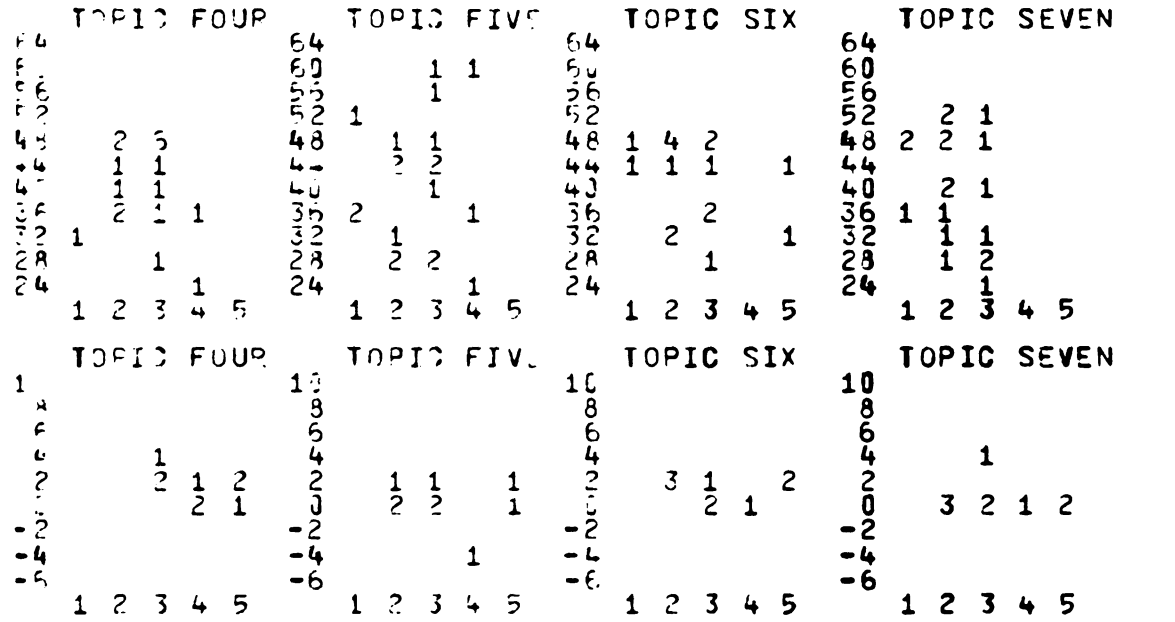
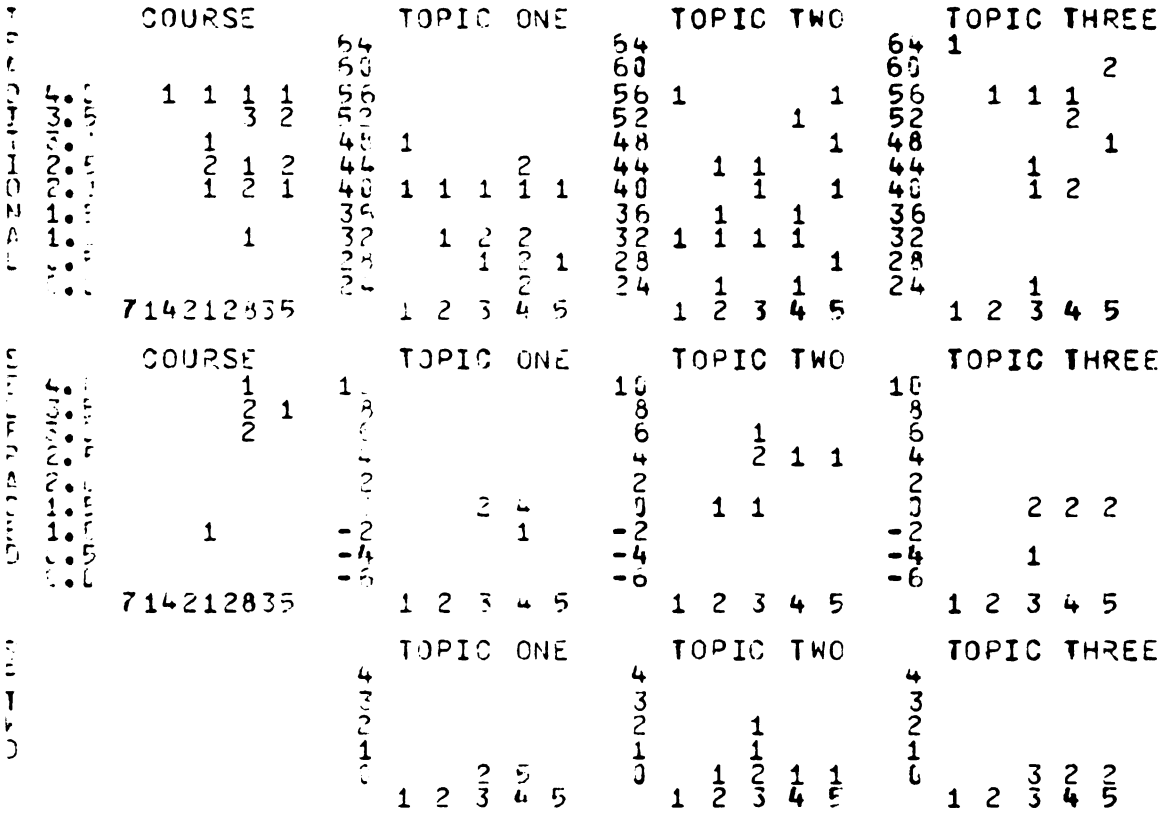


TABLE 4-1AH

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW DOGMATIC LOW TEST ANXIOUS STUDENTS



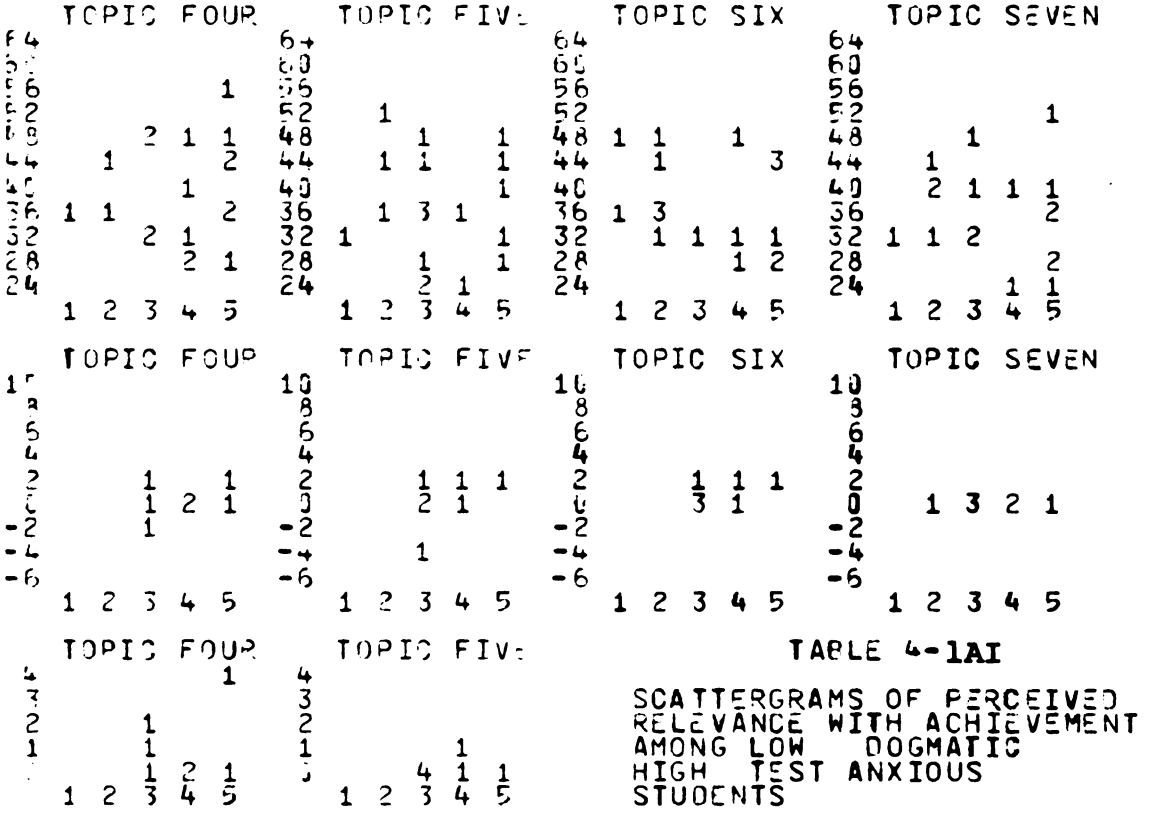


TABLE 4-1AI

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG LOW DOGMATIC HIGH TEST ANXIOUS STUDENTS

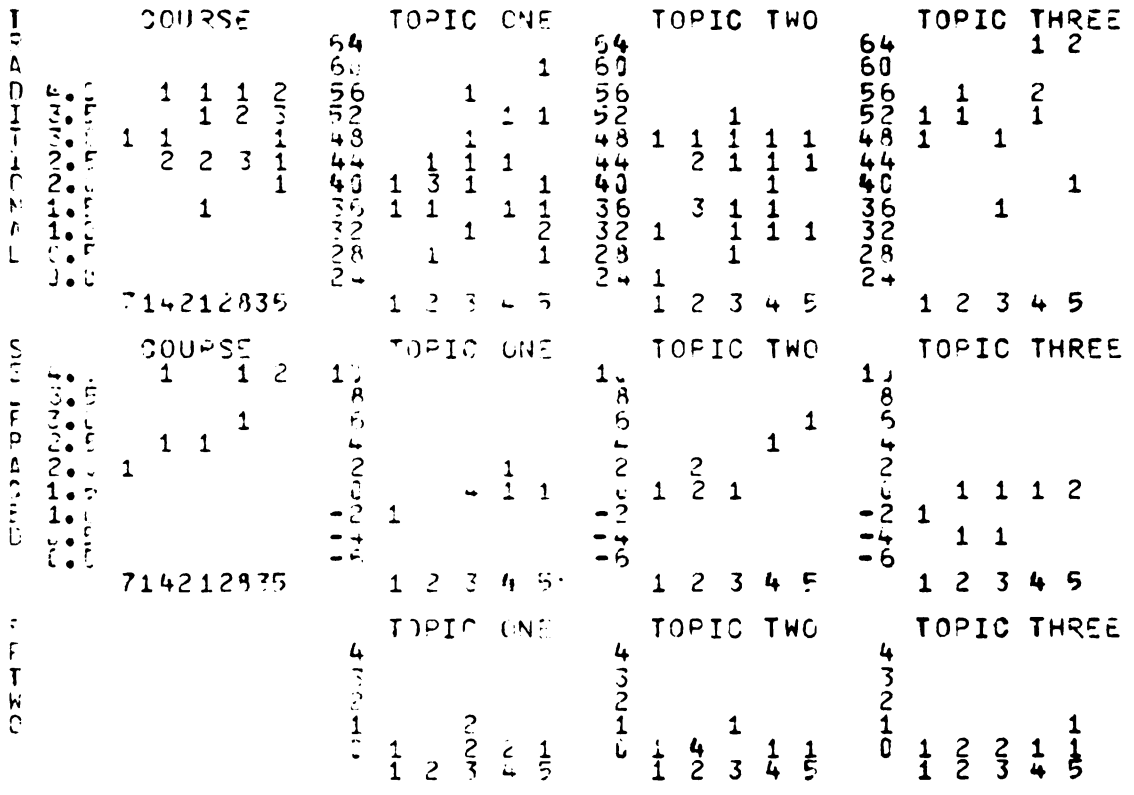
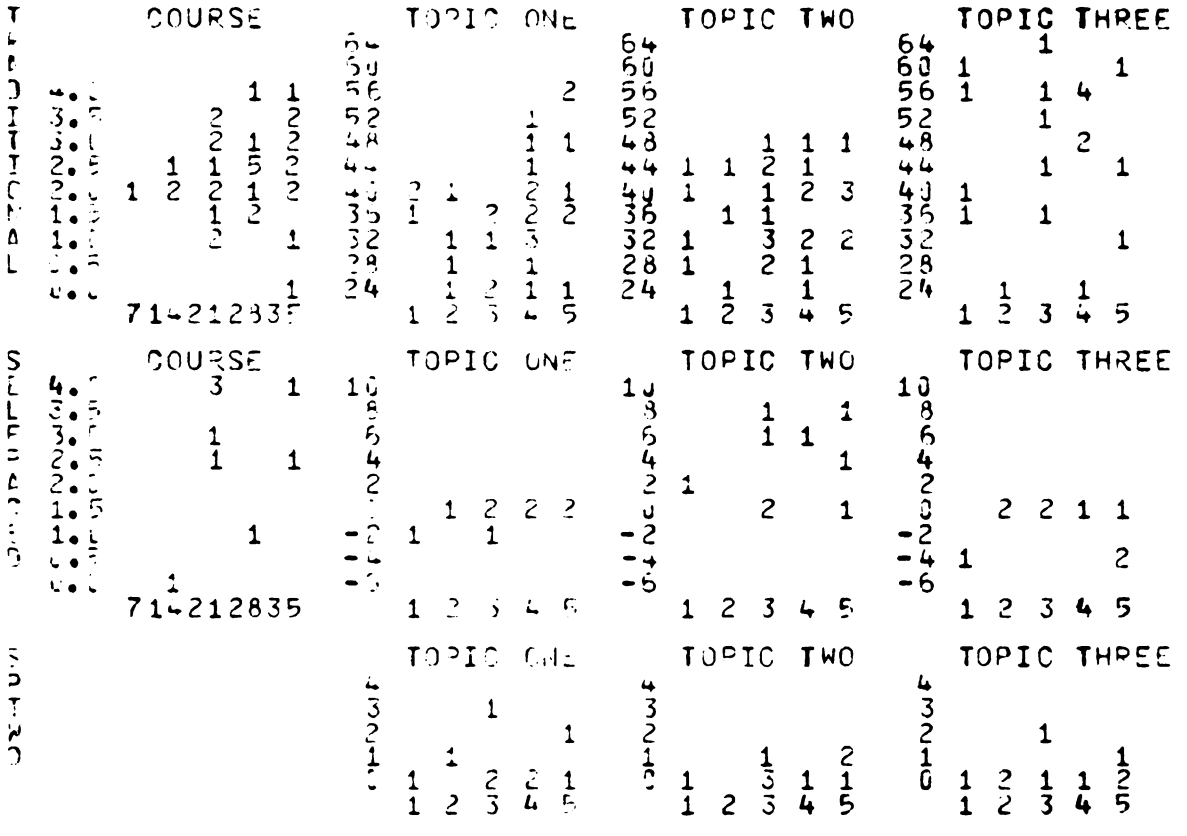
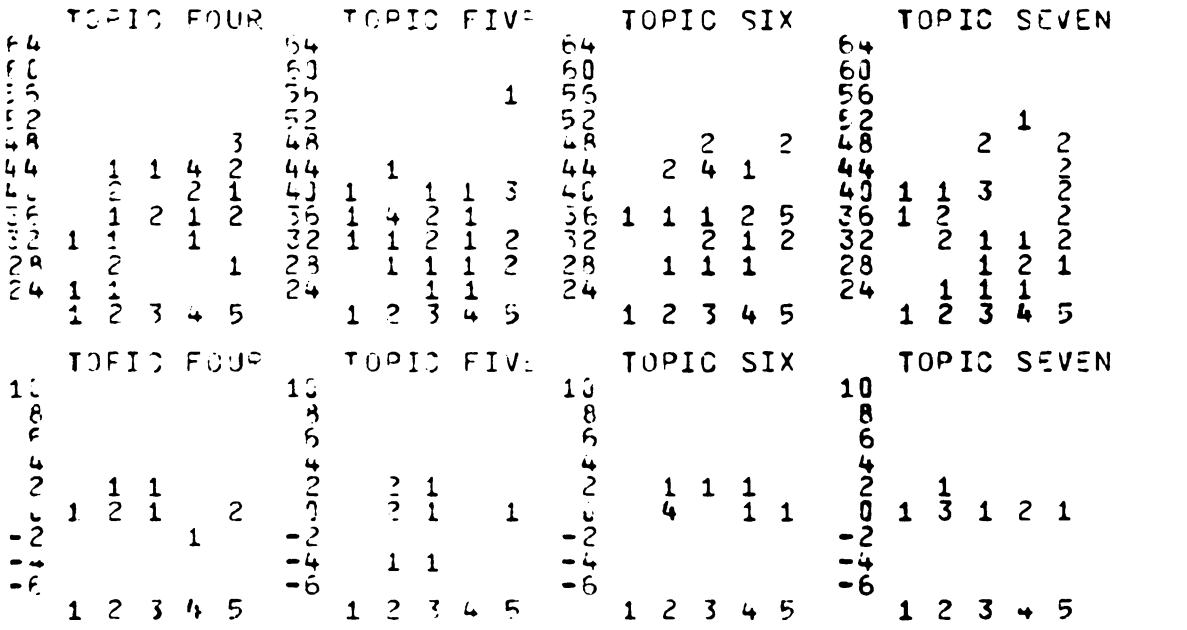


