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An educational experiment with instructional unit preference and phase achievement in a general education course

Duane Raymond Gimmel
Iowa State University

An educational experiment with instructional unit preference and phase achievement in a general education course

by

Duane Raymond Gimmel

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CHAPTER I. INTRODUCTION

There are many technological trends in society that are promoting an academic revolution within the institutions of higher education. Not only is knowledge in the sciences doubling every ten years, but in every field knowledge is growing in unprecedented proportions. The knowledge explosion and the individuals' desire for knowledge has produced a very rapid rate of technological and sociological change. Technological innovation, occupational reorientation, the changing work week, population growth, mobility, environmental problems, and many similar problems and innovations daily affect society and its educational system. These contemporary trends of society have special implications for, and have special effects on, the philosophy of general education in institutions of higher education.

Need for the Study

The knowledge explosion has created many problems in general education within institutions of higher education. The general education professor is often frustrated at the rate which educational knowledge has increased in breadth. For as David Horton Smith says:

> General education implies breadth of experience. ... It is breadth of experience, if anything, that is going to provide an opportunity for individuals to learn to think, to become educated men. (49, p. 155)

At the same time, American colleges and universities have attracted a growing heterogeneous student populace. Students are coming to the campuses with a variety of past knowledge and experiences. Yet, too often, the typical general education ideal has been conceived as a definable body of knowledge and information that should be disseminated to everybody (49, p. 160). This procedure is not only inefficient and uneconomical, but has in some instances developed into ideological or literal battlegrounds as a result of student dissatisfaction (37, p. 4).

Statement of the Problem

From the foregoing paragraphs, it appears that a dichotomy has developed. This dichotomy has become a particular problem of concern within general education courses which are designed to impart an understanding of the sociological implications of the rapidly expanding technology in this society. On one hand, the general education educator desires to establish a breadth of common knowledge and understanding within <u>every</u> student. The student, on the other hand, desires the instructional process to be as individualistically relevant as possible - relevant in terms of both <u>his</u> achievement level and <u>his</u> interest. Thus, the problem was to develop and test an instructional method that would provide greater individualistic relevance for the student without placing extra demands on the instructor. For as James G. Rice states:

> There is no question but that higher education must continue to search for ways of organizing the student's educational experience so as to achieve more effective and more economical education. (47, p. 315)

Purpose of the Study

The general purpose of the experimental study was to investigate the relative merits of what appeared to be a more flexible and efficient method of instruction for multi-section general education classes.

Objectives of the Experiment

Specifically, the objectives of the experiment were to ascertain: 1) if the experimental treatments or their interactions had a significant effect on the achievement level of students, 2) if selected independent variables had a significant relationship to the achievement level attained by students, and 3) what factors or student characteristics seemed to have a causal effect on the achievement level of students within the prescribed general education course used in this experiment.

The reader will find these general objectives refined and stated in the form of statistically testable hypotheses in Chapter IV.

Setting

The experimental study was conducted within a general

education course in the School of Industry at St. Cloud State College, St. Cloud, Minnesota. St. Cloud State College is a multi-purpose public supported four year institution with a student body of about 10,000. It offers undergraduate and graduate programs of study under six schools: 1) the School of Liberal Arts and Sciences, 2) the School of Business, 3) the School of Education, 4) the School of Fine Arts, 5) the School of Industry, and 6) the Graduate School.

Within the School of Industry, there are two departments: 1) the Department of Industrial Education, and 2) the Department of Technology. Listed under the Department of Industrial Education is the general education course that was used in this experiment. This course, Modern Technology and Civilization - Industrial 192, is described as follows:

> Analysis of contemporary technology and its effects on man and society. Special emphasis is placed on change created by technology, as well as such topics as modern industrial structure, the labor force, leisure, automation and the resulting social consequences. 4 credits. (48, p. 93)

In partial fulfillment of the general education requirements of the baccalaureate degree, every student must select three of the following four courses: 1) Regional Human Geography, 2) Historical Studies, 3) General Psychology, or 4) Modern Technology and Civilization.

Limitations and Scope of the Experiment

The population of the experiment was limited to students of St. Cloud State College who were enrolled in three common

hour sections of the general education course Modern Technology and Civilization during the spring quarter of 1972. St. Cloud State College represents what perhaps can be classified as an average cross section of the student populace for a state college within the state of Minnesota and the midwest that have similar environmental factors and admission policies.

The course, a general education course, can be considered to be typical in regard to the instructional methods and problems associated with other general education courses. Therefore, the results of this study are expected to have some basic implications for the average general education course within similar institutions within the midwest. The study may have implications beyond St. Cloud State College, the state of Minnesota, and the midwest if the background and the instructional environment of the student populace is similar to that of St. Cloud State College.

Assumptions

For the purpose of the experiment, the following assumptions were made:

1. The scores received by students on the phase achievement examinations that were developed were valid and satisfactory measures of achievement.
2. The data collected by the Student Course Evaluation Questionnaire provided a valid indication of student course perception.
3. The composite score of a student's ACT score, high school percentile rank, and college grade point average was a valid and satisfactory measure of the student's past performance.

4. The composite score of a student's age and the number of quarters of higher education completed was a valid and satisfactory measure of past experience.

5. The responses on student questionnaires concerning demographic and other data were accurate.

6. The rotation of the instructors through the control and experimental treatments eliminated instructor bias and differences.

7. The factors not considered in the experiment were not of a significant nature.

Definition of Terms

In order to clarify the meaning of the various terms used in the study, the following definitions were made:

Industrial 192	The general education course Modern Technology and Civilization taught at St. Cloud State College, St. Cloud, Minnesota. It was composed of three independent instructional phases.
Phase or Replication	One of the three divisions of Industrial 192. Each phase was composed of 14 instructional units -- 6 major units and 8 minor units.
Instructional Unit	An instructional presentation on a designated topic that was one class period in length.
Major Unit	An instructional unit that was rated as most important by the Instructor Unit Importance Questionnaire (Appendix A).
Minor Unit	An instructional unit that was not rated as most important by the Instructor Unit Importance Questionnaire (Appendix A).
Primary Phase Examination	The first examination administered to the student in each of the three phases.
Second Chance Achievement Examination	The examination administered to the student who desires to have his achievement level re-evaluated within each of the three phases.
Standardized Scores	All standardized scores in the study were Z scores with a mean of 500 and a standard deviation of 100.

Phase Achievement Treatment	The treatment within each phase that allowed a student to be reevaluated by an optional second chance achievement examination.
Control Group	The group of randomly assigned students who were not allowed to participate in the experimental individual unit preference treatment.
Experimental Group	The group of students who by random assignment received the individual unit preference treatment explained in Chapter III.
CGPA	College grade point average
ACT	American College Testing Program

Organization of the Study

The textual report of the experimental study was organized into six chapters. Chapter I was structured to provide the reader with the necessary introductory information. The information included the need for the study, statement of the problem, purpose of the study, objectives of the experiment, setting, limitations and scope of the experiment, assumptions, and definition of terms.

Chapter II was devoted to a review of general education literature pertaining to the philosophy and topic of the experiment.

Chapter III provides the reader with the specific details of the experimental procedure. Included in the chapter were topics which relate to developing the instructional paradigm, the experimental design, the treatments, the implementation of the experiment, measurement instruments, treatment of the data, and the statistical analysis procedure.

The findings of the study are reported in Chapter IV. Included in the findings are the topics of sample validation, treatment analysis, independent variable analysis, and achievement analysis.

Chapter V synthesizes and makes recommendations for further study in a discussion chapter.

Included after the last chapter (Chpater VI: Summary) are a bibliography, acknowledgements, and fourteen appendixes.

CHAPTER II. REVIEW OF RELATED LITERATURE

This review of literature has the purpose of presenting the historical development of general education and some of the contemporary trends that have been the outgrowths of its development.

The Historical Development of General Education

The development of the ideals of general education can be traced to the ancient educational philosophy of the Greeks. The educational schools of Plato and Aristotle fostered the entire range of philosophy known to us today (4 , p. 522). Through the passage of time, a fixed body of knowledge filtered through the Middle Ages, Renaissance, and Reformation. This body of knowledge was the "immutable truth," and it was to be absorbed without criticism or question by every student (10, p. 13).

When the colonial colleges were established in America, this basic philosophy was dominant. By the time of the Revolutionary War, all nine of the colonial colleges were dedicated to a program of general-liberal education (4 , p. 522). Even though this dogmatic approach was firmly implanted in American higher education, such men as Benjamin Franklin and Thomas Jefferson began to promote and advocate a practical parallel curriculum to supplement the general-liberal curriculum of education. Reaction against the practical or parallel approach were strongly expressed by the Yale Report

of 1828. This report was probably the most influential publication in the whole history of American higher education between the Revolutionary and Civil Wars. As a throughgoing defense of the traditional American college, the report declared that the aim of college was to lay a general foundation common to all the professions (10, p. 103).

Yet, many historians have felt that this report was:

> out of harmony with the needs of the day, the desires of students and prospective students, and the requirements of a rapidly changing society. ... More and more students and their parents demanded an education which was in some large measure vocational. Employers insisted that the colleges serve the nation by providing practical training. The demands were irresistible. (4, p. 523)

Colleges being specially or partially dedicated to specific purposes began to increase markedly during the nineteenth century. The first separate and distinct technical school, Rensselaer Polytechnic Institute, was established in 1825 and the technical movement was on its way. The Morrill Act of 1862 and the influence of the German gymnasium added fuel to the technical surge (10, p. 64).

With the rapid growth of knowledge and the increasingly complex demands of the growing industrialized society of the United States, a marked proliferation of college courses prevailed. The use of the elective system allowed students to select courses almost at random. The college education became to resemble an intellectual cafeteria with no guiding principles for unity. As a result, a common background was

not being provided for the college graduate.

> In a university of 14,000 students with a curriculum of 2,000 courses and the free elective system operating, the chances against any two students taking the same pattern of courses were astronomical. Husbands and wives who attended the same liberal arts college frequently found that they had taken only one or two courses in common out of a four-year curriculum. The results of such a system of education were doctors who could scarcely communicate with their patients, engineers who had no feeling for the arts-training of their wives, and psychologists who could not understand sociologists even in common conversation. (39, p. 5)

Thus, the educational system of higher education in the United States was producing men who were highly specialized technologically, but very narrow sociologically. Very little time was devoted to those functions of life that were not of a vocational nature. To ameliorate these and other undesirable conditions, the twentieth century saw a series of reforms collectively known as the general education movement.

> Early prototypes were created as early as the post-World War I period with John Erskine's course at Columbia. The 1930's saw a few more innovations as Robert Hutchins caused a revamping of the College at the University of Chicago, as Floyd W. Reeves carried the Chicago ideas to the University of Florida, as W. W. Charters led the establishment of a general education program at Stephens College, and as Alexander Meiklejohn tried a bold experiment at Wisconsin. It was in the 1940's, however, that the general movement really began to gain acceptance as a possible solution to the educational ills everywhere apparent. These programs as they developed varied from each other in important regards. They each developed out of indigenous conditions and reflected the diversity that is American education. However, the main current of development demonstrated some common elements which can be called characteristic of general education. (39, pp. 5-6)

A concluding statement that perhaps can best sum up the general philosophy behind the historical development of general education is measurably expressed in the following lines extracted from the report of the President's Commission of Higher Education in 1947.

> A society whose members lack a body of common experience and common knowledge is a society without a fundamental culture; it tends to disintegrate into a mere aggregation of individuals. Some community of values, ideas, and attitudes is essential as a cohesive force in this age of minute division of labor and intense conflict of special interests. The crucial task of higher education today, therefore, is to provide a unified general education for American youth. ... "General education" is the term that has come to be accepted for those phases of nonspecialized and nonvocational learning which should be the common experience of all educated men and women. General education should give to the student the values, attitudes, knowledge, and skills that will equip him to live rightly and well in a free society. (45, pp. 47-49)

Contemporary Trends in General Education

The preceding brief historical review of general education established the background upon which the philosophy of general education developed. General education has come to stand for the common background that most institutions of higher education feel every student should possess. As Lewis B. Mayhew states:

> The general education component of the curriculum should be viewed as providing a common set of experiences. (36, p. 71)

This philosophy has been so widely accepted that Edward B. Black states:

> General education has become, at almost all American colleges and universities, an intellectual experience, looking to a certain fundamental understanding and awareness in the major divisions of learning, especially for the non-major. (4, p. 530)

Although the implementation and acceptance of this philosophy has been almost universal among colleges and universities in the United States, it has not been without problems and pressures for change. Many of these problems and pressures for change stem from the fact that American colleges and universities have attracted a growing hetrogeneous student populace. Students are coming to the campuses with a variety of past knowledge and experiences.

> Fewer than two million students were in American colleges and universities in 1945, the figure grew to three and one-half million in 1960 and in 1970, stood in excess of seven million. Not only are more young people in college, but an increasing proportion of young men and women are completing high school and going to college. ...
>
> Students coming to college, however, have changed as a casual glance around the contemporary campus will document. Still, changes obvious to the eye may obscure less obvious but more significant changes. Although students may be brighter than earlier generations of college students and come from better secondary schools, the range of abilities from highest to lowest has never been as great. It is also obvious that today's college student tends to be more sophisticated, more urbane, more aware of the social environment in which he lives and less bound by traditional values and ideologies of his predecessors.
>
> Just as there has been a general weakening of standard orthodoxy and a growing diversity and hetrogeneity in value systems in society at large, the college campus has become more pluralistic. Societal trends have been exacerbrated by the entry of new student populations not previously served by higher education. ([29], p. 5)

In attempting to understand the expanding pressures within the

general education curriculum, it is necessary to realize the diversity of the contemporary clientele which higher education is now serving. In part, it is from this diverse clientele that the complaint of the lack of instructional relevancy in general education stems. The lack of contemporary instructional relevancy seems to be the underlying well-founded complaint. For as Stanley Ikenberry indicates:

> general education programs have remained essentially the same. Along related lines, the techniques of college instruction have not changed greatly. ... Those changes that have come about in general education have been for the most part token or surface changes. (29, p. 5)

The problem of relevancy is not a unique problem of general education. A study released by the Carnegie Commission in January of 1971 indicated that relevancy seems to be a major concern through the undergraduate curriculum of higher education. In that study, it was indicated that while 70 percent of the students surveyed agreed that most students were satisfied with their education, 90 percent of these very same students wished that course work would be more relevant to contemporary problems (27, p. 1).

General education has not only received criticism for lack of instructional relevancy, but has also received other numerous related criticisms. In 1954, Lewis B. Mayhew and Paul Dressel concluded after visiting eighty colleges and universities that, with a few notable exceptions, classes and courses in general education were routine lecture presentations

of material already available in textbooks, and that students were not particularly interested in what was being said (20, p. 3). In a more recent survey conducted in 1968, it was found that seniors at the University of Massachusetts recommended to change seven out of eight of the core requirements of general education (30).