TABLE 4-1AJ

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH DOGMATIC LOW TEST ANXIOUS STUDENTS





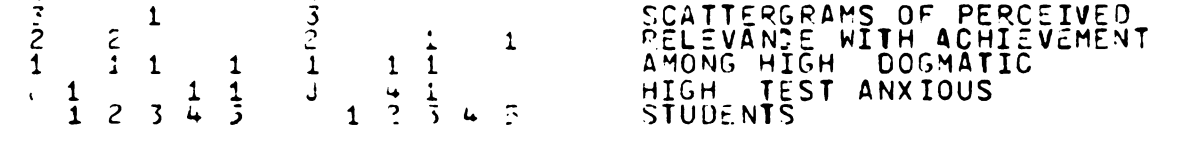


TABLE 4- lAK

SCATTERGRAMS OF PERCEIVED RELEVANCE WITH ACHIEVEMENT AMONG HIGH DOGMATIC HIGH TEST ANXIOUS STUDENTS

points near the line among low dogmatic high mathematics aptitude subjects, among low test anxious high reading aptitude subjects, or low dogmatic low test anxious subjects, while the line is distinct for high dogmatic low test anxious subjects, high test anxious low reading aptitude subjects, high test anxious low mathematics aptitude subjects, high dogmatic low reading aptitude subjects, high dogmatic subjects, high dogmatic males, low test anxious subjects, low mathematics aptitude subjects, and low reading aptitude subjects.

Correlation Coefficients

The correlation coefficients for the course and the seven topic areas and their significance levels are reported for the traditional section and the two methods of measurement of achievement in each of the sub-groups in which the self-paced section has at least six members.

The significance levels for the difference between the correlation coefficients in the self-paced and traditional sections are reported for the course and the seven topic areas. Significant within-line correlations are reported.

Total Correlations

Among all 126 subjects in the traditional section, as illustrated in Table 4-2A, five of the correlations among the seven topic area correlations are significant

Table 4-2A.--Correlation coefficients and mean final grades by group.

GROUP CODE		N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR.	FINAL GRADE	SD
	TRAD	126	.09*	.16****	-.01	.14***	.10**	.10**	.08	.10**	.11*****	2.8	.867
	SP1	35	.24***	.43*****	.19**	.20**	.02	.07	.27***	-.03	.01	3.2	1.02
	SP2	35		.02	-.20	-.08	.24***	-.11			-.15		
M	TRAD	111	.13***	.19****	.01	.18****	.15***	.10*	.11**	.18****	.14*****	2.7	.891
	SP1	27	.24**	.38****	.16	.09	-.04	.10	.25**	-.10	.05	3.1	1.10
	SP2	27		.03	-.22	-.09	.31***	-.03			-.07*		
F	TRAD	15	-.02	-.06	-.13	-.15	-.28	.17	-.18	-.18	-.19*****	3.1	.585
	SP1	8	.44**	.53***	.32	.65****	.39*	-	.52***	.43*	-.12	3.6	.594
	SP2	8		-.08	-	-	-.18	-.47			-.37		
LD	TRAD	42	-.01	.26****	-.15	.18**	.06	-.05	-.17	-.13	.02	2.9	.830
	SP1	16	-.08	.37***	.07	.35***	-.24	.04	.07	.08	.01	3.4	.806
	SP2	16		.29**	.03	.24*	-.12	-.30			-.12		
HD	TRAD	60	.14**	.14**	.08	.08	.22****	.15**	.21***	.17**	.16*****	2.6	.880
	SP1	17	.36***	.45****	.48****	.12	.06	.15	.32**	-.13	.01	3.0	1.20
	SP2	17		-.04	-.37	-.24	.21	-.28			-.17		

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HIGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.
SIGNIFICANCE LEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

at the .15 level or better, using a one tailed test. The correlation of final grade with total achievement is significant at the .20 level and the significant correlations in the topic areas include three at the .15 level, one at the .10 level, and one at the .05 level. The mean within-line correlation is .105, significant at the .01 level.

The significant correlations in the self-paced group for the first measure of achievement include the total course at the .10 level, and four among the topic areas, two at the .15 level, one at the .10 level, and one at the .01 level. The mean within-line correlation is not significantly greater than zero at any level reported in this study.

The second measure of achievement in the self-paced section has one significant correlation among the five topic areas involved, at the .10 level. Three correlations are negative and the mean within-line correlation is negative.

The differences between the correlations in the self-paced and traditional sections in this group in each of the course and seven topic areas are significant in the hypothesized direction in three of the topic areas, two at the .20 level and one at the .10 level. None of the correlation differences involving the second measure of achievement in the self-paced section are significant.

Sex Differences in Correlations
(Table 4-2A)

The correlation coefficients for the course and for six of the seven topic areas among males in the traditional section are significant, one at the .20 level, one at the .15 level, two at the .10 level (including the course correlation), and three at the .05 level. The mean within line correlation is .142, significant at the .01 level.

Among females in the traditional section all but one of the correlations are negative. None is significantly different from zero.

Males in the self-paced section exhibit two significant correlations among the topic areas on the first measure of achievement, one at the .15 level and one at the .05 level. The correlation of course grade with total achievement is significant at the .15 level. The within-line correlation is not significant. Females in the self-paced section show six significant correlations; the total course at the .15 level and five topic area correlations, two at the .20 level, two at the .10 level, and one at the .05 level.

The second measure of achievement in the self-paced section shows one significant correlation at the .10 level among males. No other significant correlations occur among either males or females.

One topic area among males shows a significant difference between correlations in the traditional and self-paced section, at the .20 level (topic one).

Among females the differences between correlations in the traditional section and the self-paced section are significant for the course at the .20 level and in six of the seven topic areas, three at the .20 level, two at the .10 level, and one at the .05 level. None of the differences in correlations on the second measure of achievement is significant.

Dogmatism (Table 4-2A)

Two correlations among the topic areas in each of the traditional section and the two measures of achievement in the self-paced sections are significant among low dogmatic students, one at the .15 level and one at the .05 level in the traditional section, two at the .10 level on the first achievement measure in the self-paced section and two at the .20 level on the second measure. The mean within-line correlation is negative on the second measure of achievement in the self-paced section.

High dogmatic students in the traditional section show a course correlation of total relevance with achievement significant at the .15 level and five significant topic area correlations, three at the .15 level and two at the .05 level. Four correlations in the self-paced section are significant on the first measure of

achievement; in the course correlation at the .10 level, in one of the topic areas at the .15 level, and in two of the topic areas at the .05 level. No correlation on the second measure is significantly greater than zero. Four, in fact, are negative. The mean within-line correlation in the traditional section is .16, significant at the .01 level, while the mean within-line correlation on the second measure of achievement in the self-paced section is negative.

None of the differences in correlations between the traditional and self-paced sections is significant among low dogmatic students while two are significant among high dogmatic students on the first measure of achievement in the self-paced section, one at the .15 level and the other at the .10 level.

Sex and Dogmatism (Table 4-2B)

There are less than six members in each of the female low and high dogmatic groups. These groups are excluded from the study.

Low dogmatic males in the traditional section show two significant topic area correlations, one at the .15 level and the other at the .05 level, and four negative correlations. The mean within-line correlation is .07, significant at the .20 level. Low dogmatic males in the self-paced section show two significant correlations in each of the two measures of achievement, both at the .20

Table 4-2B.--Correlations coefficients and mean final grades by group.

GROUP CODE		N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR,	FINAL GRADE	SD
MLA	TRAD	40	.21***	.41*****	-.09	.25***	.15*	.14	.08	.16*	.15*****	3.0	.768
	SP1	12	.52****	.58****	.31*	.60****	.05	.26	.17	-.04	.06	3.4	.753
	SP2	12		.27	-.20	-.18	.49***	.33*			-.07		
MHA	TRAD	54	.14*	.08	.09	.05	.25****	.10	.15**	.26****	.14*****	2.5	.942
	SP1	14	.31**	.28*	.26*	.07	-.08	.18	.27*	-.27	.04	2.8	1.295
	SP2	14		-.03	-.15	-.01	.04	-.34			-.07		
MLD	TRAD	36	.04	.29****	-.14	.20**	.09	-.07	-.06	-.01	.07*	2.9	.868
	SP1	12	-.09	.30*	.09	.28*	-.27	.14	.08	-.13	.10*	3.2	.865
	SP2	12		.43***	-.06	.28*	-.18	.08			-.07		
MHD	TRAD	56	.19***	.16**	.02	.10	.27****	.19***	.18***	.26****	.18***	2.6	.883
	SP1	14	.42***	.49****	.42***	.03	-	.13	.27*	-.19	-.01	2.9	1.293
	SP2	14		-.09	-.33	-.21	.31**	-.22			-.08		

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HOGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.

SIGNIFICANCE LEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

level on the first measure and one at the .20 and the other at the .10 level on the second measure. The mean within-line correlation on the first measure is .10, significant at the .20 level.

High dogmatic males in the traditional section show a correlation of final grade with total relevance that is significant at the .10 level and show five significant topic area correlations, one at the .15 level, two at the .10 level, and two at the .05 level. The mean within-line correlation is .18, significant at the .10 level. In the self-paced section the course correlation is significant at the .10 level and three topic area correlations are significant, at the .20, .10, and .05 levels for the sixth, second, and first topic area in that order. The mean within-line correlation is not significant. One of the five correlation coefficients on the second measure of achievement is significantly greater than zero at the .15 level. The other four are all negative.

None of the differences between correlations among low dogmatic males is significant, while two are significant among high dogmatic males on the first measure of achievement, one at the .20 level and the other at the .10 level.

Test Anxiety (Table 4-2C)

Low test anxious students in the traditional section exhibit a course correlation (between course grade and total relevance) significant at the .20 level and two significant topic correlations, one at the .10 level and the other at the .01 level. The mean within-line correlation is .10, significant at the .10 level. Low test anxious students in the self-paced section show five significant correlations, one for the course at the .05 level and one among the topic area correlations significant at the .20 level, one at the .10, one at the .05 and one at the .01 level, on the first measure of achievement. The second measure shows two correlations significant at the .15 level, and a negative mean within-line correlation.

High test anxious students show four significant correlations in the traditional section and four on the first measure of achievement in the self-paced section, at the .20 level in the course for both sections, at the .20, .10, and .05 levels in the traditional section and all at the .20 level in the self-paced section. The mean within-line correlations are .12 in the traditional section, significant at the .05 level, and non-significant in the other two, although negative on the second measure in the self-paced section.

Table 4-2C.--Correlation coefficients and mean final grades by group.

GROUP CODE		N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR.	FINAL GRADE	SD
LA	TRAD	46	.15*	.39*****	-.03	.20***	.08	.13	.02	.01	.10***	3.0	.750
	SP1	17	.47****	.56*****	.36***	.47****	.16	.07	.26*	.11	-.03	3.5	.717
	SP2	17		.28**	-.15	-.16	.28**	.04			-.16		
HA	TRAD	58	.12*	.08	.09	.04	.23****	.08	.13*	.22***	.12****	2.6	.918
	SP1	16	.28*	.32**	.25*	.03	-.08	.17	.27*	-.24*	.04	2.9	1.24
	SP2	16		-	-.13	-.03	.06	-.33			-.12		
LR	TRAD	72	-.02	.02	-.02	.13**	.05	-.03	.02	.07	.11**	2.6	.809
	SP1	15	.41***	.28*	.11	.44****	-.03	.18	.48****	-.20	-.01	3.2	1.083
	SP2	15		-.04	-.12	-.19	.34**	-.37			.05		
HR	TRAD	41	.14*	.21***	-.25	.16*	.09	.21***	.07	.07	.10***	3.0	.958
	SP1	15	-.29	.48****	.10	.04	-.12	-	.16	.06	-.02	3.6	.806
	SP2	15		.04	-	.21	.22	-.27			-.19		

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HIGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.

SIGNIFICANCE LEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

Three of the differences between correlations among low test anxious students are significant, at the .20 level for the course and at the .20 and .10 level for two topic areas. No other differences are significant.

Sex and Test Anxiety
(Table 4-2B)

There are less than six members in each of groups; low and high test anxious females. These groups are excluded from the study.

Low test anxious males show five significant correlations in the traditional section, at the .10 level for the course and two at the .20 level, one at the .10 level, and one at the .01 level among the topic areas. The mean within-line correlation is .15, significant at the .01 level. Four correlations are significant among the self-paced students on the first measure of achievement and two on the second. These are at the .05 level for the course and the .20, .05, and .05 on the first achievement measure, and .20 and .15 on the second.

Among high test anxious male students four correlations are significant, at the .20 level for the course, and one at the .15 level and two at the .05 level among the topic area correlations in the traditional section, at the .15 level for the course and the .20 level for two significant topic area correlations in the self-paced section. The mean within-line correlation in the

traditional section is .14, significant at the .01 confidence level.

Three differences between correlations in the traditional and self-paced sections in each topic and the course are significantly different from zero in favor of the self-paced section on the course correlations and two topic area correlations among the low test anxious males, all three at the .20 level. One topic area in the second measure in the low test anxious group shows a correlation difference significant at the .20 level.

Michigan State University
Reading Score (Table 4-2C)

One topic area correlation among students with low MSU reading scores in the traditional section is significantly greater than zero at the .15 level, and the mean within-line correlation is significant at the .15 level. In the self-paced group the correlation between course grade and total relevance is significant at the .10 level and three topic area correlations are significant, at the .20, .05 and .05 confidence levels. One topic area correlation on the second measure in the self-paced section is significantly greater than zero at the .15 level.

Among MSU reading test high scoring students in the traditional section four correlations are significant,

the course correlation at the .20 level and topic area correlations at .20, .10 and .10 levels. The mean within-line correlations is .10, significant at the .10 level.

There is one significant correlation among the course and topic area correlations on the two measures of achievement in the self-paced section, at the .05 level. The mean within-line correlations are negative.

The differences between correlations in the traditional and self-paced section on the first measure of achievement are significant for the course at the .10 level and for three topic areas at the .20, .20, and .10 levels. One difference for the topic areas is significant at the .20 level on the second measure of achievement.

Michigan State University
Mathematics Score (Table 4-2D)

One topic area correlation in the traditional section and six in the self-paced section on the first measure of achievement are significant among low scoring math test students, the first at the .15 level and the others at the .05 level for the course and the .15, .10, .05, .05, and .01 levels for topic areas.

Among high scoring students on the MSU Reading Test two topic area correlations are significant in the traditional section, at the .15 and .05 levels, and two correlations in the self-paced section, at the .20 and .10 levels. Five correlations are negative in the

Table 4-2D.--Correlation coefficients and mean final grades by group.

GROUP CODE		N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR.	FINAL GRADE	SD
LK	TRAD	64	.02	.01	.09	.15**	-.07	.05	-.06	.04	.03	2.7	.891
	SP1	15	.56****	.35**	.53****	.46****	.11	.35***	.60*****	-	.01	3.2	1.065
	SP2	15		.05	-.13	-.41	.14	-			-.04		
HK	TRAD	35	-.06	.30****	-.22	.22**	.06	.10	.16*	.11	.26*****	3.0	.874
	SP1	14	-.26	.38***	-.27	-.16	-.22	-.23	.27*	.08	-.01	3.6	.836
	SP2	14		-.17	-.02	.14	.72*****	.34			-.21		
LRLK	TRAD	54	-.04	-.05	.09	.19***	-.06	-.10	-.14	-.05	-.02	2.7	.804
	SP1	11	.72*****	.37**	.37**	.54****	.23	.29*	.63****	-	-.09	3.0	1.193
	SP2	11		.01	.03	-.46	.24	-			.02		
HRHK	TRAD	21	-.12	.27**	-.23	.23*	-.10	.12	.08	.07	.14***	3.2	.856
	SP1	11	-.23	.51***	-.17	-.13	-.18	-.10	.08	.01	-.12	3.5	.917
	SP2	11		-.10	.05	.24	.41**	.31**			-.19****		

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HIGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.

SIGNIFICANCE LEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

self-paced section and one in the traditional section. The mean within-line correlation in the traditional section is .26, significant at the .01 level.

One correlation in the self-paced section on the second measure of achievement is significant at the .01 level. The mean within-line correlation is negative.

Six differences between the correlations in the traditional and self-paced sections are significant on the first measure of achievement. One for the course at the .05 level and for five topic areas at the .20, .20, .20, .10, and the .05 levels, among low MSU Mathematics test achievers (Table 4-2D).

Among high MSU Mathematics test achievers in the self-paced section, one difference on the second measure of achievement is significant at the .01 level.

Low MSU Reading Score and Low MSU Mathematics Score

There is one significant correlation among the traditional section students. It is among the topic areas and is significant at the .10 level. Six correlations in the self-paced group on the first achievement measure are significant; one at the .20 level, two at the .15 level, and two at the .01 level. The mean within-line correlations are negative.

High MSU Reading Score and
High MSU Mathematics Score
(Table 4-2D)

Two topic area correlations are significant in this group in the traditional section; one at the .20 level and one at the .15 level. The mean within-line correlation is .14, significant at the .10 level. Two topic correlations on the second achievement measure in the self-paced section are significant, one at the .20 level and one at the .15 level. The mean within-line correlations are negative.

The difference in correlation coefficients among low test score students on the first achievement measure are significant at the .01 level for the total course and at the .20, .20, .20, and .05 levels for four topic areas. One topic area difference on the second achievement measure is significant among the high test score students at the .15 level.

Sex and MSU Mathematics Test
Score (Table 4-2E)

There are fewer than six female students with high MSU Math test scores in the self-paced section. This group is excluded from the study.

Among high math aptitude males in the traditional section four topic correlations are significant, at the .20, .15, .10, and .05 levels. Self-paced students show one correlation at the .20 level and five negative

Table 4-2E.--Correlation coefficients and mean final grades by group.

GROUP CODE		N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR.	FINAL GRADE	SD
MHK	TRAD	32	-.05	.32****	-.16*	.25***	.05	.05	.22**	.10	.30*****	2.9	.874
	SP1	9	-.47	.34*	-.33	-.47	-.25	-.24	.04	.04	.10	3.5	1.000
	SP2	9		.15	-	.14	.87*****	.56***			-.16		
MLK	TRAD	55	.12	.10	.07	.22****	-.01	.11	-.08	.14	.05*	2.6	.923
	SP1	14	.68*****	.37**	.49****	.53****	.02	.36**	.58****	-	.04	3.1	1.082
	SP2	14		.04	-.08	-.40	.21	.07			-.14		
MLR	TRAD	64	.07	.03	-.06	.19***	.12*	.07	.01	.20***	.13*****	2.6	.836
	SP1	15	.41***	.28***	.11	.44****	-.03	.18	.48****	-.20	-.01	3.2	1.083
	SP2	15		-.04	-.12	-.19	.34***	.04			-.05		
MHR	TRAD	37	.15*	.20***	.03	.17*	.09	.15*	.14	.11	.13****	2.9	.963
	SP1	9	-.56	.56***	.03	-.47	-.50	.11	-.23	-.09	.13*	3.4	.982
	SP2	9		.44***	-	.30	.54***	-			-.10		

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HIGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.

SIGNIFICANCE LEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

correlations. Two topic correlations on the second measure of achievement are significant, one at the .10 level and the other at the .01 level.

Low math aptitude male students show one significant correlation at the .05 level and one at the .20 level in the traditional section and six significant correlations in the self-paced section. In the latter the total course correlation is significant at the .01 level and five topic area correlations at the .15, .15, .05, .05, and .05 levels.

One topic area difference in correlations on the second achievement measure among high math aptitude males is significant at the .10 level.

Five difference scores are significant among low math aptitude males on the first measure of achievement and one on the second measure. These are significant for the total course at the .05 level and for the topic areas at the .20, .20, .10, .05, and .20 levels.

Sex and MSU Reading Test Score
(Table 4-2E)

There are less than six females with low MSU reading scores in the self-paced section and less than six females with high MSU reading scores in the traditional section. These groups are excluded from the study.

Males with low reading aptitude show three significant correlations in the traditional section, one at the

.20 level and two at the .10 level. The mean within-line correlation is .13, significant at the .05 level. There are four significant correlations on the first achievement measure in the self-paced section and one on the second measure. They are significant at the .10 level for the course and at the .10 level, .05 level, .05 level, and .10 level for the topic areas.

High reading aptitude males display one significant correlation at the .15 level and five negative correlations in the self-paced section. Four correlations are significant, three at the .20 level and one at the .10 level, in the traditional section. Two correlations are significant at the .10 level on the second measure in the self-paced section. Mean within-line correlations are significant at the .05 and .20 levels in the self-paced and traditional sections.

There are three significant differences in correlations on the first achievement measure, at the .20, .20, and .10 levels, among low reading aptitude males.

High reading aptitude males exhibit one significant difference in correlations in each of the two achievement measures, both at the .20 level.

Dogmatism and MSU Mathematic Test Score (Table 4-2F)

Low dogmatic high math aptitude students in the traditional section show one significant correlation at the

Table 4-2F.--Correlation coefficients and mean final grades by group.

GROUP CODE	N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR.	FINAL GRADE	SD
LDHK TRAD	13	-.32	.50****	.19	.05	.01	-.11	-.27	-.30	.16***	3.0	.787
SP1	8	-.54	.34	.05	.22	-.25	-.23	.07	-.09	-.25	3.9	.177
SP2	8		.34**	.04	.22	.35**	-.55			-.12		
HDLK TRAD	31	-.03	-.10	.14	.15	-.03	.05	.14	.05	.13****	2.4	.899
SP1	9	.70****	.63****	.63****	.41**	.39*	.33	.64****		-.18	3.2	1.372
SP2	9		-.20	-.31	-.70	.24	-.04			-.06		
LDLK TRAD	19	.29**	.05	-.07	.25*	.11	.09	-.38	-.25	-.16	3.1	.737
SP1	6	-.23	-	.39	-	-.49	.59**	.69***	-	.28****	3.1	.408
SP2	6		-	.11	-	-.20	.16			-.01		
HALK TRAD	30	.08	-.24	.15	.12	.14	.12	-.03	.12	.04	2.6	.968
SP1	9	.76*****	.39*	.51***	.61****	.17	.36*	.73****		-.01	3.0	1.225
SP2	9		-.09	-.15	-.39	-.11	.07			.01		

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HIGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.