The feelings of students toward courses in general education are also expressed by other authors. James Harvey in a review for the ERIC Clearinghouse on Higher Education commented that students view general education courses as "arbitrarily conceived, boring, and poorly taught" (27, p. 1). R. S. Morrison noted in his study that while students do not find particular vocational or professional relevance in general education programs, neither do they find experiences that provide them with a sense of personal value or meaning (42).

It would appear that students who lament the irrelevance of curriculum are aware of how little the programs consider fundamental needs of young people at the college state of development. Surely, it is time for institutions to use this information to appraise their work and adapt it to the service of their constituents - the students.

Yet, since the early 1960's, there has been a momentum for change that has been steadily increasing. Today, the whole framework of educational goals, curricula, methods, and evaluation is undergoing revision (59, p. ix).

> There is a growing self-consciousness in American colleges and universities as serious attempts are made to understand and cope with the expanding pressures for change. One of the prime targets for change is the college curriculum and the bull's eye on that target is general education. (29, p. 3)

Today, partially in response to the strong pressures from students, the typical general education program has evolved from the concentrated emphasis of general education in the first two years of college into the distribution approach fostered by Harvard. This approach not only spreads the general education requirements throughout the four year college program, but it allows the student to select from a number of broad classifications of knowledge a certain number of credits to meet the general education requirement.

Beyond this approach, the contemporary emphasis of general education is and has been shifting from the group or subject approach to placing more emphasis upon the individual, including his needs, his capabilities and his personal preferences. It has long been the goal of education to make the educational process more fully fit the needs of the individual learner (22, p. 27). As early as 1925, W. C. Reavis wrote:

> The desirability of individualizing instruction is no longer questioned by anyone. The objectives to it are concerned chiefly with the application of the theory to classroom conditions. (46, p. 49)

Individualization has been noticeable in certain institutional contexts in higher education for many years. In courses such as practice teaching, music performance, or the doctorial thesis, it is obvious that the individualization process is a

necessity. In recent years, however, there have been efforts at individualizing courses that traditionally have been taught to a large number of students -- typically the general education courses (58, p. 312).

Noted educators have long stressed the need to reform general education to provide for more individualism. Joseph Axelrod states:

> The time has come for us to concentrate our efforts on developing the individual student. (3, p. 12)

He continues by noting the need for reform by indicating:

> General education has been defined on occasion as what remains after the content of courses is forgotten or is out of date. (3, p. 13)

Lutian Wootton promotes the need for individualistic relevancy by writing:

> The student should have available a "cafeteria" of many types of learning experiences from which he may select a menu according to his immediate objectives or chosen profession. (61, p. 227)

Paul L. Dressel furthers this philosophy and also indicates the need for commonality by stressing that:

> General education courses should be planned for breadth and to be equally suitable for all students. (19, p. 83)

In the ideal, individualized instruction is a process which has the objective of providing a <u>unique</u> program for each student. Yet, because of practical limitations of the resources of the educator's time and ability and of the student himself, the ideal perhaps will never be realized. Therefore, individualization becomes a compromise in the form of differentiation or

diversification (56, p. 1). As Von Haden and King indicate:

> The objective of individualization is to take into account all the differences that exist in body chemistry, experimental background, specific interests, purposes, personal needs, and learning skills and styles among children. Having identified these differences, the teacher strives to offer unique learning experiences to provide for this perplexing diversification. ... In reality a teacher cannot be an "individualized" teacher; he can only try to provide optimum conditions for an "individualized" learner. (56, p. 1-2)

Individualizing instruction can take the form of educational retesting. Educational retesting is a testing system which allows the individual student to be reevaluated in his attempt to achieve the results he desires. Testing should be employed to assess teaching accountability rather than to categorize students. It is a desirable step toward individualization to allow a student to be reevaluated without penalty if he performed poorly the first time. As G. Kerry Smith states:

> Perhaps the most important assumption underlying a faith in the predictive value of test scores is that a student's grade point average reflects what he has learned. Indeed, the concept of flunking students is based on the assumption that students who get low grades are not profiting from their educational experience. There is, however, little evidence to support this assumption, and some recent evidence actually contradicts it. (50, p. 104)

In everyday life, the United States has developed testing programs for almost everything. There are standardized examinations for occupational application, certification standards, educational entrance, and a variety of other purposes. Yet, these examinations usually have a retesting option which allows the individual to be retested in an attempt to achieve a

satisfactory or a higher level of achievement. This procedure is not a typical procedure within courses of higher education. However, one system operating on this basic principle is in operation at Iowa State University, Ames, Iowa. This system is being used in a general education course and is called the Biology 101 Phase Achievement System (17).

This phase achievement system:

> has been developed to introduce a change in the basic philosophy of how information might be provided to students, and how the students knowledge might be examined. It does not imply any changes in the course content, nor does it provide for changes in grading philosophies; although both of these will vary somewhat from what most students have experienced traditionally. (17, p. 1)

This type of system differs from the traditional college lecture type course in the following ways: 1) the subject matter is subdivided into phases which are arranged in a logical sequence of discussions; 2) the student is supplied with a detailed list of objectives covering the phases; 3) testing covers each phase separately; 4) a student may retake the phase examinations; and 5) the student may complete the course in less than a quarter (17, p. 1).

The philosophy of the phase achievement system is to provide a more flexible program of learning for individual students. Students are also not required to compete among themselves for grades, since through reexamination they can achieve whatever level they desire regardless of what other students have done. The intent of this approach is to:

> place the emphasis on learning rather than competing. Students with good backgrounds need not waste time repeating what they already know, and students with lesser backgrounds can take the time necessary to insure success. ... PAS [phase achievement system] places the responsibility of earning a grade on the student. The instructor is a resource, not the only one to be exploited to the fullest extent in an academic sense. The student then must attempt to achieve the grade he desires by meeting the standards that have been set. (17, p. 3)

Summary

In summary, the trend of general education within institutions of higher education seems to be moving to merge the general education philosophical ideal of "commonality" with the flexibility of "individualism." It would appear that a general educational model with this dualistic framework is needed to provide selective alternatives in which the student would be guided through a decision-making process to enable him to become a better informed, concerned, and functional member in his society.

CHAPTER III. METHOD OF PROCEDURE

The chapter provides the reader with a detailed description of the procedures followed in implementation of the experiment. There are seven major divisions within the chapter which deal with: 1) developing the instructional paradigm, 2) the experimental design, 3) the treatments, 4) implementation of the experiment, 5) the measuring instruments, 6) treatment of the data, and 7) the statistical analysis.

Developing the Instructional Paradigm

The development of the instructional paradigm was based upon the underlying purposes of the study. To reiterate, the general purpose of the experimental study was to investigate the relative merits of what appeared to be a more flexible and efficient method of instruction for multi-section general education classes.

With the above guidelines, the instructional staff of Industrial 192 met to refine and modify this investigator's basic concepts and ideas. The course outline was analyzed and divided into three distinct phases: the development of technology, American industries, and the sociological implications of technology. Within each phase, fourteen units were identified that most adequately met the general objective for the course. The fourteen units were then organized around a central theme into two groupings of seven units each.

The following day, thirteen instructors were individually

interviewed to have them select three units within each of the seven unit groupings that they felt were the most important. The complete interview schedule and results can be found in Appendix A. Through the selection process, the units were ranked by the number of votes they received. The single tie score between a third place and fourth place ranking was decided by this researcher.

These units which obtained a ranking of third or higher were classified as major units and the units which obtained a ranking of fourth or lower were classified as minor units. The units were then assigned to the instructional paradigm shown in Figure 1. The order of instructional presentation within the major and minor unit classifications were in some instances rearranged in order to maintain good instructional continuity. Since the major units were classified as more important, these units were repeated to provide more of an opportunity for the student to obtain instruction in these units.

When viewing the paradigm, the reader should note that it depicts only one of the three phases of the complete course model. It should also be noted that the instructional paradigm requires the availability of two classrooms and two instructors during the same class period.

The paradigm provided the student the opportunity for individualized unit instructional preference, that is, the student had the opportunity to attend the instructional session that he felt was the most relevant on that day. Thus, the student had

	Group One Units					Group Two Un			
Instructor and Room 1	minor unit 7	major unit 1	major unit 2	major unit 1	major unit 2	major unit 3	minor unit 4	minor unit 5	m
Instructor and Room 2	major unit 3	minor unit 4	minor unit 5	minor unit 6	major unit 3	minor unit 7	major unit 1	major unit 2	m

Figure 1. One phase of the experimental instructional paradi

Group One Units					Group Two Units						
inor unit 7	major unit 1	major unit 2	major unit 1	major unit 2	major unit 3	minor unit 4	minor unit 5	minor unit 6	major unit 3	primary phase exam	secondary chance exam
ajor unit 3	minor unit 4	minor unit 5	minor unit 6	major unit 3	minor unit 7	major unit 1	major unit 2	major unit 1	major unit 2	primary phase exam	secondary chance exam

ne phase of the experimental instructional paradigm

the opportunity to select ten of the fourteen instructional units within each phase for classroom instruction.

Although the paradigm did not reduce the time spent in the classroom by the individual instructor, it did reduce the number of instructional preparations from ten to seven. It also increased the breadth of instructional coverage within each phase from ten to fourteen units.

As pictured in the instructional paradigm shown in Figure 1, the student was afforded the opportunity for phase achievement. If a student was dissatisfied with his achievement on the primary examination, he could elect to be retested in each phase a second time. The second chance examinations were administered according to a set schedule outside of the normal class time. (See Administration and Standardization section of this chapter).

The Experimental Design

The experimental design selected for the experiment was a split-plot factorial 22.32 design. The reader who is unfamiliar with this type of design will find further information on the topic in Kirk (31, pp. 245-318). According to the designation of the design, the numbers before the dot stand for the levels of the between-block treatments (A and C); the numbers after the dot stand for the levels of the within-block treatments (B and D). The design is appropriate for experiments involving subjects who receive all levels of some treatment

(within-block), but receive only one level of some other treatment (between-block). Split-plot repeated measure designs are sometimes referred to as mixed designs (31, p. 246).

The structural model for this design was:

$$X_{ijklm} = u + \alpha_i + \gamma_k + \alpha\gamma_{ik} + \pi_{m(ik)} + \beta_j + \alpha\beta_{ij} + \beta\gamma_{jk} + \alpha\beta\gamma_{ijl} + \beta\pi_{jm(ik)} + \delta_l + \alpha\delta_{il} + \gamma\delta_{kl} + \alpha\gamma\delta_{ikl} + \delta\pi_{lm(ik)} + \beta\delta_{il} + \alpha\beta\delta_{ijl} + \beta\gamma\delta_{ikl} + \alpha\beta\gamma\delta_{ijkl} + \beta\delta\pi_{jlm(ik)} + e_{o(ijklm)}.$$

Where:

u = grand mean of treatment populations.

α_i = effect of treatment i, which is a constant for all subjects within treatment population i.

γ_k = effect of treatment k, which is a constant for all subjects within treatment population k.

$\alpha\gamma_{ik}$ = effect that represents nonadditivity of effects α_i and γ_k.

$\pi_{m(ik)}$ = constant associated with person m, who is nested under level $\alpha_i\gamma_k$.

β_j = effect of treatment j, which is a constant for all subjects within treatment population j.

$\alpha\beta_{ij}$ = effect that represents nonadditivity of effects α_i and β_j.

$\beta\gamma_{jk}$ = effect that represents nonadditivity of effects β_j and γ_k.

$\alpha\beta\gamma_{ijk}$ = effect that represents nonadditivity of effects α_i, β_j, and γ_k.

$\beta\pi_{jm(ik)}$ = effect that represents nonadditivity of effects β_j and $\pi_{m(ik)}$.

δ_l = effect of treatment l, which is a constant for all subjects within treatment population l.

$\alpha\delta_{il}$ = effect that represents nonadditivity of effects α_i and δ_l.

$\gamma\delta_{kl}$ = effect that represents nonadditivity of effects γ_k and δ_l.

$\alpha\gamma\delta_{ikl}$ = effect that represents nonadditivity of effects α_i, γ_k, and δ_l.

$\delta\pi_{lm(ik)}$ = effect that represents nonadditivity of effects δ_l and $\pi_{m(ik)}$.

$\beta\delta_{jl}$ = effect that represents nonadditivity of effects β_j and δ_l.

$\alpha\beta\delta_{ijl}$ = effect that represents nonadditivity of effects α_i, β_j, and δ_l.

$\beta\gamma\delta_{jkl}$ = effect that represents nonadditivity of effects β_j, γ_k, and δ_l.

$\alpha\beta\gamma\delta_{ijkl}$ = effect that represents nonadditivity of effects α_i, β_j, γ_k, and δ_l.

$e_{o(ijklm)}$ = experimental error, which is independent and is normally distributed with mean = 0 and variance = σ^2.

The design is symbolically depicted in Figure 2. The within-block treatments are the three levels of B and the two levels of D. The between-block treatments are the two levels of A, the two levels of C, and the individual subjects in s1, s2, s3, and s4.

In the overall design, consideration also was given to the influence of the instructor. It was reasoned that an acceptable procedure to reduce the possibility of instructor differences was to rotate the three participating instructors through the treatments in the experiment. A scheme was developed to rotate each of the three instructors through the

		Phase I (b1)		Phase II (b2)		Phase III (b3)	
		primary phase exam (d1)	secondary chance exam (d2)	primary phase exam (d1)	secondary chance exam (d2)	primary Phase exam (d1)	secondary chance exam (d2)
control group(a1)	pretested (c1)	s1	s1	s1	s1	s1	s1
	not pre-tested(c2)	s2	s2	s2	s2	s2	s2
experimental group(a2)	pretested (c1)	s3	s3	s3	s3	s3	s3
	not pre-tested(c2)	s4	s4	s4	s4	s4	s4

Figure 2. A block diagram of the split-plot factorial 22.32 experimental design

experimental treatments. The scheme is portrayed in Figure 3.

Room Assignment	Treatment	Phase I Instructor	Phase II Instructor	Phase III Instructor
HH 116	Control	X	Z	Y
SH 228	Experimental	Y	X	Z
HH 230		Z	Y	X

Figure 3. Instructional rotational scheme

Because the control group was exposed to three instructors instead of the normal situation of only one, an additional assumption was made. It was assumed that a different instructor for each of the three phases of the control group would not have a deleterious effect on the achievement of the group. Thus, when all things were considered, it was believed that the rotation of the instructors provided greater experimental validity to the experiment.

Treatments

The Control Treatment (Level One of A)

Within the control treatment, the instructor was responsible for the planning and method of presentation of the instructional units. The instructor had the option to cover all fourteen units, or to cover selected units in class time and assign the remaining units for independent study.