SIGNIFICANCE SEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

.05 level and four negative correlations. The mean within-line correlation is .16, significant at the .10 level. There are four negative correlations on the first achievement measure and two significant positive correlations on the second achievement measure at the .15 level. The mean within-line correlations are negative.

Among high dogmatic low math aptitude students there are six significant correlations in the self-paced section, four at the .05, one at the .15, and one at the .20 levels, and none in the traditional section. The mean within-line correlation in the traditional section is significant at the .05 level and in the self-paced section is negative. The correlations on the second achievement measure show only one positive correlation, and that one is non-significant.

Two topic area correlations in the traditional section are significantly greater than zero at the .15 and .20 levels among low dogmatic low MSU Reading test achievers. The mean within-line correlation and three topic area correlations are negative.

Low dogmatic low math achievers in the self-paced section show two topic area correlations significantly greater than zero, one at the .15 level and one at the .10 level. The mean within-line correlation is .28, significant at the .05 level.

Significant differences between correlations in the traditional and self-paced sections occur on the first achievement measure in the high dogmatic low math aptitude group and the low dogmatic low math aptitude groups. The difference between total course correlations in the high dogmatic low math aptitude group is significant in the hypothesized direction at the .10 level. Differences in three topic area correlations in the same group are significant at the .20, .10, and .05 levels. Two topic areas show differences in correlations between the traditional and self-paced groups in the low dogmatic low math group at the .20 and .05 confidence levels.

Dogmatism and Michigan State University Reading Score (Table 4-2G)

There are less than six members in each of the low dogmatic low reading aptitude and the high dogmatic high reading aptitude groups in the self-paced sample. These groups are excluded from the study. High dogmatic low reading aptitude students in the traditional section show one topic area correlation significant at the .15 level and a mean within-line correlation of .15 significant at the .01 level. The course correlation and five topic area correlations in this group in the self-paced section are significantly greater than zero, the course correlation at the .01 level and the topic area

Table 4-2G.--Correlation coefficients and mean final grades by group.

GROUP CODE	N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR.	FINAL GRADE	SD
HDLR TRAD	35	-.04	-.16	.07	.03	.13	-.04	.19**	.07	.15*****	2.4	.894
SP1	10	.71*****	.57****	.55***	.54***	.35*	.27	.52***	-.18	-.03	3.2	1.295
SP2	10		-.08	-.20	-.30	.36*	-.08			.15****		
LDHR TRAD	13	-.53	.03	-.42	-.10	-.59	-.12	-.64	-.64	-.06	3.3	.801
SP1	10	-.37	.31*	.20	.26	-.33	-.13	.16	-.03	-.06	3.8	.350
SP2	10		.36*	.03	.26	.40*	-.52			-.19		
HALR TRAD	35	.13	-.08	.17*	.04	.36****	.18*	.17*	.28***	.12****	2.5	.985
SP1	9	.62****	.34*	.41**	.60****	.18	.22	.46**	-.28	-.15	3.1	1.299
SP2	9		-.16	-.09	-.17	-.12	-.14			.00		
LAHR TRAD	17	-.04	.44****	.12	.24*	.09	-.28	-.21	-.37	.15***	3.4	.682
SP1	9	-.50	.40**	.26	.29	-.03	-.12	.14	-.03	-.24	3.9	.167
SP2	9		.36*	-	.19	-.19	-.48			-.09		

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HIGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.

SIGNIFICANCE SEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

correlations at the .05, .10, .10, .20, and .10 levels. One topic area correlation on the second measure of achievement and the mean within-line correlation are significant at the .20 and .05 levels.

Low dogmatic high reading aptitude students in the traditional section exhibit seven negative correlations, five which would have been significant at the .10, .05, .05, .01, and .01 levels, if the hypothesis had been in the opposite direction. Five correlations in the self-paced section in this group are negative. On the second measure of achievement in the self-paced section two topic correlations are significant, at the .20 level, while one topic area correlation and the mean within-line correlation are negative.

Differences between traditional section and self-paced section correlations on the first achievement measure among high dogmatic low reading aptitude students are significant for the total course and for four topic areas, at the .05, .05, .10, .10, and .20 levels. Three topic areas on the first achievement measure and two on the second show significant differences in correlations among low dogmatic high reading aptitude students, at the .10, .05, and .10 levels on the first achievement measure and at the .20 and .05 levels on the second.

Test Anxiety and MSU Mathematics Test Scores (Table 4-2F)

There are no correlations significantly greater than zero among high test anxious low math aptitude students in the traditional section, but six correlations are significant in the self-paced section, including the course correlation at the .01 level and five topic area correlations on the first measure at the .20, .10, .05, .20, and .05 levels.

One topic area correlation and the mean within-line correlation are significant among low test anxious high reading aptitude students in the traditional section, at the .10 and .01 levels, respectively. Four topic area correlations are negative in this section and four correlations and the mean within-line correlation are negative in the self-paced group. On the second measure of achievement one topic area correlation is significant at the .10 level, and the mean within-line correlation is negative.

Low test anxious low mathematics aptitude students show two significant topic area correlations in the traditional section; one at the .15 level and the other at the .10 level. There are three significant topic area correlations on the first achievement measure and two on the second measure in this group, at the .20, .10, .05, .20, and .15 levels.

Differences between correlations in the traditional and self-paced sections are significant for the total

course and for four topic areas on the first achievement measure among high test anxious low math aptitude students, at the .05, .10, .20, .10, and .05 confidence levels. Low test anxious low math aptitude students exhibit three significant differences at the .20 level, two on the first achievement measure and one on the second.

Test Anxiety and MSU Reading Test Scores (Tables 4-2G, 4-2H)

Five topic area correlations and the mean within-line correlation are significantly greater than zero among high test anxious low reading aptitude students in the traditional section, at the .20, .05, .20, .20, .10, and .05 levels. Self-paced students in this group exhibit a significant total course correlation and four topic area correlations, at the .05, .20, .15, .05, and .15 levels respectively. The mean within-line correlation is negative.

Low test anxious low reading aptitude students in the traditional section exhibit five negative correlations. There are less than six members in this group in the self-paced section.

Two topic area correlations and the mean within-line correlation among low test anxious high reading aptitude students in the traditional section are significantly greater than zero at the .05, .20, and .10 levels, while two topic area correlations are negative.

Table 4-2H.--Correlation coefficients and mean final grades by group.

GROUP CODE		N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR.	FINAL GRADE	SD
LAHR	TRAD	14	.08	.40***	-.26	-.14	.01	.08	-.04	-.05	.25*****	3.3	.719
	SP1	8	.35	.13	.13	.28	-.25	-.20	.13	-.09	-.13	3.8	.372
	SP2	8		.34	-	.28	.21	-.55***			-.13		
LALR	TRAD	21	.01	.29**	.15	.29***	-.07	.11	.05	-.11	.02	2.9	.750
	SP1	6	.23	-	.71***	.31	.05	.80****	.54**	-	.01	3.5	.775
	SP2	6		.50*	-.11	-.43	.56**	-.05			-.08		
FHR	SP1	6	.23	.63***	.25	.50*	.66***	-.14	.67***	.39	-.24	3.8	.408
	SP2	6		-.25	-	-	-	-.38			-.33		

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HIGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.

SIGNIFICANCE LEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

Self-paced students exhibit one positive topic area correlation at the .15 level, with a negative course correlation and mean within-line correlation. One topic area correlation on the second achievement measure in the self-paced section is significant at the .20 level.

High test anxious high reading aptitude students show one significant topic area correlation at the .15 level in the traditional section. There are less than six members in this group in the self-paced section.

The differences between correlations in the traditional and self-paced section on the first measure of achievement are significant for the total course and two topic areas among high test anxious low reading aptitude students, for the course and three topic areas among low test anxious high reading aptitude students, for no area among low test anxious high reading aptitude students, and for one topic area among high test anxious high reading aptitude students. The differences for the course and one topic area among high test anxious low reading aptitude students are significant at the .10 level, the rest are significant at the .20 level.

Dogmatism and Test Anxiety
(Table 4-2I)

The course correlation, five topic area correlations, and the mean within-line correlation are

Table 4-2I.--Correlation coefficients and mean final grades by group.

GROUP CODE	N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR.	FINAL GRADE	SD
HDHA TRAD	35	.19**	.25***	.18**	-.09	.29****	.12	.25***	.27***	.16*****	2.3	.893
SP1	9	.23	.39*	.16	-.17	-.29	-	.07	-.22	-.09	2.7	1.46
S	9		-.09	-.44	-.12	.25	-.72			-.19		
HDLA TRAD	24	.15	.17	.13	.32***	.14	.17	.13	.09	.20****	3.0	.712
SP1	8	.75****	.57***	.85*****	.50**	.51**	.52***	.61***	-	.10	3.2	.845
SP2	8		.13	-.12	-.52	.23	.40*			-.14		
LDHA TRAD	20	-.10	-.33	-.06	.24*	.14	-.22	-.13	.10	.05	2.9	.868
SP1	7	.37	.06	.45*	.42*	.14	.44*	.51**	-	.21**	3.0	.976
SP2	7		-	.19	-	-.24	-.24			-.04		
LDLA TRAD	22	.20*	.65*****-.22		.01	.02	.12	-.21	-.30	-.02	3.0	.806
SP1	9	-.52	.43**	-.09	.30	-.56	-.19	-.14	-.07	-.13	3.7	.507
SP2	9		.38*	-.20	.30	-	-.37			-.17		

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HIGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.

SIGNIFICANCE LEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

significantly greater than zero among high dogmatic high test anxious students in the traditional section at the .15, .10, .15, .05, .10, .10, and .01 levels. One topic area correlation in the self-paced section is significant at the .20 level on the first achievement measure, while four topic area correlations and the mean within-line correlation are negative on the second measure.

High dogmatic low test anxious students in the traditional section show one significant topic area correlation and a significant mean within-line correlation, at the .10 and .05 levels. Self-paced students in this group show a significant total course correlation and six significant topic area correlations, at the .05, .10, .01, .15, .15, .10, and .10 levels. One topic area correlation on the second measure is significant at the .20 level while two topic area correlations and the mean within-line correlation are negative.

Among low dogmatic high test anxious students in the traditional section one topic area correlation is significantly greater than zero, while five correlations are negative. Four topic area correlations and mean within-line correlation on the first achievement measure in the self-paced section are significant at the .20 level for the topic areas and at the .15 level for the within-line correlation. None are negative.

Low test anxious low dogmatic students show a significant positive total course correlation and one significant topic area correlation in the traditional section, at the .20 and .01 levels respectively, while three topic area correlations are negative. Self-paced students in this group show one significant positive topic area correlation on each of the achievement measures, one at the .15 level and one at the .20 level, while the total course correlation, the mean within-line correlation on each measure, and six topic area correlations on the first measure of achievement and three on the second are negative.

All differences between correlations in the traditional section and the self-paced section among high dogmatic high test anxious and low dogmatic low test anxious students are non-significant.

The differences on the first measure of achievement are significant for the course and five topic areas among high dogmatic low test anxious students, at the .05, .20, .05, .20, .20, and .20 levels, and for the course and three topic areas among low dogmatic high test anxious students, all at the .20 level.

Groups Excluded Because of Low Membership (Table 4-2J)

There are several sub-groups in which there are not enough members in one or the other of traditional or

Table 4-2J.--Correlation coefficients and mean final grades by group.

GROUP CODE	N	TOTAL COURSE	TOPIC ONE	TOPIC TWO	TOPIC THREE	TOPIC FOUR	TOPIC FIVE	TOPIC SIX	TOPIC SEVEN	MEAN W-L CORR.	FINAL GRADE	SD
HDHR TRAD	20	.35***	.43****	.02	.28**	.34***	.36***	.24**	.22**	.20****	2.9	.847
LDLR TRAD	23	.02	.20*	-.22	.26**	.11	-.05	-.16	-.01	.00	2.8	.765
HDHK TRAD	15	.20	.38***	-.12	.17	.14	.21	.51****	.22	.32*****	2.8	1.012
HAHK TRAD	14	.02	.47****	.03	.27*	.16	-.02	.37**	.36**	.24****	2.5	.909
LDF TRAD	6	-.12	.04	-.16	-.05	-.22	.12	-.79	-.89	-.22****	3.2	.524
LRHK TRAD	14	.10	.42***	-.18	.22	.27*	.16	.30*	.17	.41*****	2.6	.789
HRLK TRAD	10	.28	.22	.09	.07	-.20	.53***	.42**	-.01	.08	2.8	1.317
LAF TRAD	6	.57**	.42	.54**	-.20	-.59	.14	-.43	-.65	-.25	3.5	.447
LRF TRAD	8	-.50**	-.16	.43*	-.42	-.45	-.84	.10	-.33	-.16	3.0	.463
LKF TRAD	9	-.24	.14	.36*	-.37	-.43	.03	.08	-.41	-.12	3.1	.546
LALR TRAD	24	-.12	.15	-.14	.10	.06	-.07	-.04	-.02	.07	2.8	.640
HAHR TRAD	16	.19	.17	-.17	.05	.07	.19	.19	.32**	.09	2.7	.856

KEY TO GROUP CODE; M=MALE, F=FEMALE, H=HIGH, L=LOW, D=DOGMATIC, A=TEST ANXIOUS, R=READING APT., K=MATH APT.