The Individualized Unit Preference Treatment (Level Two of A)

This treatment was the implementation of the instructional paradigm (Figure 1) developed in the study. It employed the use of two instructors and two rooms in a cooperative teaching

approach. Each instructor prepared for and presented seven of the fourteen instructional units within each phase. The students assigned to this treatment had the daily flexibility to attend the classroom presentation that they felt was the most relevant. The four units within each phase in which the student was not able to receive classroom instruction were accounted for by any of the following: 1) no study was necessary because of the student's past knowledge and experience, 2) independent study through the use of a specified reading list, 3) group study with students who attended the presentations, or 4) any combination of the above.

Pretest Effect (Treatment C)

The students in the control and experimental groups were randomly divided into two groups - those who were not pretested (level one of C) and those who were pretested (level two of C). This division provided the ability to ascertain if there was any interaction between the pretest and the other treatments.

Phase or Replication Effect (Treatment B)

Any differences that may have existed between the phases in the experiment were classified as replication effect.

Phase Achievement Effect (Treatment D)

The phase achievement option provided the student the opportunity to be retested in one or all of the three phases. However, the students were informed that: 1) the last score the student received, whether higher or lower, was the recorded achievement level for that phase, and 2) no questions were

repeated between the primary and second chance examinations.

Within the treatment, it was also felt that the majority of students would not take advantage of the second chance examination. Thus, if this was the case, for analysis purposes, the primary examination was reentered as his secondary examination score. However, a separate analysis of a subset of the students who took advantage of at least one second chance examination was also performed.

Implementation of the Experiment

For the experiment, three sections of the general education course Modern Technology and Civilization described in Chapter I were used. The administration of the School of Industry scheduled three sections of the course at the common hour of 9:00 a.m. The three sections provided one room for the control group and two rooms to accommodate the individual unit preference design.

A maximum total enrollment from the three sections was established at 200 students - 50 originally assigned to room 116, 75 originally assigned to room 228, and 75 originally assigned to room 230. Because rooms 228 and 230 were large enough to be able to handle some overflow, they were selected as the rooms to be used for the individual unit preference treatment. Thus, a randomization procedure was established to provide a probability of 60/200 that a student would be in the control group and 140/200 in the experimental.

Random numbers from 1 to 200 were drawn from a partial table based on the Table of 105,000 Random Decimal Digits (24, pp. 393-396). The numbers were then randomly grouped into three divisions as shown in Figure 6. The random numbers were then transferred to Random Number Identification Cards similar to the one shown in Figure 4.

Identification Number _____

Print your name immediately on this card.

Name _____
last first middle

Figure 4. Random Number Identification Card

On the first day of the experiment, each instructor was positioned by the door of his classroom with a stack of Random Number Identification Cards. As the student entered the room, he was given a Random Number Identification Card.

After each student had received a random "identification number," it was recorded by the student on the Personal Data

Name _____

Identification Number _____

Primary Examination Form _____

Secondary Examination Form _____

Advisory Instructor _____

Office and Hours _____

Figure 5. Student Information Recording Card

50 Random Numbers for Room 116					75 Random Numbers for Room 228								75 Random Numbers for Room 230						
079	131	125	121	055	049	178	081	063	136	154	018	041	153	037	174	189	024	044	158
099	113	027	026	067	150	085	192	016	106	096	138	177	057	108	116	182	164	141	199
015	134	115	035	132	084	068	098	140	200	005	082	001	080	114	196	117	007	090	166
062	191	064	056	119	022	046	186	163	176	073	100	148	031	043	086	004	040	109	047
076	171	092	107	144	167	011	093	145	014	165	197	129	028	160	146	003	012	042	104
066	008	185	135	124	029	195	059	180	020	147	053	118	023	075	052	181	032	013	045
101	173	156	148	190	142	137	133	038	094	009	070	120	010	179	083	143	161	152	103
130	095	085	089	151	110	069	036	030	071	050	122	097	065	037	168	088	155	194	187
087	034	169	193	128	019	188	002	149	074	127	077	157	051	054	066	061	078	184	060
025	021	017	111	159	139	102	112	175	105	183	091	198	072	033	162	170	172	123	126

Figure 6. Random number assignments

Questionnaire (Appendix K). The questionnaire was hence completed, collected, and checked to make sure that all students had recorded their identification number.

The students were then handed a recording card similar to the one pictured in Figure 5. On the card, the information was recorded as follows:

name: the name of the student

identification number: the assigned random number

primary examination form: Form A; 1-30, 61-95, 131-165
Form B; 31-60, 96-130, 166-200

secondary examination form: opposite primary examination

office and hours of the advisory instructor

The original random number identification cards were then collected to verify the numbers recorded by the students on the Personal Data Questionnaire. The students were then told to report immediately to the following rooms according to their random number assignment:

random numbers 1 - 60 reported to Headley Hall 116

random numbers 61 - 130 reported to Stewart Hall 228

random numbers 131 - 200 reported to Headley Hall 230

After the students had shifted to their assigned rooms, the course syllabus (Appendix B) was handed out and explained. The students who were in the experimental sections also received the unit schedule calendar (Appendix C).

On the second day, the first ten minutes were spent randomizing any other new students. The last forty minutes of the

class session were devoted to the administerization of the pre-test. As dictated by the experimental design, only one-half of the group was to be pretested. Therefore, on a random basis, the students who had even identification numbers were selected to be pretested. The third day was the beginning of the instruction process. More information on this topic is available for the interested reader in Appendix L: Instructions for the Implementation of the Experiment.

Measurement Instruments

Achievement

The success or failure of the treatments was primarily based upon the achievement level attained by the students. For this reason, great care was taken to insure that the pre-test and phase examinations were valid measures of achievement. Womer (60, p. 75) indicates that test items can be evaluated in two forms: 1) a subjective judgement by qualified evaluators, and 2) statistical treatments to judge an item's worth. This researcher elected to employ a subjective method to develop the items for the achievement criterion, and a statistical method to provide a post-test evaluation. The following is an explanation of the procedure by which the pretest and phase achievement criterions were developed.

Development Procedure

After the instructional staff identified the forty-two units that most adequately met the general objectives of the

course, specific objectives were developed for each unit. From the objectives, a minimum of twelve multiple choice questions were developed or compiled from past examinations for each unit. This provided a pool of 589 questions with an average of fourteen questions per unit.

The questions for each unit were then combined with the accompanying references and objectives into a test question evaluation booklet for each phase. Eleven instructors who had previously taught the course evaluated the questions. In the evaluation process, the instructors selected the questions which they felt were the most valid measures for each unit. They also eliminated the questions which they believed were poor or invalid questions. If an evaluator could not pass judgement on a particular question, he could reserve judgement by not evaluating that question. Because of the length of these evaluation booklets and the evaluation forms, 128 pages in all, only the cover letter and recording forms are included in the dissertation (Appendix I).

From the evaluation process, each question received a rating score. The score was determined by the number of valid ratings minus the number of invalid ratings. The ten top questions in each major unit were randomly assigned to a pretest and two test forms for each phase. Two questions were assigned to the pretest and four questions to each of the two phase examination forms (Form A and Form B). From each minor unit, the nine top questions were then randomly assigned. One question

was allocated to the pretest and four questions were assigned to each of the two phase examination forms. The two major unit questions that were first assigned to the pretest were then randomly reassigned to either test Form A or test Form B. Through the randomization process, a pretest over all three phases (Appendix D) comprising sixty multiple choice items was constructed. It consisted of thirty-six major unit questions (two questions from each of the eighteen major units) and twenty-four minor unit questions (one question from each of the twenty-four minor units).

The process also yielded two test forms (Form A and Form B) for each of the three phases. A phase test form was composed of thirty major unit questions (five questions from each of the six major units in each phase), and thirty-two minor unit questions (four questions from each of the eight minor units in each phase). A total of sixty-two questions were on each of the two forms. No questions were repeated between the two phase examination forms.

After the completion of the subjective evaluation process, the original 589 questions were reduced by approximately one-third (193 questions). Based upon the expertise of the evaluators, the remaining 396 questions were assumed to have high content validity for their respective units.

Administration and Standardization

The design developed for the experiment required that approximately one-half of the sample was to be pretested. The

randomly selected students were administered the pretest on the second class meeting - April 3, 1972. The phase examinations were administered according to the specified schedule shown in Figure 7.

Examination	Date
Phase I	
Primary Examination	April 21
Optional Second Chance Examination	April 27
Phase II	
Primary Examination	May 10
Optional Second Chance Examination	May 18
Phase III	
Primary Examination	June 2
Optional Second Chance Examination	June 7

Figure 7. Phase examination schedule

To establish the various levels of achievement for the form examinations for each phase, one-half of the students received examination Form A and the other half received examination Form B as the primary examination. The examination which the student received was dictated by his random identification number as explained earlier in the chapter. The test forms were then standardized on the primary examination scores and achievement levels were assigned. More detailed information on this topic can be found in Appendix M: Test Coordination and Administration Procedures.

If a student elected to be retested by the second chance examination, he was evaluated according to the standardized scores established for that form by the primary examination.

Statistical Validation

To double check the subjective construction of the pretest and achievement criterion, a post-administration statistical analysis was performed.

One of the most important statistics for the indication of the quality of a test item is its item discrimination index. If the item-score correlation is low or negative, the item is not discriminating between the different levels of achievement and is classified as a poor item (41, p. 8). An item discrimination analysis was performed on all of the examinations. As a result of the analysis, the questions that were statistically rated as poor were eliminated as part of the pretest or criterion.

To estimate the internal reliability of the examinations, the Kuder-Richardson Formula #20 (43, p. 197) was used. Table 1 provides a summary of the reliability estimates obtained by the procedure.

Table 1. The number of subjects and the internal reliability of the examinations used in this experiment

Examination	Number of Subjects	KR-20 Reliability
Pretest	89	.62
Phase I - Form A	92	.66
Phase I - Form B	83	.77
Phase II - Form A	90	.66
Phase II - Form B	82	.76
Phase III - Form A	89	.68
Phase III - Form B	81	.61

The Composite Achievement Criterion

The success or failure of a student in the experiment was based upon the achievement level of the student. Therefore, an essential objective of the experiment was to analyze the factors that seemed to directly influence student achievement. For this purpose, multiple composite indicators were developed for the variables which were likely to be subjected to measurement error.

A composite score of the three appropriate standardized phase achievement examinations was selected as the dependent criterion variable. The reliability of the composite criterion was calculated by the Spearman-Brown reliability formula (44, p. 223) and found to be .76.

Independent Variables

Previous research conducted by Lacroix (32), established an a priori upon which specific variables were selected to be analyzed for their relationship to the criterion achievement. Seven independent variables: 1) past experience, 2) past performance, 3) course perception, 4) course interest, 5) instructional treatment, 6) student sex, and 7) whether or not a student elected to take advantage of the phase achievement option were the variables that were selected. Other variables that were not included in the analysis were considered to be part of the residual factor.

Past Experience (PE)

Lacroix (32) found that the achievement level of a student

was directly related to the amount of experience brought by that student to the classroom. From this information, it was theorized that the advantage of being able to associate and reinforce the instructional material with past experience made the instruction more meaningful and influenced the achievement level. Two measures were selected as indicators of past experience.

It was deduced that a logical measure of past experience was the past college experience of the student. Thus, a measurement scale of one point for each quarter of higher educational experience was selected as one indicator.

A second factor that was logically felt to be a measure of past experience was the age of the individual. Greater exposure is a natural result of increased age. Thus, the student's age, recorded in months, was considered to be a second acceptable measure of past experience.

These two measures were standardized and then added into a composite score as a measure of past experience.

Past Performance (PP)

In the previously sighted research conducted by Lacroix (32), the composite ACT score and the high school percentile rank were found to be significant contributors to the achievement level of a student. It was reasoned that these scores were common measures that could be classified into the category of past performance. Therefore, the ACT composite score and the high school percentile rank were retained as appropriate indicators of past performance. In addition, the college grade

point average of the student was selected as a third measurement of past performance. The three measures were standardized and added together to form a composite indicator of past performance.

Course Perception (CP)

Astin indicated that there are many personal characteristics which may affect students to do academically better or worse than expected (2, p. 13). For this study, it was felt by this researcher that the perception the student had toward the course would directly influence the achievement level attained. Three measurement indicators were used to form a composite score of the student's perception toward the course.

The first measurement of course perception was based upon the reason the student was enrolled in the course. A rating scale was developed to allow the student to record this information on a one (educational requirement) to nine (personal desire) point scale. This information was part of the personal data questionnaire found in Appendix K.

A modified version of the Illinois Course Evaluation Questionnaire (13) was used as the second and third measurements of student perceptions toward the course. The modified questionnaire (Appendix I) had a total of forty statements to which the students responded. Twenty of these statements were of a positive nature and twenty were of a negative nature. A scale score of the addition of the negative items was used as the second

indicator of the student's course perception. The scale scores obtained by the addition of the positive items transposed - that is 1=4, 2=3, 3=2, and 4=1 - were used as the third indicator of the student's course perception. Thus, when the standardized scores of these three measures were added together, the higher the composite score the more favorable was the student's perception toward the course.

Course Interest (CI)

It was reasoned that the interest level that a student had in the subject matter presented in the course would directly influence his perception toward and achievement in the course. A rating scale was developed to record the level of interest a student had in each of the fourteen units in the three phases. The instrument used for the measurement of course interest was included as part of the preliminary information recorded for each phase examination. (See the cover of any phase examination booklet, Appendix E, F, or G).

The interest questionnaire involved the respondents evaluating their level of interest in the fourteen units within each phase on a four point scale. The simple addition of the ratings for each unit provided an interest rating for each of the three phases. These ratings were standardized and then added together to form a composite indicator of course interest. Therefore, if the student indicated a high degree of interest in the units covered, he would have a high interest composite score.

Instructional Treatment (IT)

It seemed plausible that the instructional treatment to which the student was exposed would possibly influence the student's achievement level. With this concept in mind, the instructional treatment was included as a factor to be analyzed for its relationship to the dependent variable of course achievement.

Sex (S)

Lacroix (32), conducting research under similar circumstances, found that the sex of a student had a significant influence on the achievement level of the student. Thus, the sex of the student was considered to be an appropriate consideration in predicting the achievement success of the student in this particular course. The sample provided 75 males and 95 females upon which to base this analysis.

Phase Achievement (PA)

Although the phase achievement option was available to all students, some students did not choose to take advantage of this option. It was reasoned by this researcher that the degree to which a student took advantage of this provision would have some relationship to his achievement level. Therefore, the number of times a student took advantage of the phase achievement option was also considered as an independent variable in the analysis of the achievement composite.

Treatment of the Data

The necessary informational data were collected, coded, and verified. They were then placed on International Business Machine data processing cards for computer input and processing. This information was processed using the computer hardware of the Computational Center of Iowa State University. The hardware of the computer facilities consisted of an IBM 360/65 computer and the appropriate peripheral equipment.

The software used for the data analysis consisted of various Fortran programs written and tested by this researcher.

Statistical Analysis

For the statistical analysis of the data, a decision framework was established prior to the implementation of the experiment. This framework had four parts: 1) sample validation, 2) treatment analysis, 3) independent variable analysis, and 4) an investigation by path analysis into the causual relationships between the independent and dependent variables.

Sample Validation

To ascertain if the randomization process established similar groups prior to the administration of the experimental instructional treatments, an analysis of variance through regression techniques was used to compute and analyze the group means on four factors: 1) past experience, 2) past performance, 3) pretest scores, and 4) the student's beginning course perception response.

Treatment Analysis

The mathematical model (page 25 of this dissertation) for the split-plot factorial design selected for this experiment was analyzed according to the least-squares procedures for unbalanced data as outlined by Kirk (31, pp. 245-318). Often in repeated measure experiments, the variance-covariance matrices of the within-block effects do not have the diagonal elements equal to σ^2 and the off-diagonal elements equal to $p\sigma^2$ (31, p. 247). As a result, univariate analysis procedures do not provide an appropriate test of the null hypothesis (31, p. 257). Therefore, if there was any reason to suspect that these assumptions were violated, a Geisser-Greenhouse conservative F test (31, p. 362) was chosen to be an alternative statistical procedure. This technique accounts for the most serious type of variance-covariance violations.

Independent Variable Analysis

Each independent composite variable, sex, and the number of times an individual elected the phase achievement option were analyzed for their relationships to the dependent composite criterion variable of achievement. These independent variables were analyzed for their relationship to the dependent variable by common regression techniques in an analysis of variance format.

Achievement Analysis

As the fourth and final consideration of this study, this researcher conducted an investigation by path analysis into the causal relationships between the independent and dependent

variables.

The process of path analysis was developed in the 1920's by a geneticist named Sewall Wright. Duncan (21), Land (33), Heise (28), and others have applied these techniques to sociology. Once the variables have been specified, it is necessary to order the causation of the variables and to draw the path diagram. The ordering of the variables stems from theory, past research, hypotheses, or logic.

The path model in Figure 8 was constructed in order to analyze the dependent variable of course achievement. This model was primarily based upon this researcher applying logic to the past research of Lacroix (32). In descriptive terms, this model indicates that: 1) past performance, sex, treatment, phase achievement, and past experience are correlated; 2) course interest is caused by past performance, sex, treatment, phase achievement, and past experience; 3) course perception is caused by past performance, sex, treatment, phase achievement, past experience, and course interest; and 4) course achievement is caused by past performance, sex, treatment, phase achievement, past experience, course interest, and course perception.

Mathematically, the conceptual-path model can be represented by the following recursive equations:

$$Z_6 = P_{61}Z_1 + P_{62}Z_2 + P_{63}Z_3 + P_{64}Z_4 + P_{65}Z_5 + P_{6u}R_u$$

$$Z_7 = P_{71}Z_1 + P_{72}Z_2 + P_{73}Z_3 + P_{74}Z_4 + P_{75}Z_5 + P_{76}Z_6 + P_{7v}R_v$$

$$Z_8 = P_{81}Z_1 + P_{82}Z_2 + P_{83}Z_3 + P_{84}Z_4 + P_{85}Z_5 + P_{86}Z_6 + P_{87}Z_7 + P_{8w}R_w$$

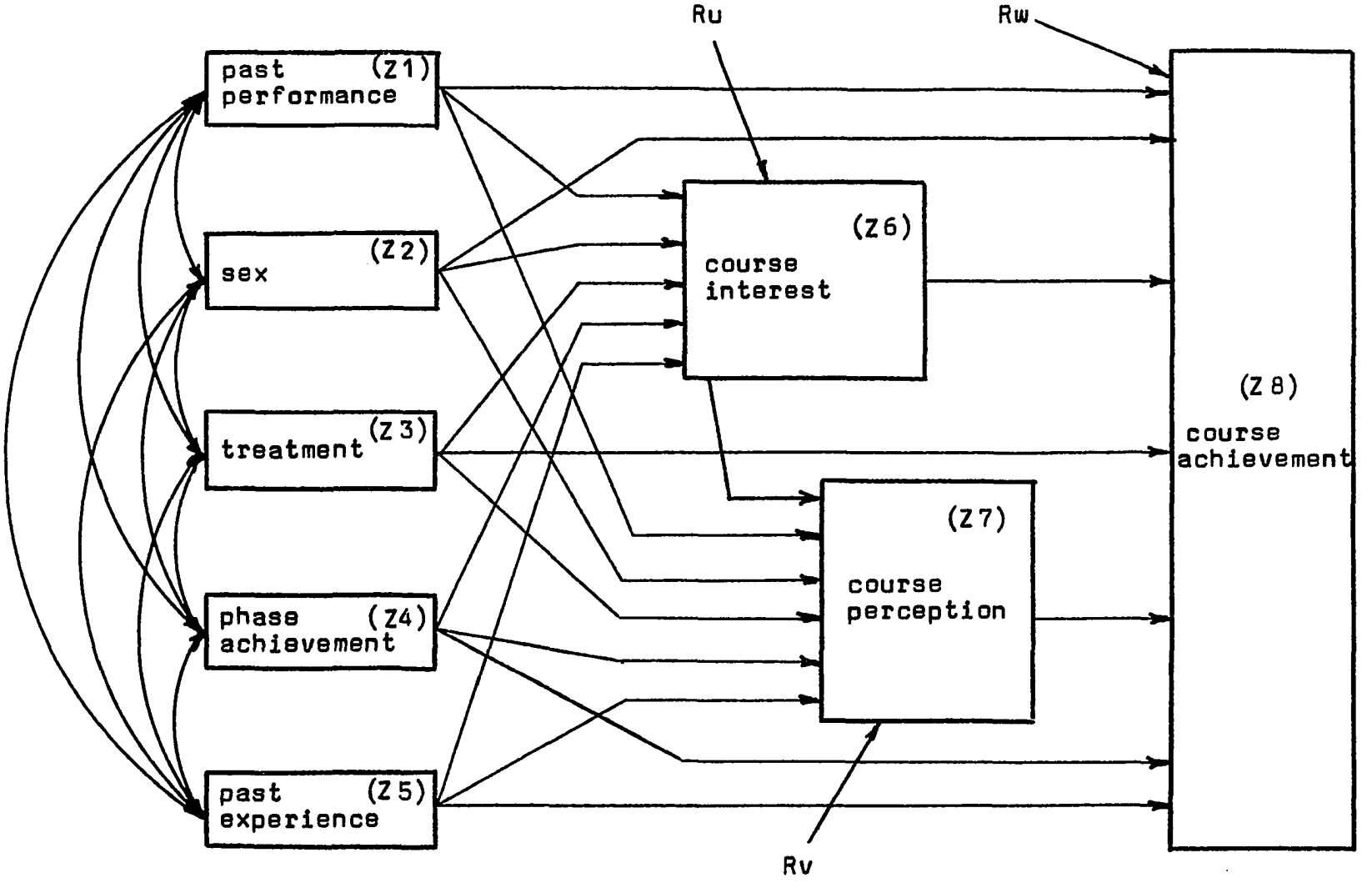

Figure 8. The conceptual-path model

Since the data in the study were used both to refine and test the specified conceptual-path model, steps were taken to reduce the probability of introducing bias which would influence the probability levels of tests and inferences concerning the model selected (57, p. 2). To reduce the probability of introducing bias, only one-half of the data was used to test the statistical significance of the paths in the conceptual-path model. Following the procedures of Duncan (21) and Land (33), sequential-regression analyses were completed to test for the statistical significance of the path coefficients. Non-significant paths were then deleted and a new model was formulated.

The second half of the data was then corrected for attenuation by using the correlations between the sets of measures and the Spearman-Brown reliability formula (44, p. 223). These data were then used to estimate the path coefficients of the refined path model. Chapter IV provides more information on the findings of this procedure.

CHAPTER IV. FINDINGS

The data in the experiment were analyzed according to the procedures outlined in Chapter III. This analysis focuses upon four main considerations: A) sample validation, B) experimental treatment analysis, C) individual variable analysis, and D) an investigation by path analysis into the causual relationships between the independent and dependent variables.

Sample Validation

Four hypotheses were formulated for analysis to ascertain if the randomization process was effective.

Null hypothesis number 1: There were no significant differences between the treatment past experience composite score means.

As shown in Table 2, a non-significant F-value of 0.127 was obtained by an analysis of variance on this composite variable. Null hypothesis number 1 was not rejected. As a double check of this analysis, the variables which composed the experience composite (age and number of quarters of higher education) were also tested by the following sub-hypotheses:

Null hypotheses number 1a and 1b: There were no significant differences between the means of:

1a) the age variable of the treatments, and

1b) the college experience variable of the treatments.

As shown in Table 3 and 4, non-significant F-values of

0.324 and 0.001 were respectively obtained. The data also supported these sub-hypotheses. Table 5 provides the reader with a complete breakdown of the various past experience means.

Table 2. Analysis of variance of past experience composite scores by treatments

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Between Trts.	1	3657.12	3657.12	0.128
Error	174	4984615.06	28647.21	
Total	175	4988272.18		

Table Value $F_{(.05)} = 3.87$

Table 3. Analysis of variance of the age of students by treatments

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Between Trts.	1	141.75	141.75	0.324
Error	174	76160.05	437.70	
Total	175	76301.80		

Table Value $F_{(.05)} = 3.87$

Table 4. Analysis of variance of the number of higher education quarters attended by students by treatments

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Between Trts.	1	0.007	0.007	0.002
Error	174	1070.152	6.150	
Total	175	1070.159		

Table Value $F_{(.05)} = 3.87$

Table 5. Means and standard deviations of students' past experience scores

Groups	Number of Students	Mean	Standard Deviation
Age in months			
Control	54	235.31	19.39
Experimental	122	233.37	21.55
Combined	176	233.97	20.88
Quarters of higher education			
Control	54	2.91	2.55
Experimental	122	2.89	2.45
Combined	176	2.90	2.47
Experience Composite			
Control	54	1006.85	178.61
Experimental	122	996.97	164.99
Combined	176	1000.00	168.83

Null hypothesis number 2: There were no significant differences between the treatment past performance composite score means.

Again, as shown in Table 6, an insignificant F-value of 0.062 was obtained by an analysis of variance on this composite variable. Thus, null hypothesis number 2 was not rejected. Following the example of null hypothesis number 1, the variables which composed the past performance composite (ACT, HS%R, and CGPA) were also tested by sub-hypotheses.

Null hypotheses number 2a, 2b, and 2c: There were no significant differences between the means of:

2a) the ACT composite variable,

2b) the high school percentile rank variable, and

2c) the college grade point average variable of the treatments.

Table 6. Analysis of variance of past performance composite scores by treatments

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Between Trts.	1	4246.40	4246.40	0.062
Error	174	11847873.39	68091.23	
Total	175	11852119.79		

Table Value $F_{(.05)} = 3.87$

The analysis of these sub-hypotheses provided F-values of 0.018, 0.003, and 0.534 respectively for ACT, HS%R, and CGPA. Tables 7, 8, and 10 provide the reader with the results of these analyses with Table 9 providing a breakdown of the various past performance means and standard deviations.

Table 7. Analysis of variance of differences in ACT between the treatments

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Between Trts.	1	0.16	0.16	0.018
Error	174	1485.39	8.54	
Total	175	1485.55		

Table Value $F_{(.05)} = 3.87$

Table 8. Analysis of variance of differences in HS%R between the treatments

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Between Trts.	1	1.28	1.28	0.003
Error	174	73261.27	421.04	
Total	175	73262.55		

Table Value $F_{(.05)} = 3.87$

Table 9. Means and standard deviations of students' past performance scores

Groups	Number of Students	Mean	Standard Deviation
ACT Composite			
Control	54	21.70	3.04
Experimental	122	21.64	2.87
Combined	176	21.66	2.91
High School Percentile Rank (HS%R)			
Control	54	63.46	19.13
Experimental	122	63.65	21.10
Combined	176	63.59	20.46
College Grade Point Average (CGPA)			
Control	54	2.41	.58
Experimental	122	2.48	.62
Combined	176	2.46	.61
Performance Composite			
Control	54	1492.62	247.82
Experimental	122	1503.27	266.48
Combined	176	1500.00	260.24

Table 10. Analysis of variance of differences in CGPA between the treatments

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Between Trts.	1	0.196	0.196	0.534
Error	174	63.976	0.368	
Total	175	64.172		

Table Value $F_{(.05)} = 3.87$

Null hypothesis number 3: There were no significant differences between the treatment pretest score means.

The analysis of variance on this variable (Table 11) revealed a non-significant F-value of 0.225. As a result, null hypothesis number 3 was not rejected.

Table 11. Analysis of variance of differences in pretest scores between the treatments

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Between Trts.	1	2194.55	2194.55	0.225
Error	86	840519.95	9773.49	
Total	87	842714.50		

Table Value $F_{(.05)} = 3.96$

Null hypothesis number 4: There were no significant differences between the treatment reason for course selection scale means (as measured by the response to question number 13 on the Personal Data Questionnaire - Appendix K).

As with the analyses of the other sample validations, the analysis of variance in regard to this variable produced a non-significant F-value of 0.254. Therefore, null hypothesis number 4 was not rejected. Table 12 portrays this analysis.

Table 12. Analysis of variance of differences in reason for course selection scale means between the treatments

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Between Trts.	1	1.04	1.036	0.254
Error	174	710.87	4.085	
Total	175	711.91		

Table Value $F_{(.05)} = 3.87$

Based upon the results of the findings in the sample validation analyses, the randomization process seem to establish similar treatment groups prior to the conducting of the experimental conditions.

Treatment Analysis

At the beginning of the study, there were a total of 176 subjects in the experiment. Three students dropped the course. The data on three other students were unusable. Therefore, the experiment had a subject mortality of three percent.

To evaluate the experimental design, a univariate statistical analysis was used to test the following null hypothesis.

Null hypothesis number 5: There were no significant differences between the means of the A treatment levels (control and experimental groups).

Null hypothesis number 6: There were no significant differences between the means of the C treatment levels (pretested and non-pretested groups).

Null hypothesis number 7: There were no significant interactions between the levels of treatment A and the levels of treatment C.

Null hypothesis number 8: There were no significant differences between the means of the B treatment levels (replications).

Null hypothesis number 9: There were no significant interactions between the levels of treatment A and the levels of treatment B.

Null hypothesis number 10: There were no significant interactions between the levels of treatment B and the levels of treatment C.