SIGNIFICANCE LEVELS; *=.20, **=.15, ***=.10, ****=.05, *****=.01

self-paced sections to be used in this study. Those groups that have six or more members in the traditional section but not in the self-paced section are described below. Among high dogmatic high MSU Reading test achievers in the traditional section the correlation of course grades with total relevance is significant at the .10 level. The correlation of topic one achievement with relevance is significant at the .05 level. Topics four and five show correlations significant at the .10 level, topic three at the .15, and topics six and seven at the .20 level. The within-line correlation is .20, significant at the .05 level.

Among low dogmatic low MSU Reading test achievers two topic area correlations are significantly greater than zero at the .15 and .20 levels. The mean within-line correlation is .00005. The correlation coefficient for topic two is negative.

High dogmatic students with high MSU Mathematics test scores show two significant topic area correlations, one at the .10 level and the other at the .05 confidence level. The within-line mean correlation is .32, significant at the .01 level.

Students showing high test anxiety and high MSU Mathematics test scores show four significant topic area correlations, one at the .20 level, two at the .15 level,

and one at the .05 level. The within-group mean correlation is significant at the .05 level.

Low dogmatic females show six negative correlations in the traditional section. If the hypothesis had been that the correlation would be negative, one of these would have been significant at the .05 level and another at the .01 level. The within-group mean correlation is negative and would have been significant at the .05 level.

Students with low reading scores and high math scores exhibit three significant topic correlations, one at the .10 level and two at the .20 level. The within group mean correlation is .41, significant at the .001 level.

Better readers with low math scores show two significant topic correlations, one at the .10 level and the other at the .15 level.

Summary of Significant Correlation Coefficients

Total Course Correlation Coefficients:

Correlation coefficients were calculated for 47 groups in the traditional section. Seven of these total course correlation coefficients are significantly greater than zero at the .20 level, five at the .15 level, and four at the .10 level.

Among 35 total course correlation coefficients in the self-paced section one is significantly greater than zero at the .20 level, three at the .15 level, 5 at the .10 level, 6 at the .05 level, and 4 at the .01 level.

Topic Area Correlation Coefficients:

Twenty-six of the 329 topic area correlation coefficients in the traditional section are significant at the .20 level, 26 at the .15 level, 27 at the .10 level, 22 at the .05 level, and 3 at the .01 level.

In the self-paced section on the first achievement measure 26 of 245 correlation coefficients are significantly greater than zero at the .20 level, 19 at the .15 level, 20 at the .10 level, 27 at the .05 level, and 4 at the .01 level. On the second achievement measure 5 of 175 correlation coefficients are significant at the .20 level, 6 more at the .15 level, 8 at the .10 level, none at the .05 level, and 2 at the .01 level.

Mean Within-Line Correlation:

In the traditional section 32 of the 47 mean within-line correlations are significantly different from zero; 9 at the .20 level (6 greater than zero and 3 less than zero), 11 at the .10 level (10 greater than zero and one less than zero), and 11 at the .02 level (10 greater than zero and one less than zero).

Among the mean within-line correlations in the self-paced section 9 are significantly different from zero on the first measure of achievement; one at the .20 level (negative), 6 at the .10 level (two positive and 4 negative), and two at the .02 level (one positive and one negative). On the second measure of achievement 13 mean within-line correlations are significantly different from zero, one positive correlation at the .02 level and 12 negative correlations at the .20, .10, and .02 levels (4, 5, and 3, respectively).

Differences Among Final Course Grades

Since all but three final grade distributions among the groups in the self-paced section are skewed with the majority of students earning high grades, the means of the distributions are lower than the medians or the modes. Thus if the means of the distributions in the traditional section are significantly less than the means in the self-paced section, they are also less than the medians and the significance level is higher than is reported here.

Analysis of variance among the fifty groups and subgroups reported in this study yields a F ratio of 10.59, significant at better than the .0005 level.

On every group in which the self-paced section has at least six members the mean final grade in the

Table 4-3.--Analysis of variance for mean final grades among groups in the traditional section.

	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Category Means	81.162	46	1.764	F = 2.384
Within	1158.354	1566	0.740	$F_{.9995(46,1566)} = 1.79$
Total	1239.516	1612		

traditional section is less than the mean final grade in the self-paced section. The differences are significant in 19 of the 37 groups at the .01 level, 8 at the .05 level, 5 at the .10 level, and one at the .15 level.

The following differences in mean grades are significant in the traditional section:

Pairs	Significance Level
Females-Males	.10
Low test anxious-High test anxious	.025
High reading aptitude-Low reading aptitude	.025
High math aptitude-Low math aptitude	.10
Low dogmatic-High dogmatic	.10

The differences between high reading aptitude and low reading aptitude students are 0.5, significantly different from zero at the .01 level, among both high dogmatic and low dogmatic students. The differences between low dogmatic and high dogmatic students are 0.4 among both high and low reading aptitude students. There is no

difference significant at any level reported in this study between high dogmatic high reading aptitude and low dogmatic low reading aptitude students. The difference between low dogmatic high reading aptitude and high dogmatic low reading aptitude students is significantly greater than zero at the .0005 level.

Among groups determined by dogmatism score and MSU Mathematics test score only the difference between high dogmatic high math aptitude and high dogmatic low math aptitude, high dogmatic low math aptitude and low dogmatic high math aptitude, and high dogmatic low math aptitude and low dogmatic low math aptitude are significantly greater than zero. High dogmatic students earn lower grades than low dogmatic students among low math aptitude students, high math aptitude students earn higher grades than low math aptitude students among high dogmatic students, and low dogmatism combines with high math aptitude to earn higher grades than high dogmatism combined with low math aptitude.

The differences among groups differentiated by test anxiety and sex show significant differences with females earning higher grades than males and low test anxious students earning higher grades than high test anxious students. The effects reinforce one another.

Three of six differences among groups determined by test anxiety and dogmatism are significant, each at

Table 4-4A.--Mean final grade differences between traditional and self-paced sections.

Group Code	N_t	$Grade_t$	N_{sp}	$Grade_{sp}$	Difference
TOTAL	126	2.8	35	3.2	.4*****
M	111	2.7	27	3.1	.4*****
F	15	3.1	8	3.6	.5***
LA	46	3.0	17	3.5	.5*****
HA	58	2.6	16	2.9	.3****
LR	72	2.6	15	3.2	.6*****
HR	41	3.0	15	3.6	.6*****
IK	64	2.7	15	3.2	.5*****
HK	35	3.0	14	3.6	.6*****
LD	42	2.9	16	3.4	.5*****
HD	60	2.6	17	3.0	.4*****
HAHD	35	2.3	9	2.7	.4****
LAHD	24	3.0	8	3.2	.2
HALD	20	2.9	7	3.0	.1
LALD	22	3.0	9	3.7	.7*****
HALR	35	2.5	9	3.1	.6*****
HAHR	16	2.7	--	---	
LALR	24	2.8	--	---	
LAHR	17	3.4	9	3.9	.5****
HALK	30	2.6	9	3.0	.4****
LAHK	14	3.3	8	3.8	.5***

Table 4-4A.--Continued.

Group Code	N_t	$Grade_t$	N_{sp}	$Grade_{sp}$	Difference
LALK	21	2.9	6	3.5	.6****
HDLR	35	2.4	10	3.2	.8*****
LDHR	13	3.3	10	3.8	.5***
HDHR	20	2.9			
LDLR	23	2.8			
HDHK	15	2.8			
HDLK	31	2.4	9	3.2	.8*****
LDHK	13	3.0	8	3.9	.9*****
LDLK	19	3.1	6	3.1	
FLA	6	3.5			
MLA	40	3.0	12	3.4	.4****
MHA	54	2.5	14	2.8	.3****
LRHK	14	2.6			
HRLK	10	2.8			
LRLK	54	2.7	11	3.0	.3****
HRHK	21	3.2	11	3.5	.3**
FLK	9	3.1			
MLK	55	2.6	14	3.1	.5*****
MLR	64	2.6	15	3.2	.6*****
FLR	8	3.0			
MHR	37	2.9	9	3.4	.5*****
FHR			6	3.8	

Table 4-4A.--Continued.

Group Code	N_t	$Grade_t$	N_{sp}	$Grade_{sp}$	Difference
MHD	56	2.6	14	2.9	.3****
FLD	6	3.2			
MLD	36	2.9	12	3.2	.3***

Table 4-5.--Differences within the traditional section.

Group Codes	Difference	Group Codes	Difference
LDHR-HDLR	.7*****	FLA-MLA	.5**
HDHR-HDLR	.4****	FLA-MHA	1.0****
LDLR-HDLR	.4****	MLA-MHA	.5***
LDHR-HDHR	.4**	MHK-MLK	.3
LDHR-LDLR	.5***	FLK-MHK	.2
HDHR-LDLR	.1	FLK-MLK	.5***
HDHK-HDLK	.4***	FLR-MLR	.4
HDHK-LDHK	-.2	MHR-MLR	.3**
LDLK-HDHK	.3	FLR-MHR	.1
LDHK-HDLK	.6****	MLD-MHD	.3**
LDLK-HDLK	.7****	FLD-MHD	.6****
LDLK-LDHK	.1	FLD-MLD	.3
HRLK-LRHK	.2	LALK-LAHK	.4**
LRLK-LRHK	.1	LAHK-HALK	.7****
HRHK-LRHK	.6****	LALK-HALK	.3
HRLK-LRLK	.1		
HRHK-HRLK	.4		
HRHK-LRLK	.5***		
HALD-HAHD	.6*****		
LAHD-HAHD	.7****		
LAHD-HALD	.1		

Table 4-5.--Continued.

Group Codes	Difference	Group Codes	Difference
LAHD-LALD	0.0		
LALD-HALD	.1		
HAHR-HALR	.2		
LALR-HALR	.3		
LAHR-HALR	.9****		
LALR-HAHR	.1		
LAHR-HAHR	.7****		
LAHR-LALR	.6****		

the .0005 level. Three differences among groups determined by test anxiety and reading aptitude are significant, one at the .005 level and the others at the .025 level.

The difference in mean grades between females and males among low math aptitude students is significant at the .005 level. The difference in mean grades between low reading aptitude and high reading aptitude males is significant at the .10 level. The mean grades of low dogmatic males and low dogmatic females are higher than the mean grade of high dogmatic males, at the .10 and .005 confidence levels.

The differences between mean final grades in the self-paced section are in the same direction as in the traditional section, except that while low test anxious high dogmatic students, low test anxious low dogmatic students, and high test anxious low dogmatic students have nearly the same mean final grade in the traditional section, high test anxious low dogmatic and low test anxious high dogmatic students have mean final grades that are 0.7 and 0.5 points below low test anxious low dogmatic students in the self-paced section.

Final Course Grade Distribution in the Self-Paced Section

The final course grades of students who completed usable questionnaires include eighteen 4.0 grades, four 3.5 grades, four 3.0 grades, five 2.5 grades, one 2.0,

two 1.0 grades, and one 0.0. All of the subgroups that have at least six members have similar grade distributions, except the groups limited to students with high test anxiety and low MSU Mathematics test scores, low dogmatism and low MSU Mathematics test scores, and low dogmatism with high test anxiety. These groups do not include a large number of 4.0 grades.

Table 4-6.--Final grade distribution among responding students in the self-paced section.