Null hypothesis number 11: There were no significant

interactions between the levels of treatment A, the levels of treatment B, and the levels of treatment C.

Null hypothesis number 12: There were no significant differences between the means of the D treatment levels (phase achievement).

Null hypothesis number 13: There were no significant interactions between the levels of treatment A and the levels of treatment D.

Null hypothesis number 14: There were no significant interactions between the levels of treatment C and the levels of treatment D.

Null hypothesis number 15: There were no significant interactions between the levels of treatment A, the levels of treatment C, and the levels of treatment D.

Null hypothesis number 16: There were no significant interactions between the levels of treatment B and the levels of treatment D.

Null hypothesis number 17: There were no significant interactions between the levels of treatment A, the levels of treatment B, and the levels of treatment D.

Null hypothesis number 18: There were no significant interactions between the levels of treatment B, the levels of treatment C, and the levels of treatment D.

Null hypothesis number 19: There were no significant interactions between the levels of treatment A, the levels of treatment B, the levels of treatment C, and the levels of treatment D.

The statistical analysis of the treatments (Table 13) resulted in the rejection of null hypothesis number 12. The test statistic on this hypothesis (testing phase achievement) resulted in an F-value of 28.611. This statistic is highly significant beyond the .01 level (depicted throughout by **). With reference to Table 17, the reader will note that the secondary chance examination means (D2) are higher than the primary examination means (D1) in all groups and replications.

A .05 level of significance (depicted throughout by *) was indicated for the fourth order interaction. This researcher decided that further investigation into the possible causes of this unusual pretest-treatment-phase achievement-replication interaction was necessary before the concerned hypothesis could be rejected. The data seemed to indicate that the variations in the D2 mean gains were a possible cause of this interaction. Therefore, a second treatment analysis was made with only those students who participated in phase achievement (reevaluation).

Forty-nine students took at least one second chance examination. This sub-group represented approximately 29 percent of the total experimental sample. The statistical analysis of this sub-group is presented in Table 15. A second interaction (ACD) became "statistically significant" as a result of this analysis. An examination of this interaction (Figure 9) indicated the presence of some achievement trends. Also, it seemed that if a greater percentage of students within a group elected to be reevaluated, the greater would be the difference between

Table 13. Analysis of variance of the treatments in the split-plot design

Source of Variation	D.F.	Sum of Squares	Mean Square	F
$SS_{between\ subj}$	169	5846236.06	34593.11	0.993
SS_A	1	28029.13	28029.13	0.805
SS_C	1	35492.51	35492.51	1.019
SS_{AC}	1	555.51	555.51	0.016
$SS_{S/A\&C}$	166	5782158.92	34832.28	
$SS_{within\ subj}$	853	3245247.33	3804.51	
SS_B	2	226.66	113.33	0.015
SS_{AB}	2	18523.42	9261.71	1.186
SS_{BC}	2	8014.43	4007.21	0.513
SS_{ABC}	2	8137.01	4068.50	0.521
$SS_{B \times S/A\&C}$	332	2592695.82	7809.32	
SS_D	1	41498.07	41498.07	28.611**
SS_{AD}	1	80.03	80.03	0.055
SS_{CD}	1	2.81	2.80	0.002
SS_{ACD}	1	3341.55	3341.55	2.304
$SS_{D \times S/A\&C}$	166	240767.54	1450.41	
SS_{BD}	2	1543.51	771.75	0.802
SS_{ABD}	2	3494.41	1747.20	1.815
SS_{BCD}	2	903.86	451.93	0.470
SS_{ABCD}	2	6458.69	3229.35	3.355*
$SS_{BD \times S/A\&C}$	332	319559.53	962.53	
SS_{total}	1019	9091483.40	8921.97	

Table 14. Summary tables for the analysis of variance in table 13

Totals	B1D1	B1D2	B2D1	B2D2	B3D1	B3D2
A1C1	13793 (27)	14478	13477	14102	14256	14332
A1C2	13154 (26)	13301	13240	13242	13413	13774
A2C1	28852 (57)	29186	29174	29490	28803	29955
A2C2	30104 (60)	30569	29534	30815	28895	29957
C1	42645 (84)	43664	42651	43592	43059	44287
C2	43258 (86)	43870	42774	44057	42308	43731
A1	26947 (53)	27779	26717	27344	27669	28106
A2	58956 (117)	59755	58708	60305	57698	59912
A&C	85903 (170)	87534	85425	87649	85367	88018

Totals	D1	D2	B1	B2	B3	D&B
A1C1	41526 (81)	42912	28271 (54)	27579	28588	84438 (162)
A1C2	39807 (78)	40317	26455 (52)	26482	27187	80124 (156)
A2C1	86829 (171)	88631	58038 (114)	58664	58758	175460 (342)
A2C2	88533 (180)	91341	60673 (120)	60349	38852	179874 (360)
C1	128355 (252)	131543	86309 (168)	86243	87346	259898 (504)
C2	128340 (258)	131658	87128 (172)	86831	86039	259998 (516)
A1	81333 (159)	83229	54726 (106)	54061	55775	164562 (318)
A2	175362 (351)	179972	118177 (234)	119013	117610	355334 (702)
A&C	256695 (510)	263201	173437 (340)	173074	173385	519896 (1020)

Table 15. Analysis of variance of the treatments using only those subjects who participated in phase achievement

Source of Variation	D.F.	Sum of Squares	Mean Square	F
$SS_{between\ subj}$	48	1898989.94	39562.29	0.986
SS_A	1	63384.07	63384.07	1.580
SS_C	1	30286.77	30286.77	0.755
SS_{AC}	1	104.76	104.76	0.003
$SS_{S/A\&C}$	45	1805214.34	40115.87	
$SS_{within\ subj}$	248	1256744.33	5067.52	
SS_B	2	9552.33	4776.17	0.705
SS_{AB}	2	14771.50	7385.75	1.090
SS_{BC}	2	1945.18	972.59	0.144
SS_{ABC}	2	9140.25	4570.12	0.674
$SS_{B \times S/A\&C}$	90	610120.08	6779.11	
SS_D	1	146372.78	146372.79	55.903**
SS_{AD}	1	2862.12	2862.12	1.093
SS_{CD}	1	86.98	86.98	0.033
SS_{ACD}	1	16397.93	16397.93	6.263*
$SS_{D \times S/A\&C}$	45	117825.18	2618.34	
SS_{BD}	2	6460.13	3230.06	1.008
SS_{ABD}	2	8934.56	4467.28	1.394
SS_{BCD}	2	2524.61	1262.30	0.394
SS_{ABCD}	2	21326.25	10663.13	3.327 *
$SS_{BD \times S/A\&C}$	90	288424.46	3204.72	
SS_{total}	293	3155734.27	10770.42	

Table 16. Summary tables for the analysis of variance in table 15

Totals	B1D1	B1D2	B2D1	B2D2	B3D1	B3D2
A1C1	2952 (6)	3637	2765	3390	3166	3347
A1C2	3096 (6)	3243	3180	3182	2861	3222
A2C1	8800 (18)	9134	9192	9508	8409	9561
A2C2	8696 (19)	9161	8788	10018	8692	9754
C1	11752 (24)	12771	11957	12898	11575	12908
C2	11792 (25)	12404	11968	13200	11553	12976
A1	6048 (12)	6880	5945	6572	6027	6569
A2	17496 (37)	18295	17980	19526	17101	19315
A&C	23544 (49)	25175	23925	26098	23128	25884

Totals	D1	D2	B1	B2	B3	D&B
A1C1	8883 (18)	10374	6589 (12)	6155	6513	19257 (36)
A1C2	9137 (18)	9647	6339 (12)	6362	6083	18784 (36)
A2C1	26401 (54)	28203	17934 (36)	18700	17970	54604 (108)
A2C2	26176 (57)	28933	17857 (38)	18806	18446	55109 (114)
C1	35284 (72)	38577	24523 (48)	24855	24483	73861 (144)
C2	35313 (75)	38580	24196 (50)	25168	24529	73893 (150)
A1	18020 (36)	20021	12928 (24)	12517	12596	38041 (72)
A2	52577 (111)	57136	35791 (74)	37506	36416	109713 (222)
A&C	70597 (147)	77157	48719 (98)	50023	49012	148754 (294)

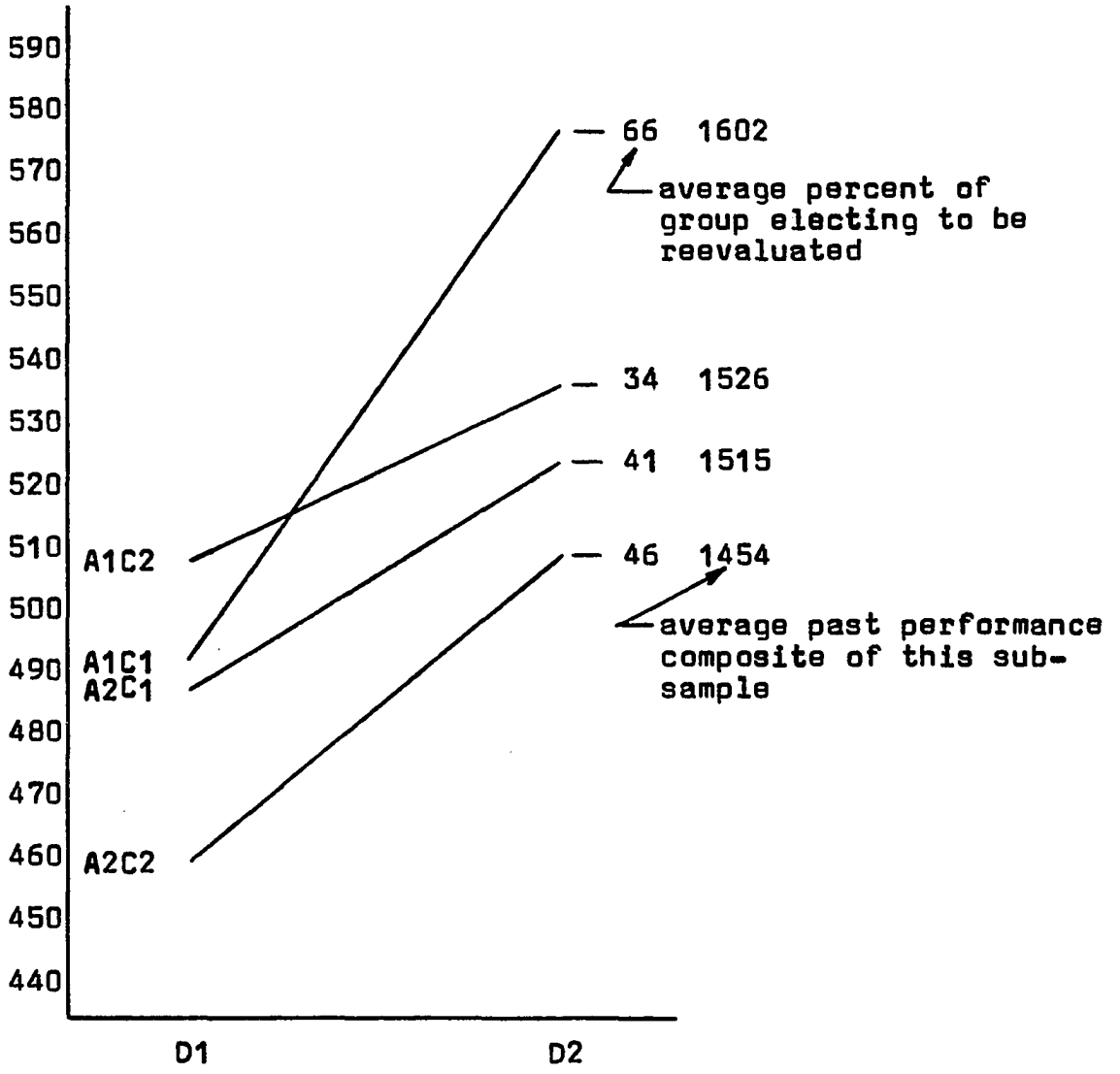

Figure 9. The ACD interaction diagram of only those who elected phase achievement at least once

Table 17. Mean table of the complete sample

Means	B1D1	B1D2	B2D1	B2D2	B3D1	B3D2
A1C1	510.85	536.22	499.14	522.30	528.00	530.81
A1C2	505.92	511.58	509.23	509.31	515.88	529.77
A2C1	506.18	512.04	511.82	517.37	505.32	525.53
A2C2	501.73	509.48	492.23	513.58	481.58	499.28

Table 18. Mean table using only those subjects who participated in phase achievement

Means	B1D1	B1D2	B2D1	B2D2	B3D1	B3D2
A1C1	492.00	606.17	460.83	565.00	527.67	557.83
A1C2	516.00	540.50	530.00	530.33	476.83	537.00
A2C1	488.89	507.44	510.67	528.22	467.17	531.17
A2C2	457.68	482.16	462.53	527.26	457.47	513.37

the primary and second chance examination means. Thus, it was felt that null hypothesis number 15 concerning the ACD interaction could not be rejected for three reasons: 1) data snooping, 2) intellectual trends, and 3) the percentage trends of the reevaluation effect.