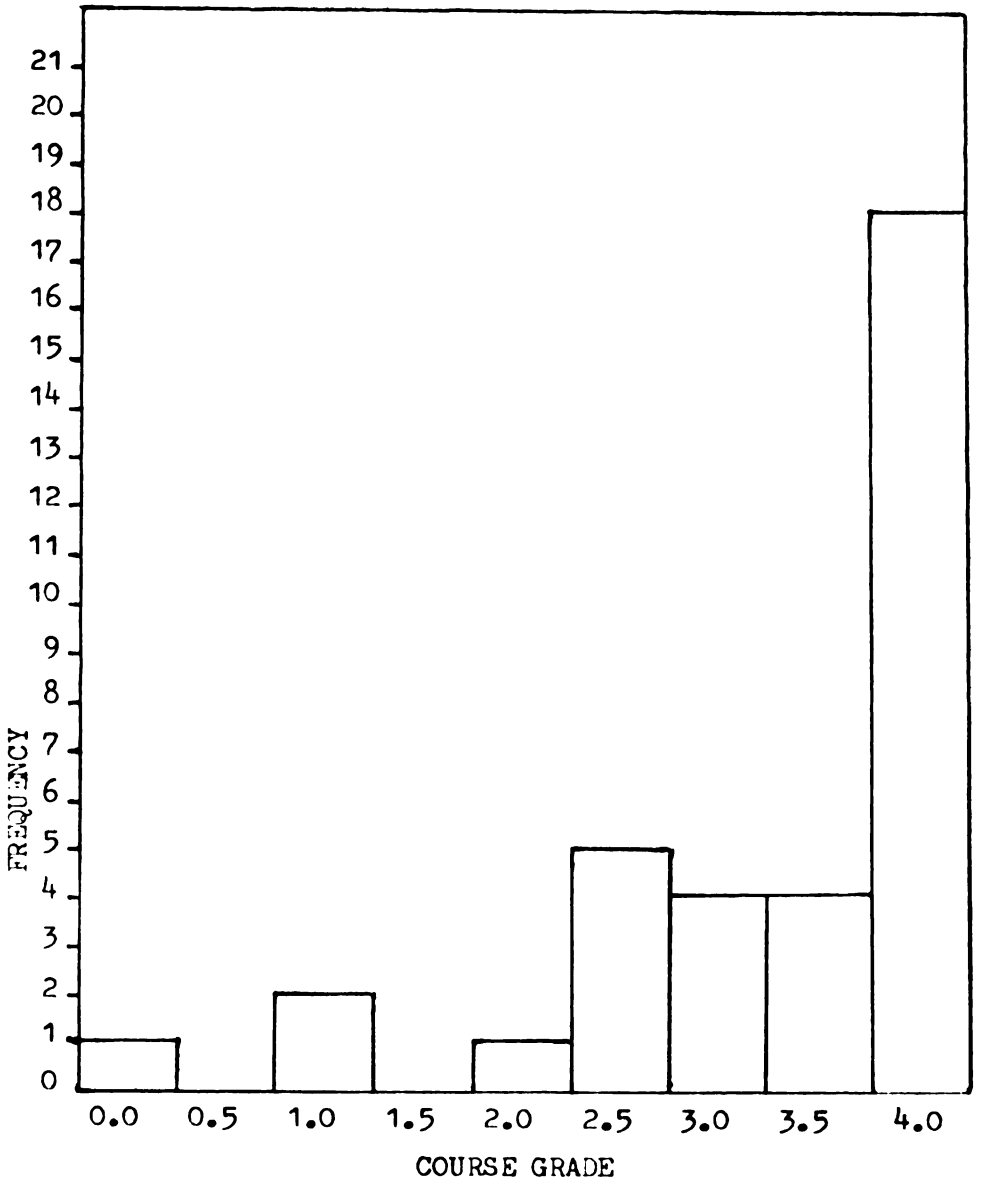


Table 4-7A.--Correlations among all variables in the study subjects in the traditional section.

Dogmatism:Sex						-.07		
Test Anxiety:Sex						-.06		
Reading Aptitude:Sex						-.001		
Mathematics Aptitude:Sex						-.09		
Dogmatism:Test Anxiety						.32***		
Dogmatism:Reading Aptitude						.003		
Dogmatism:Mathematics Aptitude						.72***		
Test Anxiety:Reading Aptitude						-.27**		
Test Anxiety:Mathematics Aptitude						-.15		
Mathematics Aptitude:Reading Aptitude						.48***		
Relevance with:								
Sex	-.26**	-.02	-.06	-.16	-.26**	.005	-.34***	-.36***
Dogmatism	.19*	.06	.07	.11	.21	.23**	.21*	.24**
Test Anxiety	.07	.03	.09	.02	.09	.21	.008	.15
Reading Aptitude	.06	-.03	.05	.09	.05	.003	-.16	.06
Mathematics Aptitude	.03	-.05	.04	.02	-.01	-.05	.01	.09
Achievement with:								
Sex	.19*	.06	.08	-.005	.12	.15	.09	.29***
Dogmatism	-.30***	-.17	-.16	-.25**	-.20*	-.26**	-.008	-.008
Test Anxiety	-.35***	-.32***	-.28**	.02	-.28**	-.41***	-.29***	-.32***
Reading Aptitude	.33***	.31***	.29***	-.001	.14	.43***	.31***	.38***
Mathematics Aptitude	.14	.13	.20*	.07	.11	.26**	.15	.28**

Table 4-7B.--Correlations among all variables in the study subjects in the self-paced section.

Dogmatism:Sex	.41**
Test Anxiety:Sex	.35*
Reading Aptitude:Sex	.51***
Mathematics Aptitude:Sex	.55***
Dogmatism:Test Anxiety	.27
Dogmatism:Reading Aptitude	.09
Dogmatism:Mathematics Aptitude	.37*
Test Anxiety:Reading Aptitude	-.07
Test Anxiety:Mathematics Aptitude	.18
Mathematics Aptitude:Reading Aptitude	.62***

Relevance with:

Sex	.24	.23	.24	.20	.21	.31	.20	.08
Dogmatism	.006	.13	-.70***	.12	.09	-.16	.03	-.10
Test Anxiety	.12	.14	.20	.14	.04	.06	.02	.06
Reading Aptitude	.42**	.39**	.14	.46**	.39**	.48**	.37*	.29
Mathematics Aptitude	.35*	.46**	.26	.35*	.26	.30	.26	.13

Achievement (First Measure) with:

Sex	.45**	.13	.04	-.33*	-.14	-.13	-.30	-.06
Dogmatism	.08	-.09	-.06	-.50***	-.25	-.18	-.17	-.09
Test Anxiety	.06	-.20	.22	.07	.23	.08	.11	-.24
Reading Aptitude	.44**	.01	-.05	-.18	.08	-.11	.20	.09
Mathematics Aptitude	.51***	.04	.27	-.14	.09	.07	.16	.13

Achievement (Second Measure) with:

Sex	.04	-.006	-.12	.07	.15
Dogmatism	.30	-.006	.14	.05	.09
Test Anxiety	.14	.32	.03	.32	.32
Reading Aptitude	.40**	-.20	-.16	-.32	-.16
Mathematics Aptitude	-.04	-.02	.11	.21	.02

CHAPTER FIVE

SUMMARY, FINDINGS, OBSERVATIONS, AND RECOMMENDATIONS

Summary

The purpose of this study is to search for an association of the relevance of course material as perceived by the student with student achievement in a self-paced course in physics. Secondary purposes of this study include a search for an association of perceived relevance with achievement in a traditionally taught course in physics and for interactive effects of perceived relevance and selected variables on both types of course.

The selected variables include sex, test anxiety as measured by the Sarason True-False Test Anxiety Scale (Sarason, '59), Dogmatism as measured by the Rokeach Dogmatism Scale (Rokeach, '68), and aptitude as measured by the Michigan State University Reading Test and the Michigan State University Mathematics Test.

A questionnaire containing the Rokeach Dogmatism Scale, the Sarason True-False Test Anxiety Scale, a relevance scale incorporating descriptions of course study areas, and questions about the students' sex, age,

marital status, academic program, academic level, geographic origin, hometown size, work experience, and reasons for selecting the traditional or self-paced section of an undergraduate physics course, was distributed to all students enrolled in Physics 288 at Michigan State University in the Winter Term of 1974. 48.95 percent of the students in the traditional section and 39.42 percent of the students in the self-paced section returned usable questionnaires and completed the course. The final sample included 126 students in the traditional section and 35 students in the self-paced section.

Scores on test items on midterm and final examinations in each of the seven topic areas described to the students on the relevance scale were obtained from the course instructor during the quarter, and final course grades were obtained at the end of the quarter, to be used in forming composite scores in each topic area. Scores on the MSU Reading and Mathematics tests were obtained from the Office of Evaluation Services.

In handling the data students were divided into groups differentiated by sex, high or low test anxiety, high or low dogmatism, high or low reading aptitude, and high or low mathematics aptitude. High and Low were defined as above or below the median score of the sample population in the self-paced section. All possible groups that included zero, one, or two of these variables

were formed, then all groups containing less than six members in the self-paced section were dropped from the study.

Correlations between perceived relevance and achievement as measured by final course grade and composite scores of test items in each of the topic areas, converted to standard scores, were calculated for each group retained in the study. The coefficients were examined for differences from zero in the positive direction and for differences between the correlations in the traditional and self-paced sections using the Fisher R to Z transformation.

Mean grades were calculated for each group and examined for differences in the traditional section using analysis of variance. The direction of differences in the self-paced section were compared to the corresponding differences in the traditional section, and the mean final grade in the self-paced section compared to the mean final grade in the traditional section, in each group.

Restatement of the Hypotheses

(1) The correlation between perceived relevance of the course and final course grades will be negative or zero, within each of the two methods of instruction, traditional and self-paced, and among subgroups

differentiated by sex, MSU Reading Test scores, test anxiety, and dogmatism.

(2) The correlation between the perceived relevance of topic areas in physics and scores on test items in each topic area will be negative or zero, in each topic area within each method of instruction, and among subgroups differentiated by sex, MSU Reading Test scores, test anxiety, and dogmatism.

(3) The numbers obtained as the correlation coefficients in the self-paced section will be less than or equal to the corresponding numbers in the traditional section.

(4) The final grade distribution in the self-paced section will not be skewed with the majority of students earning high grades.

(5) The mean final grade in the self-paced section will be equal to or lower than the mean final grade in the traditional section.

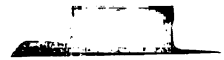
(6) There will be no differences in mean final grades among groups differentiated by sex, MSU Reading Test scores, test anxiety, and dogmatism, in the two sections.

Findings

The first null hypothesis cannot be rejected for the group of all 47 groups in the traditional section and all 35 groups in the self-paced section. It can be

rejected for 16 groups at the .20 level, 9 at the .15 confidence level, and 4 at the .10 confidence level, in the traditional section. In the self-paced section the first hypothesis can be rejected at the .20 confidence level for 19 groups, or at the .15 level for 18 groups, the .10 level for 15 groups, the .05 level for 10 groups, or the .01 confidence level for 4 groups.

The significance levels are calculated for each correlation coefficient as if it were the only coefficient being considered or as if it were independent of other coefficients being considered. For independent measures where one measure is different from zero at the .20 confidence level it is expected that 10 of 50 measures will differ from zero by the same amount or more. For 47 measures the expected numbers are 9.4, 7, and 4.7 for the .20, .15, and .10 confidence levels, compared to obtained numbers of 16, 9, and 4. The numbers of "significant" differences do not differ greatly from chance in the traditional section. The expectation for variation by chance in a group of 35 samples should produce 7, 5, 4, 2, and .4 deviations from zero, "significant" at the .20, .15, .10, .05, and .01 confidence levels. The numbers of groups differing from zero at these confidence levels in the self-paced section are 19, 18, 15, 10, and 4. These are 2.7 to ten times as high as expected by chance.



The second hypothesis cannot be rejected for every one of the topic areas in every one of the groups in the traditional and self-paced sections. It can be rejected for 104 of the 329 topic area correlations in the traditional section at the .20 level, 78 at the .15 confidence level, 52 at the .10 confidence level, 25 at the .05 confidence level, and 3 at the .01 level. The corresponding numbers expected by chance are 63, 49, 33, 16, and 3. The numbers obtained are all a factor of 1.55 to 1.65 higher than expected by chance, except the last one.

Among the 245 topic area-group combinations in the self-paced section the second hypothesis may be rejected for 96 samples at the .20 confidence level, 70 at the .15 level, 51 at the .10 level, 24 at the .05 level, and 4 at the .01 level. The numbers expected by chance are 49, 37, 25, 14, and 3. The numbers obtained are 1.0 to 2.1 times larger than expected by chance.

The final course grade in the traditional section does not appear to be related to perceived relevance over all groups, but perceived relevance does seem to be related to final grade in the self-paced section. Topic area achievement appears to be unrelated to perceived relevance over all groups in both sections.

The third null hypothesis cannot be rejected for all differences calculated. Differences between the correlations of total relevance with final course grade

in the traditional section and the correlation of total relevance with final course grade in the self-paced section are significant in favor of the self-paced section at at least the .20 level for 14 of the 35 groups, at at least the .15 level for 11 groups, the .10 level for 9 groups, the .05 level for 5 groups, and the .01 level for one group. This is over twice as many as might be expected by chance.

Differences between individual topic area correlations in the two sections are significantly greater than zero in favor of the self-paced section in 69 of the 245 pairs of correlations in the 35 groups, at at least the .20 level. The differences are significant at the .15 level for 33 pairs, at the .10 level for 30 pairs, and at the .05 level for 11 pairs. This is 1.0 to 1.4 times greater than expected by chance. The correlation of perceived relevance with final course grade seems to be greater in the self-paced than in the traditional section, but the correlations for the topic areas are not significantly different overall.

The fourth hypothesis is rejected by inspection. Eighteen of 35 students in the sample in the self-paced section earned grades of 4.0. Eight more earned grades of 3.0 and 3.5. More than 70 per cent of the sample earned grades of 3.0 or better.

The difference in mean final grades between all students in the sample in the traditional section and all students in the sample in the self-paced section is 0.4, significant at the .01 confidence level. The grade distribution in the self-paced section is skewed with the median larger than the mean, so the difference in final grades may be expected to be greater than 0.4. The fifth null hypothesis is rejected.

The difference in mean grades between the traditional and self-paced sections in each subgroup is in favor of the self-paced section in every group containing at least six members in the self-paced section. The differences are significant in 33 of the 37 groups at the .15 confidence level, and in 19 groups at the .01 level.

An analysis of variance in the traditional section indicates differences between final grades among the groups at the .0005 confidence level. Differences in magnitude of mean grades among groups in the self-paced section are all in the same direction as in the traditional section, except that low test anxious high and low dogmatic students and high test anxious low dogmatic students earn nearly the same mean grade in the traditional section, while low test anxious low dogmatic students earn higher grades than either low test anxious high dogmatic or high test anxious low dogmatic students in the self-paced section. The sixth null hypothesis is

rejected. There are differences in mean grades among groups differentiated by sex, MSU Reading Test score, test anxiety, and dogmatism.

Observations on Student Choice and Testing

(1) A smaller percentage of students in the self-paced than in the traditional section believed that they would earn higher grades in the "other" section than in the section they were in (3% and 8%). Seventy-two of the 126 students in the traditional section chose the traditional section over the self-paced section deliberately, 47 because of a strong personal preference for the traditional course and 64 because they believed they would earn higher grades in the traditional course. Twenty-seven of the 35 students in the sample from the self-paced section expressed a strong personal preference for the self-paced section. More students believe they will earn higher grades in the course they chose than chose the course for that reason, 30 to 20 in the self-paced section and 116 to 64 in the traditional section.

(2) The method of instruction in the self-paced section appears to result in very high or very low test performance, corresponding to the "excellent" or "not yet" grades.

Observations on Group Correlations

Examining the correlations in each of the groups yields the following observations.

(1) In the group including all students in the sample in the traditional section the course and the topic area correlations are nearly all positive. Six of the eight correlations are significantly greater than zero at the .20 level. Five of the eight correlations are significantly greater than zero at the .20 confidence level in the self-paced section and are generally larger than in the traditional section. Three of the seven topic area correlations in the self-paced section are significantly larger than their counterparts in the traditional section at the .20 confidence level, one of them at the .10 level. Perceived relevance seems to be related to achievement among "all" students, more strongly in the self-paced than in the traditional section.

(2) Male students in the traditional section show seven of the eight correlations greater than zero at the .20 confidence level, three significantly greater than zero at the .05 level. Female students display seven negative correlations in the traditional section, although the largest is -.28. In the self-paced section male students show somewhat smaller correlations than they do in the traditional section, but female students show six of eight correlations greater than zero at the .20

confidence level, three of them at the .10 confidence level. The difference between the correlations in the self-paced and traditional sections for female students is significant for the total course correlation and six of the seven topic area correlations at the .20 confidence level or better. Perceived relevance is positively related to achievement for male students in both sections with about the same correlation. For female students it seems to be negatively related to achievement in the traditional section and positively related in the self-paced section, with the correlation for females more than twice as large as for males.

(3) Low dogmatic students in both sections show both negative and positive correlations, with two positive correlations in each section significantly greater than zero at the .20 confidence level. Nearly all correlations in both sections are positive for high dogmatic students, with six significantly greater than zero in the traditional section and four in the self-paced section, at the .20 confidence level or better. Increasing dogmatism seems to be related to an increasing positive relationship between perceived relevance and achievement, in both types of instruction.

(4) Low test anxious students in the traditional section show three correlations significantly greater than zero, while there are five correlations significantly

greater than zero among low test anxious students in the self-paced section. The difference in correlations is significant between the traditional and self-paced sections at the .20 level for each of the total course correlations and two topic area correlations. There are no significant differences among high test anxious students in the two sections. They exhibit four correlations significantly greater than zero at the .20 confidence level in each of the sections. Low test anxiety seems to be related to changes in the relationship between perceived relevance and achievement and method of instruction, with perceived relevance more strongly related to achievement in the self-paced than the traditional section.

(5) Low reading aptitude students exhibit four correlations significantly greater than zero at the .20 confidence level or better in the self-paced section, three correlations larger than .40, and one significant correlation in the traditional section, equal to .13. The differences in correlations in the traditional and self-paced sections are significant for the total course correlation and three topic area correlations at the .20 level or better. The relationship of perceived relevance with achievement seems to be greater in the self-paced section than in the traditional section for low reading aptitude students. There seems to be no differential effect of course type on the relationship between

perceived relevance and achievement among high reading aptitude students. The total course correlation is positive in the traditional section and negative in the self-paced section, while there is one comparatively large topic area correlation in the self-paced section. This appearance may be due to a ceiling effect.

(6) One correlation is significantly greater than zero in the traditional section at the .15 confidence level and four in the self-paced section, among low mathematics aptitude students. Four of those six correlations in the self-paced section are significant at the .05 level. The differences between correlations in the traditional and self-paced sections are significant for the total course correlation and for five of the topic area correlations. High mathematics aptitude students show positive correlations in the traditional section and negative correlations in the self-paced section. There seems to be an interaction with high mathematics aptitude related to an increased positive relationship of perceived relevance with achievement in the traditional section and low mathematics aptitude related to an increased positive relationship of perceived relevance with achievement in the self-paced section. The low math aptitude pattern repeats among students with both low math and low reading aptitude, and among low reading aptitude male students.

There are less than six low reading aptitude female students in the self-paced section, so that group is excluded from the study.

(7) Dogmatism seems to interact with test anxiety in their relationship with the correlation of perceived relevance with achievement in the traditional and self-paced sections. The combination of high dogmatism and high test anxiety seems to depress the correlation of perceived relevance with achievement in the self-paced section. Either factor alone seems to be related to positive correlations in the self-paced section. Low test anxiety seems to reduce the relationship of dogmatism with the correlation of perceived relevance in the traditional section and produce very strong correlations in the self-paced section, while low dogmatism reduces the relationship of low test anxiety with the correlation in the self-paced section.

(8) The high dogmatic low reading aptitude group exhibits small negative and positive correlations in the traditional section and large positive significant correlations in the self-paced section. The differences are significant at the .05 and .10 confidence levels. The low dogmatic high reading aptitude group shows large negative correlations in the traditional section and generally smaller, positive correlations in the self-paced section. The differences are significant at the .10 and

.05 confidence levels. High perceived relevance seems to be associated with increased achievement among high dogmatic low reading aptitude students in the self-paced section. High perceived relevance seems to be associated with decreased achievement among low dogmatic high reading aptitude students in the traditional section.

The remaining groups do not yield any new information.

Summary of Observations

The correlation of perceived relevance with achievement as measured by course grades is greater in the self-paced section than in the traditional section, and may be greater in self-paced courses than in traditional courses. The relationship is less clear for topic areas but may also be toward higher correlations in self-paced than in traditional courses.

Students in the self-paced section earn higher final grades, on the average, in nearly every group, than students in the traditional section. The effect of high perceived relevance appears to be generally neutral or positive but may be negative for some groups in one of the methods of instruction, perhaps for low dogmatic high reading aptitude students in traditional courses. The high positive correlation among low dogmatic high reading aptitude students in the self-paced section may indicate

a negative influence on the performance of students who believe the course is irrelevant.

Female students exhibit somewhat lower achievement if they believe the course is highly relevant, in the traditional section, while high perceived relevance is associated with high performance for females in the self-paced section.

High dogmatic students show high correlations of perceived relevance with achievement.

Low test anxious students show somewhat higher correlations of relevance with achievement in the self-paced section than in the traditional section, as do low reading aptitude students, while high mathematics aptitude students show considerably lower correlations in the self-paced section than they do in the traditional section, to the extent of becoming negative in the self-paced section.

Recommendations

(1) Since it appears that students do earn higher grades and may learn more in self-paced courses, and since self-pacing may encourage the development of independent learners, it is recommended that self-paced courses be increased in number and that students be encouraged to enroll in self-paced courses.

(2) Since there are differences in the relationship of perceived relevance with achievement between the self-paced and traditional course among various groups

and since students come to the course with large differences in their perceptions of the relevance of the course, and since many students express a strong preference for the traditional course, it is recommended that traditional courses continue to be made available.

(3) It is recommended that further research to examine the relationships between sex, dogmatism, test anxiety, aptitude, perceived relevance, method of instruction, and achievement be carried out using experimental rather than correlational designs. It might be helpful to know that students who believe that a course they have to take is irrelevant will be harmed less by this belief in a traditional than in a self-paced course, or vice-versa. Research should be directed to determining if these differences in correlations correspond to causal relationships and to determining how large the effects are.

(4) It is recommended that guidance personnel make interim use of these observations in influencing their advice to students who are selecting between self-paced and traditional sections of a course.

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APPENDIX A

COVER LETTER AND QUESTIONNAIRE

Great concern has developed in the last few years regarding the relevance of the courses that students have been required to take and successfully complete in order to obtain a degree or even to continue in attendance at a university. Efforts are being made to increase the relevance of course work and to increase freedom of choice and student involvement in curriculum construction.

Information about the effects of various methods of instruction on students with varying abilities, personalities, and goals is necessary in order to help choose which methods we will spend our relatively scarce resources on, and to help the student determine which of the available methods will be most effective for him in reaching his or her goals.

A variety of research is being done to obtain such information. This questionnaire is designed to help determine the effect of the perceived relevance of course material on achievement among students of varying personalities and between two different methods of instruction.

Some information about your personality and ability, along with a measure of how relevant you feel various parts of the course are to your career, is needed in order to discover the relationships among these variables. This information must be "tied together," so some identification is necessary at first. I ask you to write your student number on each page of this questionnaire.

In order to assure the confidentiality of this information a random number will be assigned to each student and all information will be filed under that number through a master list. When all relevant information has been collected and recorded, the master list will be destroyed.

Doing experiments involving people is not like doing experiments in physics. People are more variable. In order for an experiment of this nature to be meaningful at all nearly everyone in the group has to reply. So please complete and return this questionnaire.

Thank you.

There will be a box in the undergraduate physics office for deposit of this questionnaire. Please return it by Monday, January 14, 1974.

Student Number_____

Please circle the most appropriate response to each item.

The first three items involve levels of agreement with various answers to the following question:

> Why, given the choice between a self-paced and a lecture-recitation type section of this course, did you make the choice you made?

___ 1. Because of scheduling problems or other reasons not related to the differences between a self-paced and a lecture-recitation course.

1)yes, totally 2)yes, mainly 3)maybe 4)no 5)not at all

___ 2. Because of a strong personal preference for this type of course.

1)yes, totally 2)yes, mainly 3)maybe 4)no 5)not at all

___ 3. Because I feel I will do better in this type of course than in the other.

1)yes, totally 2)yes, mainly 3)maybe 4)no 5)not at all

___ 4. I feel I would do better in

1)a self-paced course 2)a lecture-recitation course

___ 5. Sex;

1)male 2)female

___ 6. Age;

1)15-18 2)19-22 3)23-26 4)27-30 5)over 30

___ 7. Marital status;

1)single 2)married 3)separated 4)divorced 5)widowed

___ 8. Program;

1)pre-law 2)pre-vet 3)pre-med 4)other (specify)_____

___ 9. Level;

1)freshman 2)sophomore 3)junior 4)senior 5)graduate

Student Number_____

___ 10. I was raised in the

1)Northeast 2)Southeast 3)Midwest 4)Northwest
5)Southwest

___ 11. I was raised in

1) the country or
a city of population
2) 0-10,000 3) 10,000-50,000 4) 50,000-250,000
5) over 250,000

___ 12. I have worked for at least six months each as;

1)a laborer
2)a clerical worker
3)a skilled tradesman
4)a professional
5)I have not had six months full time employment.

RELEVANCE SCALE

In this section I ask you how relevant you feel a number of topics in physics are to your career goals. Try to decide whether these topics will be useful in practicing your profession or necessary to understanding and learning other material you will have to know in your profession.

On each item mark one of the numbers 1 through 5, 1 for totally irrelevant, 5 for extremely relevant, and 2, 3, or 4 for intermediate levels.

1 totally irrelevant 2 3 4 5 extremely relevant

___ 1. Statistics and thermodynamics. A description of the average effects of very large numbers of molecules. Heat, temperature, pressure are such average effects. Heat engines such as the internal combustion engine and steam turbines are one subject of thermodynamics.

___ 2. Gravity. The universal law of gravitation. The interaction--or force--between masses. Motions produced by gravitational forces. Planetary motion.

Student Number_____

1 totally irrelevant 2 3 4 5 extremely relevant

___ 3. The electrostatic interaction; force between two or more charged objects. Potential energy and motion.

___ 4. The magnetic interaction; force between charged objects due to the motion of the objects.

___ 5. Gauss's Law and capacitance. The electrostatic interaction and energy, charge storage.

___ 6. Ampere's Law and magnetic flux. The current in a wire is moving charge and produces a magnetic interaction. Electric motors.

___ 7. Michael Faraday and Joseph Henry; "Faraday's" Law. A change in the strength of a magnetic field through a wire coil produces a voltage between the ends of the wire of the coil. Electric generators, transformers.

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement below is your personal opinion. We have tried to cover many different and opposing points of view. You may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others. Whether you agree or disagree with any statement, you can be sure that many people feel the same as you do.

Mark each statement on the answer sheet according to how much you agree or disagree with it. Please mark for every statement.

Write +1, +2, +3, or -1, -2, -3 depending on how you feel in each case.

1 I agree a little	-1 I disagree a little
2 I agree on the whole	-2 I disagree on the whole
3 I agree strongly	-3 I disagree strongly

Student Number_____

3 I agree strongly	-3 I disagree strongly
2 I agree on the whole	-2 I disagree on the whole
1 I agree a little	-1 I disagree a little

___ 1. The United States and Russia have just about nothing in common.

___ 2. The highest form of government is a democracy and the highest form of democracy is a government run by those who are most intelligent.

___ 3. Even though freedom of speech for all groups is a worthwhile goal, it is unfortunately necessary to restrict the freedom of certain political groups.

___ 4. It is only natural that a person would have a much better acquaintance with ideas he believes in than ideas he opposes.