Applying the findings of the ACD interaction, plots were made of the ABCD interactions (Figure 10) and compared to the reevaluation percentage irregularities shown in Table 19. The reader will note that these interactions very closely follow

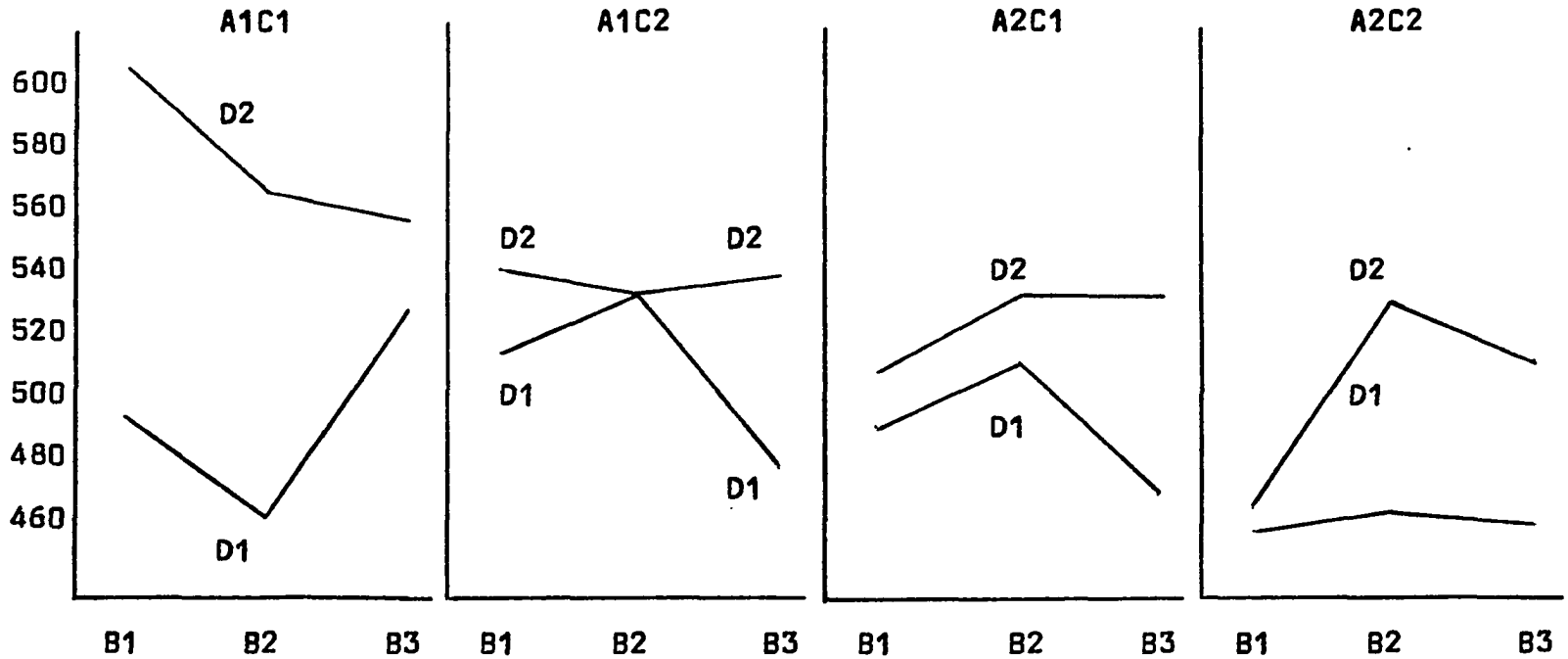

Figure 10. The ABCD interaction diagrams of only those students who elected phase achievement at least once

the reevaluation percentage irregularities shown in Table 19. The number of observations in the various classifications were also fairly small. Therefore, this researcher felt that there was substantial reason not to reject null hypothesis number 19 -- even though it was statistically significant.

Thus, the analysis of the treatment effects and their interactions resulted in only one treatment (the D or phase achievement effect) having a significant development.

Table 19. The number and percentage of students who elected to be reevaluated

	Group Size	Phase I	Phase II	Phase III
Total Sample				
A1C1	27	5 - 19%	4 - 15%	3 - 11%
A1C2	26	1 - 4%	1 - 4%	4 - 15%
A2C1	57	5 - 9%	6 - 11%	11 - 19%
A2C2	60	7 - 12%	8 - 13%	11 - 18%
ALL	170	18 - 11%	19 - 11%	29 - 17%
Sub-sample				
A1C1	6	5 - 83%	4 - 67%	3 - 50%
A1C2	6	1 - 17%	1 - 17%	4 - 67%
A2C1	18	5 - 28%	6 - 33%	11 - 61%
A2C2	19	7 - 37%	8 - 42%	11 - 58%
ALL	49	18 - 37%	19 - 39%	29 - 59%

Independent Variable Analysis

Before each independent composite variable, sex, and the number of times an individual elected the phase achievement option were analyzed for their relationships to the dependent variable, the composite variables were analyzed by a multitrait-multimethod matrix for convergent and discriminant validity. The intercorrelations of variables within sets of measures and between sets of measures are presented in Table 20. Based upon the examination of the multitrait and multimeasure matrix, it was ascertained that the first measure of course perception was not valid (12). Therefore, because of the low correlation this variable had with all other variables, it was considered a poor measurement indicator. This variable was thus dropped from the course perception composite and the remaining analyses in this study.

To ascertain whether or not the past experience composite variable had a significant relationship to the achievement composite, the following null hypothesis was tested.

Null hypothesis number 20: There were no significant relationships between the past experience composite variable and the achievement composite.

Table 21 exhibits that this hypothesis must be rejected. The calculated F-value of 7.756 is highly significant beyond the .01 level.

In order to determine if there was any significant relationship between the achievement variable and the past performance

Table 20. Intercorrelation of variables

Var. No.	PE 1	PP 4	CP 7	CI 10	A 13	PE 2	PP 5	CP 8	CI 11	A 14	PE 3	PP 6
1-PE	1.00											
4-PP	.05	1.00										
7-CP	.19	-.02	1.00									
10-CI	.06	-.05	.18	1.00								
13-A	.21	.46	-.04	.13	1.00							
2-PE	.44	.05	.17	.11	.15	1.00						
5-PP	-.09	.58	-.21	-.13	.28	-.04	1.00					
8-CP	.03	-.05	.15	.32	.14	-.01	-.16	1.00				
11-CI	.07	-.04	.23	-.54	.12	.04	-.10	.32	1.00			
14-A	.22	.44	.02	.03	.58	.17	.29	.14	.03	1.00		
3-PE	--	--	--	--	--	--	--	--	--	--	1.00	
6-PP	.05	.68	-.26	-.07	-.50	-.03	.61	-.15	-.06	-.46	--	1.0
9-CP	.04	-.01	.12	.27	.20	-.01	-.13	.89	.30	.16	--	-.1
12-CI	.04	-.07	.08	.45	.14	.07	-.07	.49	.53	.13	--	-.0
15-A	.10	.39	.02	.00	.45	.04	.37	.14	.00	.52	--	.4
16-S	.24	-.22	.29	.18	.13	.14	-.24	.14	.20	.22	--	-.2
17-PA	.01	-.02	-.04	.04	.06	-.03	-.03	-.04	-.01	.12	--	.0
18-IT	-.07	-.00	-.05	.10	-.07	-.01	.01	-.04	-.00	-.00	--	.0

PE = Past Experience
- 1 = Age
- 2 = Quarters
- 3 = No Variable

PP = Past Performance
- 4 = ACT Composite
- 5 = HS%R
- 6 = CGPA

CP = Course Perception
- 7 = Reason for Enrollment
- 8 = Course Evaluation Scale 1
- 9 = Course Evaluation Scale 2

CI = Course Interest
- 10 = Interest for Phase I
- 11 = Interest for Phase II
- 12 = Interest for Phase III

A

S

PA

I1

relation of variables

CI 10	A 13	PE 2	PP 5	CP 8	CI 11	A 14	PE 3	PP 6	CP 9	CI 12	A 15	S 16	PA 17	IT 18
)														
3 1.00														
1 .13	1.00													
7 .11	.15	1.00												
1 -.13	.28	-.04	1.00											
5 .32	.14	-.01	-.16	1.00										
3 -.54	.12	.04	-.10	.32	1.00									
2 .03	.58	.17	.29	.14	.03	1.00								
- --	--	--	--	--	--	--	1.00							
5 -.07	-.50	-.03	.61	-.15	-.06	-.46	--	1.00						
2 .27	.20	-.01	-.13	.89	.30	.16	--	-.11	1.00					
8 .45	.14	.07	-.07	.49	.53	.13	--	-.04	.50	1.00				
2 .00	.45	.04	.37	.14	.00	.52	--	.42	.16	.11	1.00			
9 .18	.13	.14	-.24	.14	.20	.22	--	-.25	.10	.19	.04	1.00		
4 .04	.06	-.03	-.03	-.04	-.01	.12	--	.07	-.03	.05	.11	-.09	1.00	
5 .10	-.07	-.01	.01	-.04	-.00	-.00	--	.07	-.12	-.01	-.10	-.09	.07	1.00

ce CP = Course Perception
7 = Reason for Enrollment
8 = Course Evaluation Scale 1
9 = Course Evaluation Scale 2
le
nce CI = Course Interest
site 10 = Interest for Phase I
11 = Interest for Phase II
12 = Interest for Phase III

A = Achievement
13 = Achievement Level Phase I
14 = Achievement Level Phase II
15 = Achievement Level Phase III
S = Sex (1 = female, 2 = male)
PA = Phase Achievement
IT = Instructional Treatment
(1 = Control; 2 = Experimental)

composite variable, null hypothesis number 21 was drafted.

Null hypothesis number 21: There were no significant relationships between the past performance composite variable and the achievement composite.

As testified by Table 22, this hypothesis was rejected.

Table 21. Analysis of variance of relationships between past experience and achievement

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Past Experience	1	386173.06	386173.06	7.756**
Error	168	8364579.55	49789.16	
Total	169	8750752.61		

Table Value $F_{(.05)} = 3.90$

Table 22. Analysis of variance of relationships between past performance and achievement

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Past Performance	1	2744989.32	2744989.32	76.786**
Error	168	6005763.29	35748.59	
Total	169	8750752.61		

Table Value $F_{(.05)} = 3.90$

The next variable that was analyzed for its relationship to the achievement composite was course interest. The following null hypothesis was formulated to test for any significant relationship.

Null hypothesis number 22: There were no significant relationships between the interest and achievement composite variable.

The statistical analysis of this hypothesis revealed a non-significant F-value of 2.077 (Table 23). Therefore, this null hypothesis was not rejected.

Table 23. Analysis of variance of relationships between interest and achievement

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Interest	1	106874.67	106874.67	2.077
Error	168	8643877.94	51451.65	
Total	169	8750752.61		

Table Value $F_{(.05)} = 3.90$

The final composite variable to be tested for its relationship to the achievement composite was the course perception variable. The hypothesis formulated to test this variable also followed the null format.

Null hypothesis number 23: There were no significant relationships between the course perception composite variable and

the achievement composite.

The statistical test of this variable indicated that it was of a significant nature. This is shown in Table 24.

Table 24. Analysis of variance of relationships between course perception and achievement

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Course Perception	1	322618.39	322618.39	6.431*
Error	168	8428134.22	50167.47	
Total	169	8750752.61		

Table Value $F_{(.05)} = 3.90$

Two single variables were investigated for their relationship to the composite variable of achievement. These two variables were sex and the number of times an individual participated in the second chance reevaluation examination. The following hypotheses were composed to test for significant relationships with the achievement composite.

Null hypothesis number 24: There were no significant relationships between sex and the achievement composite variable.

Null hypothesis number 25: There were no significant relationships between number of times a student elected to be reevaluated and achievement.

Table 25 indicates that there was a significant relationship

between sex and achievement. However, no significant relationship was found between phase achievement and the achievement composite (Table 26).

Table 25. Analysis of variance of relationships between sex and achievement

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Sex	1	274940.21	274940.21	5.450*
Error	168	8475812.40	50451.26	
Total	169	8750752.61		

Table Value $F_{(.05)} = 3.90$

Table 26. Analysis of variance of relationships between the number of times a student selected phase achievement reevaluation and achievement

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Phase Achievement	1	119247.48	119247.48	2.321
Error	168	8631505.13	51378.01	
Total	169	8750752.61		

Table Value $F_{(.05)} = 3.90$

Achievement Analysis

Following the method of procedure outlined in Chapter III, the data were randomly divided into two equal data sets of 85 observations each. Using the first data set, the theorized conceptual-path model was tested. As shown in Figure 11, all paths leading to the variable course interest were of a non-significant nature. The path from course interest to course perception was found to be significant (t-value = 4.883). All other paths leading to course perception were non-significant. The regression analysis of the paths leading to course achievement resulted in the paths from the variables of course interest and treatment to be insignificant. Whereas, the paths stemming from past performance, sex, course perception, phase achievement, and past experience were of a significant nature.

All non-significant paths were deleted and the recursive equations for the revised model were formulated:

$$Z_7 = P_{76}Z_6 + P_{7v}R_v$$

$$Z_8 = P_{81}Z_1 + P_{82}Z_2 + P_{84}Z_4 + P_{85}Z_5 + P_{87}Z_7 + P_{8w}R_w$$

From these equations, the t-values for the remaining paths were again calculated with the first set of data. The results of these calculations are shown in Figure 12.

Before the second data set was used to test the refined conceptual path model, the reliability coefficients for the multimeasure variables were calculated (Table 27). The reliability coefficients were employed to correct the correlations of the second data set for attenuation (measurement

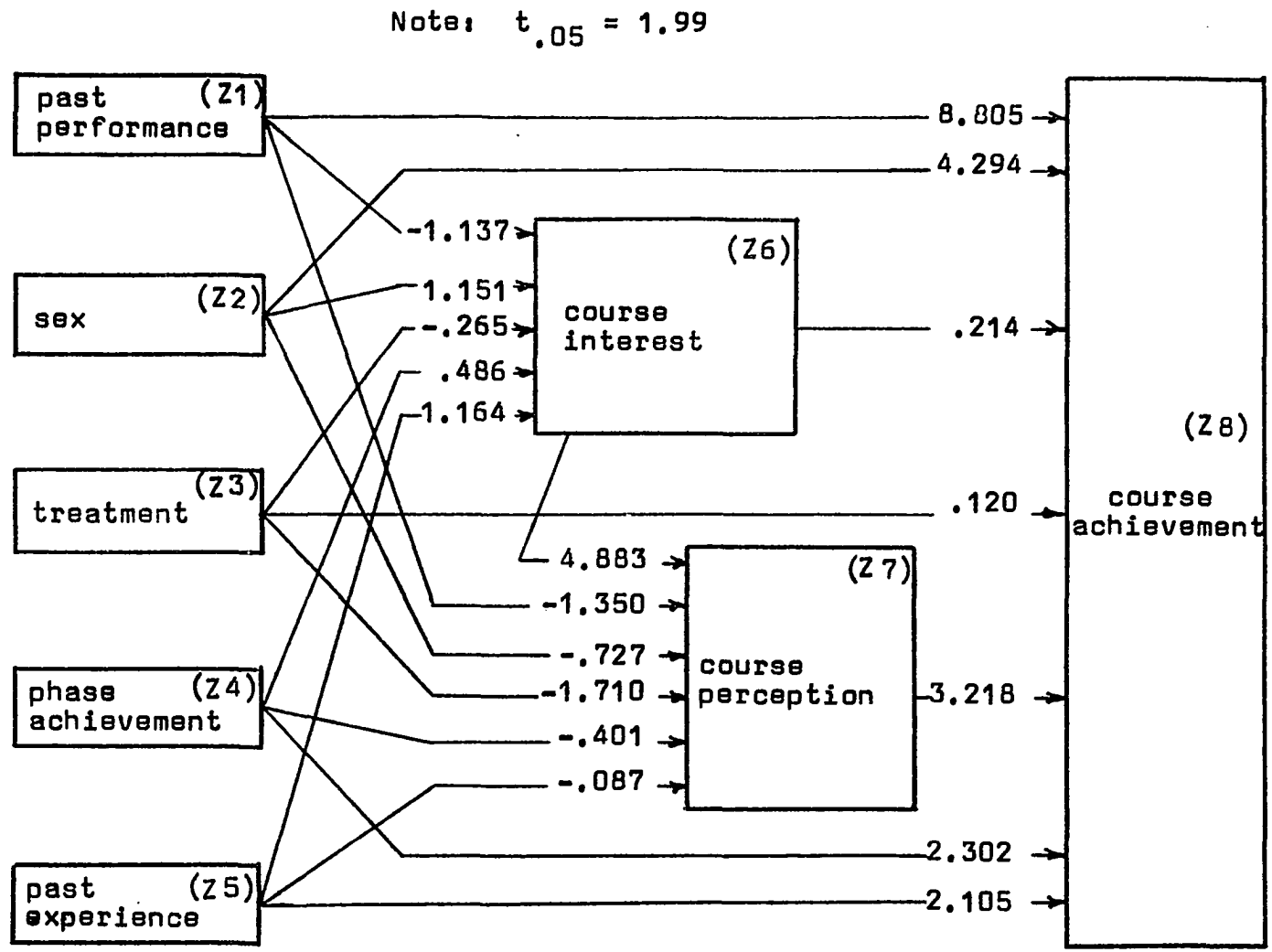

Figure 11. T-values of the conceptual-path model

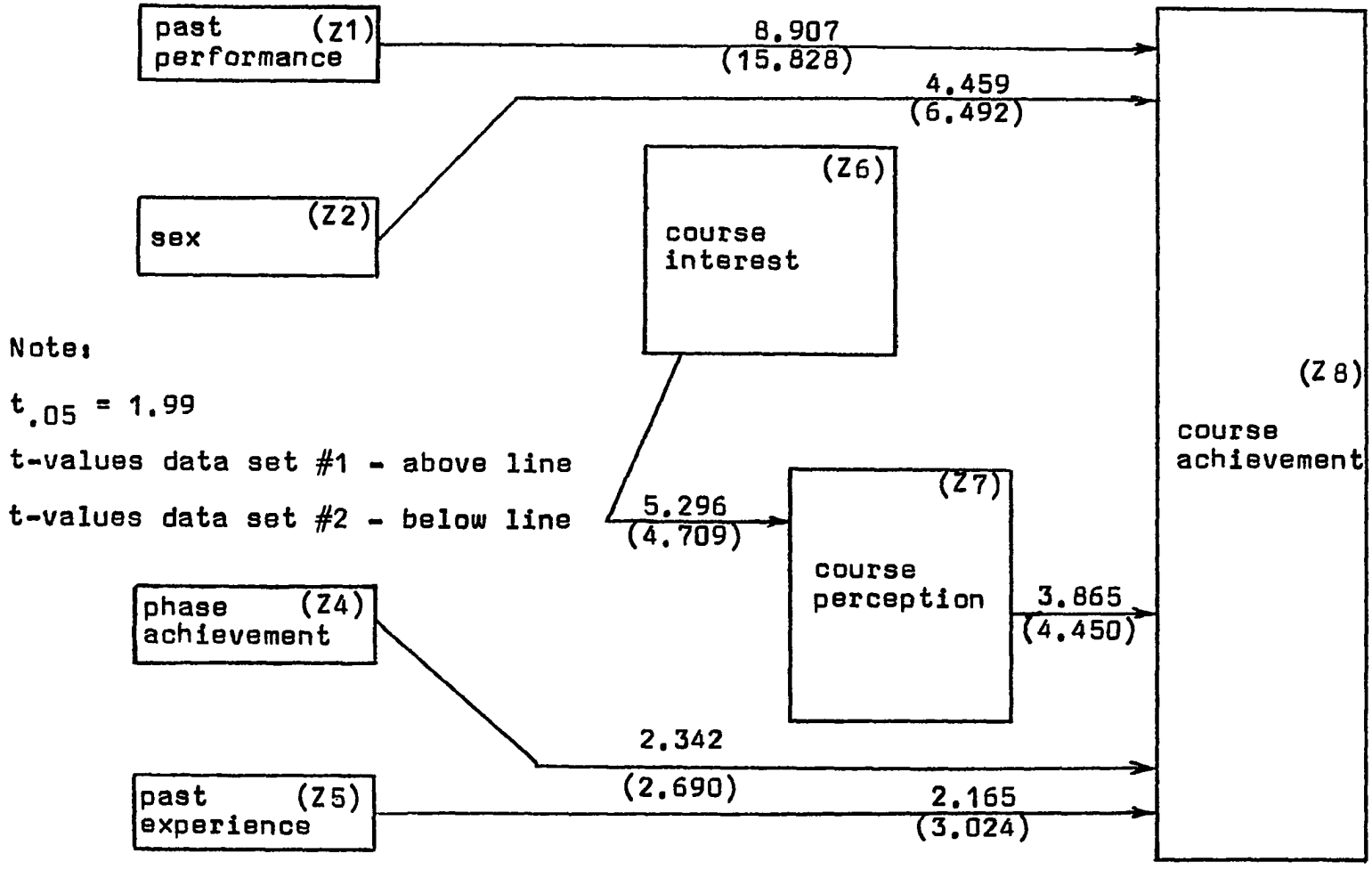

Figure 12. T-values of the refined conceptual-path model

error). With the corrected correlation matrix (Table 27), the revised conceptual-path model again was statistically evaluated. All paths of this revised model remained significant (Figure 12). The R-squared value for this model was .796, that is, 79.6 percent of the variance in course achievement was explained by this model. The residual paths for this model were .706 for R_V and .452 for R_W.

The inspection of this model was continued into an analysis of the direct and indirect effects of these variables. As shown in Table 28, past performance has the greatest direct path toward course achievement. However, past performance also suppresses (as shown by a negative sign) some of the effect of the other variables - primarily sex in this case. Sex has the second greatest direct effect. Yet, it has the greatest suppressive indirect effect of all the variables. Course perception has the third greatest direct effect with only a small amount of suppressive indirect effect. Past experience had next to the last smallest direct effect with the greatest positive indirect effect through sex. Phase achievement had the least amount of direct effect with some additional positive effect through past performance.

The reader may note that there are some other positive and suppressive effects within these variables. However, the magnitude of these effects are small in comparison to those just elaborated upon. A more indepth discussion of these direct and indirect effects will follow in the next chapter.

Table 27. The correlations and reliabilities of path model variables using only the second data set

	S	PA	PE	PP	I	CP	A
S	(1.000)[a]	-.033	.229	-.300	-.310	.154	.175
PA	-.033	(1.000)	-.034	.062	.020	.065	.157
PE	.179	-.067	(.611)	.011	.056	-.043	.240
PP	-.274	.057	.008	(.833)	-.052	-.069	.735
I	-.269	.017	.038	-.042	(.757)	.502	.098
CP	.150	.063	-.033	-.061	.424	(.941)	.212
A	.153	.137	.163	.586	.074	.180	(.761)

[a]The reliability coefficients are in parenthesis. Below this reliability diagonal are the simple correlations of the second data set. Above the diagonal are the correlations corrected for attenuation (measurement error).

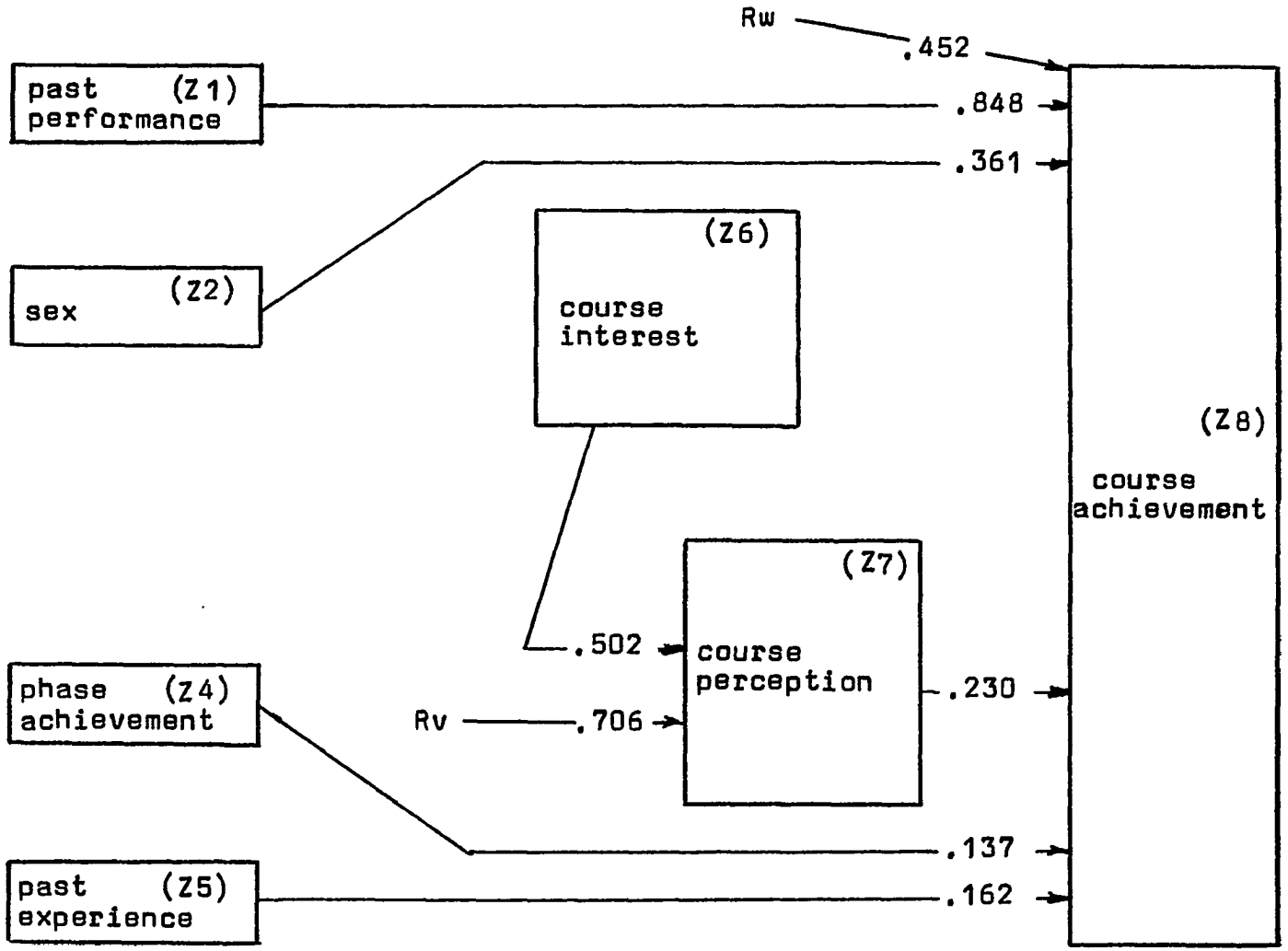

Figure 13. Path coefficients of the refined conceptual-path model

Table 28. The direct and indirect effects of the refined path model

Variable	Achievement Correlation	Total Direct Effect	Total Indirect Effect	Amount and Source of Indirect Effect Through
sex	.1748	.3611	-.1863	-.0046 phase achievement .0371 past experience -.2543 past performance .0355 course perception
phase achievement	.1574	.1373	.0201	-.0120 sex .0055 past experience .0526 past performance -.0150 course perceptiion
past experience	.2394	.1621	.0773	.0827 sex -.0047 phase achievement .0154 past performance -.0099 course perception
past performance	.7354	.8480	-.1126	-.1083 sex .0085 phase achievement .0018 past experience -.0157 course perception
course perception	.2121	.3201	-.0180	.0557 sex -.0090 phase achievement -.0070 past experience -.0582 past performance

CHAPTER V. DISCUSSION

This chapter was written with the purpose of elaborating upon the findings of Chapter IV and to provide additional comments about the experimental method of instruction employed in this study. Thus, this chapter has three main topics of discussion: 1) implications, 2) limitations, and 3) recommendations.

Implications of the Study

Treatment Implications

In discussing the implications of any experiment, a researcher must be sure that the experimental groups are of a similar nature at the onset of the experiment. It was the belief of this investigator that the sample validation statistics adequately indicate that the groups were not significantly different on those factors which may have affected course achievement. It was felt that experimental control was adequate and that there was no evidence that would indicate any violation of statistical assumptions. Also after a careful inspection of the data, this researcher was of the opinion that there was no substantial reason to believe that there was any significant replication, pretest, or interaction effects in the experiment. Thus, upon this basis, the implications of the treatments were analyzed.

One of the major concerns of the study was whether or not there were any differences between the control and individual unit preference treatments. Although no statistical difference

was found between the two treatments, the following comments stem from student evaluations and comments. It appears that many students were generally in favor of increasing the flexibility and freedom within the classroom. However, there were still those students who did not know how to cope with these freedoms. Perhaps what is needed is to allow the student a choice in instructional methods.

A second concern of this study was the relative merits of retesting. The data presented in Chapter IV verified the benefits of this option. It should be noted that almost one out of every three students elected to be retested. It also should be noted that the student who was reevaluated raised his achievement level for that phase on an average of one standard deviation (99.6 points). It seemed obvious to this researcher that the person who was motivated to be reevaluated was the individual who was dissatisfied with his learning level. Therefore, the reevaluation option permitted the student to improve upon his achievement level for whatever motivational reason there may have been.

Perhaps of equal importance was that the instructional design did accomplish its intent. The students were given greater flexibility, the instructors had a reduction in class preparations, and the breadth of general education knowledge was able to be increased without any significant difference in the level of student achievement. This factor should have direct implications for the instructional procedures of general education.

For if general education educators truly believe in providing a breadth of experience, this method of instruction deserves their consideration.

Variable Implications

The discussion in this section on the independent relationship of the variables to course achievement was designed to be brief. A more detailed and informative discussion will follow in the next section.

Six variables were studied independently for their relationship to the achievement variable. All composite variables were validated through use of a multimeasure-multitrait correlation matrix. One indicator of the variable course perception was deleted because of its failure to discriminate.

Four composite variables and two single indicator variables were analyzed for their independent relationship to the achievement variable. Of these variables, past experience and past performance had a highly significant relationship with achievement. Course perception and sex were also found to have significant statistical relationship with achievement. Course interest and the number of times an individual elected to be re-evaluated did not appear to have a statistically significant relationship.

A greater understanding of the implications of the relationships of the variables was gained through the procedure of path analysis.

Significant insights were obtained into the reasons for course achievement by splitting the data and employing the statistical procedure of path analysis. Through this procedure, an unusually high behavioral science R-squared of .796 was obtained for the refined model. In layman's terms, this means that about 80 percent of the factors which cause course achievement were identified.

Directly, past performance had the greatest effect on course achievement. It seems very reasonable to expect present achievement to be greatly affected by past achievement. Sex was the second greatest direct contributor of those factors which influenced achievement.

Ranking third in direct importance was the variable of course perception. This tends to substantiate the opinion that the attitude a student has toward a course will directly influence his level of achievement.