___ 5. Man on his own is a helpless and miserable creature.

___ 6. Fundamentally, the world we live in is a pretty lonesome place.

___ 7. Most people just don't give a "damn" for others.

___ 8. I'd like it if I could find someone who would tell me how to solve my personal problems.

___ 9. It is only natural for a person to be rather fearful of the future.

___10. There is so much to be done and so little time to do it in.

___11. Once I get wound up in a heated discussion I just can't stop.

___12. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.

___13. In a heated discussion I generally become so absorbed in what I am going to say that I forget to listen to what the others are saying.

___14. It is better to be a dead hero than to be a live coward.

Student Number_____

3 I agree strongly	-3 I disagree strongly
2 I agree on the whole	-2 I disagree on the whole
1 I agree a little	-1 I disagree a little

___15. While I don't like to admit this even to myself, my secret ambition is to become a great man, like Einstein, or Beethoven, or Shakespeare.

___16. The main thing in life is for a person to want to do something important.

___17. If given the chance I would do something of great benefit to the world.

___18. In the history of mankind there have probably been just a handful of really great men.

___19. There are a number of people I have come to hate because of the things they stand for.

___20. A man who does not believe in some great cause has not really lived.

___21. It is only when a person devotes himself to an ideal or cause that life becomes meaningful.

___22. Of all the different philosophies which exist in the world there is probably only one which is correct.

___23. A person who gets enthusiastic about too many causes is likely to be a pretty "wishy-washy" sort of person.

___24. To compromise with our political opponents is dangerous because it usually leads to the betrayal of our own side.

___25. When it comes to difference of opinion in religion we must be careful not to compromise with those who believe differently from the way we do.

___26. In times like these, a person must be pretty selfish if he considers primarily his own happiness.

___27. The worst crime a person could commit is to attack publicly the people who believe in the same thing he does.

Student Number_____

3 I agree strongly	-3 I disagree strongly
2 I agree on the whole	-2 I disagree on the whole
1 I agree a little	-1 I disagree a little

___28. In times like these it is often necessary to be more on guard against ideas put out by people or groups in one's own camp (or family) than by those in the opposing group.

___29. A group which tolerates too much differences of opinion among its own members cannot exist for long.

___30. There are two kinds of people in the world; those who are for the truth and those who are against the truth.

___31. My blood boils whenever a person stubbornly refuses to admit he's wrong.

___32. A person who thinks primarily of his own happiness is beneath contempt.

___33. Most of the ideas which get printed nowadays aren't worth the paper they're printed on.

___34. In this complicated world of ours the only way we can know what's going on is to rely on leaders or experts who can be trusted.

___35. It is often desirable to reserve judgement about what's going on until one has had a chance to hear the opinions of those on respects.

___36. In the long run the best way to live is to pick friends and associates whose tastes and beliefs are the same as one's own.

___37. The present is all too often full of unhappiness. It is only the future that counts.

___38. If a man is to accomplish his mission in life it is sometimes necessary to gamble, "all or nothing at all."

Student Number_____

3 I agree strongly	-3 I disagree strongly
2 I agree on the whole	-2 I disagree on the whole
1 I agree a little	-1 I disagree a little

___39. Unfortunately, a good many people with whom I have discussed important social and moral problems don't really understand what's going on.

___40. Most people just don't know what's good for them.

Student Number_____

A number of statements which students have used to describe themselves are given below. Read each statement and decide whether it is true or false as applied to you. If a statement is true, or mostly true as applied to you, respond by marking "T" in the space provided. If a statement is false, or mostly false as applied to you, respond by marking "F" in the space provided.

___ 1. While taking an important examination, I perspire a great deal.

___ 2. I get to feel very panicky when I have to take a surprise examination.

___ 3. During tests, I find myself thinking of the consequences of failing.

___ 4. After important tests, I am frequently so tense that my stomach gets upset.

___ 5. While taking an important exam I find myself thinking of how much brighter the other students are than I am.

___ 6. I freeze up on things like intelligence tests and final exams.

___ 7. If I were to take an intelligence test I would worry a great deal before taking it.

___ 8. During a course examination, I get frequently so nervous that I forget facts I really know.

___ 9. During course examinations, I find myself thinking of things unrelated to the actual course material.

___10. If I know I was going to take an intelligence test, I would feel confident and relaxed beforehand.

___11. I usually get depressed after taking a test.

___12. I have an uneasy, upset feeling before taking a final examination.

___13. When taking a test, my emotional feelings do not interfere with my performance.

Student Number_____

___14. Getting a good grade on one test does not seem to increase my confidence on the second.

___15. After taking a test I always feel I could have done better than I actually did.

___16. I sometimes feel my heart beating very fast during important tests.

APPENDIX B

SAMPLE STUDY GUIDE FROM THE SELF-PACED SECTION

Physics 288SP Winter 1973

Unit 23 Electric Interaction I

Prepared by: J. Kovacs and P. Signell

We come now to another one of the important "fundamental interactions" in nature, the electromagnetic interaction. The remainder of the term's work will be on the study of the nature and effects of this interaction. In this unit of work you will learn about the "static" electric part of that interaction: the magnitude and direction of the force associated with it, the dependence of this force on the displacement from the source of the interaction, the nature of the source of this interaction, and some definitions that will be useful later on.

Objectives:

When you have mastered the objectives of this unit, you should be able to

1) Calculate the force on a charged point particle due to the presence of another charged point particle as a function of the separation of the two particles. You should also be able to calculate the force on this particle due to a distribution of charged point particles.

2) Calculate the electric field at any point in space due to a charged point particle as well as due to a distribution of charged point particles.

3) Calculate the force on a charged point particle at a point where you know the electric field. Also be able to determine the motion of a charged particle in a region where the electric field is known.

Suggested Procedure

Read sections 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, and 16.8 in the text (pp 331-343).

Memorize Coulomb's law. The value $\frac{1}{4\pi\varepsilon_o} = 9 \times 10^9$ newtonmeters ^{2} per coulomb ^{2} is easier to remember than the value of ε_o. However this constant will be given to you on any test.

Work through the worked-out examples 16.1, 16.2, and 16.3.

Understand the meaning of the "lines of force" in the diagrams of figures 16.8, 16.9, 16.12, 16.13, 16.15 and 16.16. (The dotted equipotential lines will be treated in the next unit.)

Work problems 16.2*, 16.3*, 16.7*, 16.9, 16.10, 16.11*, 16.12 (part (a)) and 16.13*. Don't attempt a unit test until you have worked at least the starred problems and the preassessment test.

Comments

Because the electric force is also an "inverse r^2" force, its properties are quite similar to the gravitational force. Only the "strengths" are different. Problem 16.2 has you directly compare these strengths.

The answers to even-numbered problems and those odd-numbered ones for which the answers in the book are incorrect are:

16.2*: (Put in the units with the numbers when you make this calculation. This will assure you that your answer has the correct dimensions and pinpoint for you sources of error if your numerical answer is wrong.) The answer is 8.20×10^{-8} newtons as compared with the gravitational force between these same particles, 3.62×10^{-47} newtons. You might say, you can safely neglect the gravitational force in this case!

16.3*: Sketch all the forces on one of the balls before you try to solve the problem. The answer in the book is the correct relation that 0 must satisfy.

16.7*: Answer is O.K.

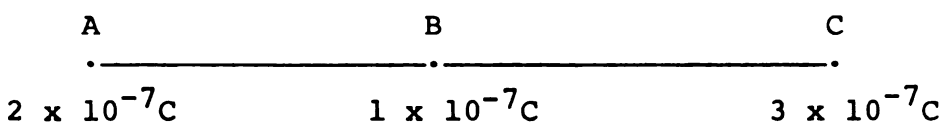
16.9: Solve with symbols first before you insert numbers, get $\varepsilon = \frac{2mx}{et^2}$, when m, e are the electron mass and charge and x is the separation of plates. Put in the units with the numbers and make appropriate unit cancellations. Also get $v = \frac{e\varepsilon t}{m} = \frac{2x}{t}$. The answer to (a) is correct, the answer to (b) should be 2.67×10^{6} m-s^{-1}.

16.10: This is a constant acceleration trajectory problem. See equations 5.28. (a) The time to reach the maximum height occurs when the vertical component of the velocity reduces to zero: $t = \frac{mV_o \text{Sin } 30^o}{e\varepsilon} = 5.69 \times 10^{-9}$ sec. The vertical

displacement will be zero (or y_o) again when $t = \frac{2mV_o \text{Sin } 30^o}{e\varepsilon}$ (Get this by solving for t in the equation $y = y_o + V_{oy}t + \frac{at^2}{2}$ when you set $y = y_o$). Numerically this is 9.9×10^{-2} meters.

16.11*: (See example 16.3.) Note that the field point and the two charge points are on the vertices of a 3-4-5 right triangle. The resultant field should be 1.88×10^5 N-C^{-1} directed about 5^o below the line joining the charges (when you take the field point below this line). (b) $\vec{\varepsilon}$ is zero at a point $(1 + \sqrt{2})$ meters from the smaller charge, along the line joining them, but not between them. (c) At the point between the charges $(\sqrt{2} - 1)$ meters from the smaller charge.

16.12: With the charges aligned as shown:



and with A at the origin and B at x = 0.10 meters and C at x = 0.20 meters on the x-axis, the force felt by each of the charges is

$\vec{F}_A = -3.15 \times 10^{-2}\ \vec{u}_x$ newtons

$\vec{F}_B = -9.00 \times 10^{-3}\ \vec{u}_x$ newtons

$\vec{F}_C = +4.05 \times 10^{-2}\ \vec{u}_x$ newtons

16.13*: (a) Answer is O.K.

(b) Note that vertical ($\vec{u}_y$) components cancel and the $\vec{u}_x$ components add. Answer is correct.

***Objective 1 is illustrated by Example 16.1, Problems 16.2, 16.3 and 16.12 (a).

***Objective 2 is illustrated by Example 16.3, Problems 16.11 and 16.13.

***Objective 3 is illustrated by Example 16.2, Problems 16.7, 16.9, and 16.10.

Unit 23 Preassessment Test

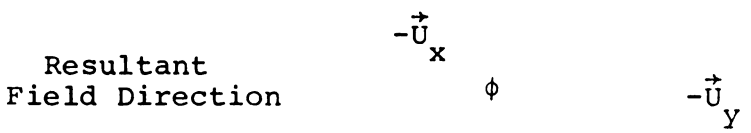
1. Write down the expression for Coulomb's Law. Put in the units for each one of the factors in the expression (including the constant) and verify that the expression has the dimensions of a force.
2. A charge $q_1 = -3 \times 10^{-6}$ coulombs is located at the origin of a cartesian coordinate system while a charge $q_2 = +4 \times 10^{-6}$ coulombs is located at $x = +0.3$ meters, $y = 0$, $z = 0$. (a) Calculate the force on q_1 due to q_2 (b) Calculate the force on q_2 due to q_1.
3. Due to the above two charges (question 2) find (a) the magnitude and (b) the direction of the electric field at the point $x = +0.6$, $y = 0$, $z = 0$.
4. Do the same for point $x = +0.1$, $y = 0$, $z = 0$.
5. Do the same for point $x = 0$, $y = 0.4$, $z = 0$.
6. Using the results of questions 3, 4, and 5, find the force at each of the points of these three questions on a $+2.0 \times 10^{-8}$ coulomb charge.
7. Is the force on this particle constant? This force will give to the particle an acceleration. Will the acceleration be constant? (can you use the same kinematic equations relating position, velocity, and acceleration as you do for a particle in the constant gravity field near the surface of the earth?).
8. Repeat question 6 for a charge of -2.0×10^{-8} coulombs.

9. A uniform electric field of $\vec{\varepsilon} = +5 \times 10^{7}\ \vec{U}_z$ Newtons per coulomb exists in a region of space. (a) What is the force that $+3 \times 10^{-6}$ coulomb charge feels when placed at a point in this region? What force does a -3×10^{-6} coulomb charge feel in this same region?

10. Repeat question 7 applied to the particles in question 9.

Answers:

1. Read section 16.4, page 334.
2. (a) $1.2\ \vec{U}_x$ Newtons (b) $-1.2\ \vec{U}_x$ Newtons
3. (a) 3.25×10^{5} N-C^{-1}. (b) $+\vec{U}_x$
4. (a) 3.6×10^{6} N-C^{-1} (b) $-\vec{U}_x$
5. (a) 1.02×10^{5} NC^{-1} (b) $\phi = 31.8^{o}$ below $-\vec{U}_x$ direction in X-Y plane:



6. at $x = 0.6, y = 0, z = 0$ $\vec{F} = +6.5 \times 10^{-3}\ \vec{U}_x$ Newtons
   at $x = 0.1, y = 0, z = 0$ $\vec{F} = -7.2 \times 10^{-2}\ \vec{U}_x$ Newtons
   at $x = 0, y = 0.4, z = 0$ $\vec{F} = 2.03 \times 10^{-3}$ Newtons in same direction as $\vec{\varepsilon}$
7. No, No, (no).
8. Same as (6) except direction of each $\vec{F}$ is opposite to that of (6)

9. (a) $150\ \vec{U}_z\ NC^{-1}$ (b) $-150\ \vec{U}_z\ NC^{-1}$

10. Yes, Yes (Yes)