At this point, a comment about the effect of interest should be made. Although the variable interest did not provide any direct paths to the achievement composite, it should be noted that it did have a significant path to course perception. Thus, the effect of course interest was channeled through course perception.

Past experience ranked fourth in its direct relationship with course achievement. Viewing past experience in this context, it does not appear to be as important as the independent

variable analysis revealed it to be.

The fifth and last significant path to achievement was that of phase achievement, that is, the number of times a student desired to be reevaluated. This path could almost be classified as a "desire to succeed" path. It indirectly indicates that motivation has an important relationship with achievement.

However, the calculations of the indirect path effects yielded perhaps the greatest insights into course achievement. Both sex (coded 1 = female and 2 = male) and past performance had positive casual effects on course achievement. Yet, past performance indirectly suppressed some of the direct effect of sex, and sex indirectly suppressed some of the direct effect of past performance.

An inspection of the data lead this researcher to the following conclusion concerning this phenomenon. The suppression of some of the sex (male) direct effect by past performance was equated to a male with a poor past performance composite. The suppression of some of the past performance direct effect by sex was equated to a female with a good past performance composite. The implications of these effects were that a female was at a definite dissadvantage in this course. For some reason, a male student was able to achieve a higher performance level than his female counterpart.

This trait seemed to be verified by the strongest positive indirect effect being that of past experience through sex. This appeared to indicate that the past experiences of males in our

society related more to the course than those of females. No doubt, this was a direct consequence of the male-female experiences fostered in our society.

This trait was also evident in that the second strongest indirect effect was that of course perception through sex.

It should be evident to the reader that the procedure of path analysis revealed some relationships that would not have appeared in a standard regression analysis approach.

Limitations of the Study

Educational research very often has some limitations or shortcomings. Among the limitations of the study were those of: 1) an administrative nature, and 2) those of an inferential nature.

Administrative Limitations

The physical implementation of the experiment had some definite limitations. The first limitation was the location of the two classrooms for the individual unit preference treatment. Although the two classrooms for this treatment were similar, they were located in two different buildings about 300 yards apart. If the student changed his or her mind on which class session to attend shortly before the start of class, it was difficult for the student to change classrooms. This may have had some deleterious effect.

The size of the classrooms may have also had some effect on the experiment. The classroom in Stewart Hall was smaller

than was desired. This classroom allowed for only about a fifteen percent overflow. Some of the sessions in this classroom had greater than a fifteen percent overflow. As a result, seating proved to be an occasional problem. The exact consequences of this situation can not be realistically determined.

A third administrative limitation was that of testing. To avoid allowing the instructors to "teach to the test," they were not given copies of the examinations until the day before the examination date. This may have caused some instructional frustration for the instructors who did not know "exactly" what to teach - even though the syllabus had specific objectives. It was the belief of this researcher that some of the frustration may have been passed on to the students. The effects of this factor can not be ascertained with the available data.

Inferential Limitations

The scope of the inferences which may be drawn from the study have already been presented in Chapter I. However, one additional limitation seems to be evident. It appears that the material covered in this course was such that it produces a form of sex discrimination. This factor should be kept in mind when applying the statistical findings of the study to other types of general education courses.

Recommendations for Further Study

To reap the full benefits of educational research, it must be applied. Therefore, the following recommendations are made

from the findings of this study.

1.) If it is the objective of education to allow an individual to develop to the fullest extent of his ability, a provision for reevaluation should be given consideration by educators.

2.) Further research should be conducted to ascertain the maximum benefits of the individual unit preference instructional model developed in this study.

3.) This experiment should be replicated in a different subject matter area and the achievement path model developed reevaluated.

4.) St. Cloud State College should seek the services of a female consultant in an attempt to eliminate the sex discriminating in the course (Modern Technology and Civilization) used in this study.

In addition, if this or a similar study were replicated, the following recommendations are rendered to improve the administrative structure of the experiment.

1.) All classrooms which allow freedom of selection should be large enough to accommodate about at least a 25-35 percent overflow.

2.) All classrooms which allow freedom of selection should be located within the same building.

3.) To promote instructor harmony, instructors should be permitted to have access to a pool of examination questions from which the phase examinations are made.

SUMMARY

The primary purpose of the experimental study was to ascertain the relative merits of an instructional method promoting flexibility and phase achievement within a general education course.

The study was conducted within a general education course at St. Cloud State College during the spring quarter of 1972. The specific course used in this experiment was entitled Modern Technology and Civilization. The study had a sample of 170 students (95 female and 75 male) from diverse disciplines.

The underlying philosophy of the experiment was concerned with merging the general education concept of breadth with the flexibility of individualism. An instructional model was developed (page 23 of this dissertation) that provided a student with individualized unit instructional preference and phase achievement. This model also reduced the number of instructional preparations for the instructor and increased the breadth of the course.

The experimental design selected for this experiment was a split-plot factorial design (page 27 of this dissertation). Within-block effects were phase achievement and replications. Between-block effects were those of instructional treatment and pretest effect.

To eliminate instructor bias, the instructors involved in this experiment were rotated through the treatments.

The achievement criteria were based upon the evaluations of test questions by eleven staff members associated with the general education course used in this experiment. Those questions evaluated as best were randomly assigned to a pretest and two examination forms for each phase. At the end of each instructional phase, one-half of the students in each treatment received one of the forms while the other half received the other form. The primary examination scores were standardized and used as standards of evaluation for those students who desired to be reevaluated. The student who elected to be reevaluated was administered the examination form that he did not take on the primary examination. Post-examination statistical analyses were performed on all examinations.

Students were randomly assigned to instructional treatments. The randomization process was validated through an investigation for treatment equality in past performance, past experience, pretest performance, and the reason for course selection.

Although no statistical differences were found between the control and experimental treatments, many students expressed favoritism toward the increased flexibility and freedom within the classroom. However, there were still those students who did not know how to cope with these new freedoms.

Approximately one out of every three students elected to be reevaluated at least once. The average increase for the student who elected reevaluation was approximately one standard deviation. Therefore, the reevaluation option permitted the

student to significantly improve (beyond the .01 level) upon his achievement.

A secondary consideration of the study was to ascertain what factors had significant relationships to course achievement. In the achievement analysis, a composite score of the three appropriate standardized phase examinations was selected as the criterion variable.

Seven independent variables were analyzed for their relationship to the criterion achievement. The variables were: 1) past experience, 2) past performance, 3) course perception, 4) course interest, 5) instructional treatment, 6) student sex, and 7) whether or not a student elected to take advantage of the reevaluation. Multiple measures were developed for the variables of past experience, past performance, course perception, and course interest. The composite variables were validated through the use of a multimeasure-multitrait correlation matrix. The relationships of the variables to the achievement criterion were then investigated independently and through the use of path analysis.

In an independent variable analysis, past experience, past performance, sex, and course perception were found to have a significant relationship with course achievement.

For the investigation of course achievement by path analysis, the data were split into two equal data sets of 85 observations each. The first data set was used to test and refine a conceptual-path model. The second data set was corrected for

attenuation and used to retest the refined path model (page 76 of this dissertation). All paths of the refined model remained significant. The R-square for the refined path model was found to be .796.

Ranked in order of importance, the direct factors affecting course achievement were past performance (.848), sex (.361), course perception (.320), past experience (.162), and phase achievement (.137).

The analysis of the indirect effects discovered the strongest two indirect effects to be suppressor variables. Past performance indirectly suppressed .254 of the direct effect of sex. Sex suppressed .108 of the direct effect of past performance. Past experience had the strongest positive indirect effect (.083) through sex. Course perception had an indirect effect of .056 through sex and phase achievement had an indirect effect of .053 through past performance. A complete analysis of the direct and indirect effects has been presented in Table 28 (page 80 of this dissertation).

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APPENDIX A:

UNIT IMPORTANCE QUESTIONNAIRE

UNIT IMPORTANCE INDUSTRIAL 192 INTERVIEW SCHEDULE

Read the following:

At our meeting yesterday, you will recall that we divided the course syllabus into three phases. We then divided the phases into two seven unit groupings. It is now necessary for us to individually identify the three MOST IMPORTANT units within each group.

(Hand the evaluator the group listings.)

First, take a few minutes to review all the units within each phase. Then, starting with Phase I Group 1, select the three units that you feel are the MOST IMPORTANT. If you need any clarification or review as to the subject matter content represented by the unit titles, please feel free to ask.

Take your time and when you have your responses ready, I will record your answers.

INDUSTRIAL 192 UNIT IMPORTANCE QUESTIONNAIRE

Select the three units that you feel are the most important within each of the seven unit groupings.

PHASE I - GROUP I (TECHNOLOGICAL DEVELOPMENT)

1. _____ Dynamics of Change
2. _____ Development of Man through Tools
3. _____ The History of Technology from the Industrial Revolution
4. _____ The History of Labor
5. _____ Techniques of Labor and Management
6. _____ The Industrial Organization
7. _____ The Industrial Organization's Structure

PHASE I - GROUP II (TECHNOLOGICAL DEVELOPMENT)

1. _____ The Development of Mass Production
2. _____ Automation
3. _____ Computer Development and Basic Operation
4. _____ Computer Applications and Implications
5. _____ Oceanography
6. _____ Education and Technology
7. _____ Sources of Power

PHASE II - GROUP I (AMERICAN INDUSTRIES)

1. _____ Forestry and Wood Products
2. _____ The Paper Industry
3. _____ The Iron and Steel Industry
4. _____ Extraction
5. _____ Synthetics and Plastics
6. _____ Machine Tools and Processes
7. _____ Housing and Construction

PHASE II - GROUP II (AMERICAN INDUSTRIES)

1. _____ Air and Space Transportation
2. _____ Rail Transportation
3. _____ Water and Pipeline Transportation
4. _____ Highway Transportation
5. _____ Telemobility
6. _____ Printing and the Graphic Arts
7. _____ The Service Industries

PHASE III - GROUP I (THE SOCIOLOGICAL IMPLICATIONS OF TECHNOLOGY)

1. _____ Factors of Hard-Core Unemployment
2. _____ Production and the Worker
3. _____ The Guaranteed Income Concept
4. _____ Leisure
5. _____ Working Women
6. _____ Moonlighting
7. _____ Unemployment and Underemployment

PHASE III - GROUP II (THE SOCIOLOGICAL IMPLICATIONS OF TECHNOLOGY)

1. _____ Population
2. _____ Air Pollution
3. _____ Water Pollution
4. _____ Land and Noise Pollution
5. _____ The Social Costs of Cybernation
6. _____ Control and Use of Technology
7. _____ The Future of the Future

INDUSTRIAL 192 UNIT IMPORTANCE RECORDING FORM

Respondent		A	B	C	D	E	F	G	H	I	J	K	L	M
PHASE I	GROUP I	5	1	1	1	1	1	1	3	2	1	1	5	1
		6	2	3	3	6	5	6	1	3	2	3	1	7
		7	3	5	6	3	6	5	6	5	3	6	3	6
	GROUP II	2	1	1	2	1	2	3	1	1	2	1	2	2
		3	2	4	6	3	4	2	7	2	6	2	3	3
		7	3	7	7	6	6	6	3	6	5	3	5	4
PHASE II	GROUP I	3	3	1	3	3	3	2	3	2	4	5	5	3
		5	5	6	5	5	5	3	5	4	1	6	4	4
		6	6	7	6	1	6	5	7	7	3	7	1	5
	GROUP II	2	4	4	5	1	4	7	5	1	1	5	2	7
		5	7	5	7	5	5	1	7	5	2	7	5	5
		7	5	7	6	4	6	5	-	7	5	1	7	1
PHASE III	GROUP I	2	1	4	1	3	4	2	4	-	4	1	4	7
		4	2	6	2	5	7	4	5	-	3	2	7	4
		7	4	7	4	7	2	5	6	-	2	4	3	2
	GROUP II	5	1	4	1	1	5	1	1	-	2	7	1	1
		6	2	5	5	5	1	3	5	-	1	5	7	5
		7	3	7	7	7	2	4	-	-	6	1	4	7

INDUSTRIAL 192 UNIT IMPORTANCE QUESTIONNAIRE TOTALS

PHASE I - GROUP I (TECHNOLOGICAL DEVELOPMENT)

1. (11) Dynamics of Change
2. (3) Development of Man through Tools
3. (9) The History of Technology from the Industrial Revolution
4. (0) The History of Labor
5. (6) Techniques of Labor and Management
6. (9) The Industrial Organization
7. (3) The Industrial Organization's Structure

PHASE I - GROUP II (TECHNOLOGICAL DEVELOPMENT)

1. (6) The Development of Mass Production
2. (10) Automation
3. (8) Computer Development and Basic Operation
4. (3) Computer Applications and Implications
5. (2) Oceanography
6. (6) Education and Technology
7. (4) Sources of Power

PHASE II - GROUP I (AMERICAN INDUSTRIES)

1. (4) Forestry and Wood Products
2. (2) The Paper Industry
3. (10) The Iron and Steel Industry
4. (4) Extraction
5. (10) Synthetics and Plastics
6. (6) Machine Tools and Processes
7. (3) Housing and Construction

PHASE II - GROUP II (AMERICAN INDUSTRIES)

1. (6) Air and Space Transportation
2. (3) Rail Transportation
3. (0) Water and Pipeline Transportation
4. (4) Highway Transportation
5. (13) Telemobility
6. (2) Printing and the Graphic Arts
7. (9) The Service Industries

PHASE III - GROUP I (THE SOCIOLOGICAL IMPLICATIONS OF TECHNOLOGY)

1. (3) Factors of Hard-Core Unemployment
2. (8) Production and the Worker
3. (3) The Guaranteed Income Concept
4. (11) Leisure
5. (3) Working Women
6. (2) Moonlighting
7. (6) Unemployment and Underemployment

PHASE III - GROUP II (THE SOCIOLOGICAL IMPLICATIONS OF TECHNOLOGY)

1. (10) Population
2. (3) Air Pollution
3. (2) Water Pollution
4. (3) Land and Noise Pollution
5. (8) The Social Costs of Cybernation
6. (2) Control and Use of Technology
7. (7) The Future of the Future

APPENDIX B:

COURSE SYLLABUS

INDUSTRIAL 192

MODERN TECHNOLOGY AND CIVILIZATION

SPRING 1972

INSTRUCTIONAL STAFF

BERGSTROM, CARTER, WOOD

INDUSTRIAL 192

MODERN TECHNOLOGY AND CIVILIZATION

Catalog Description

Ind. - 192 - Modern Technology and Civilization -- Analysis of contemporary technology and its effects on man and society. Special emphasis is placed on change created by technology, as well as such topics as modern industrial structure, the labor force, leisure, automation and the resulting social consequences. 4 credits.

Philosophy and Objective

The concept of technology is by no means new, it is not a creation of the 20th century; rather it is as old as man himself. As you proceed throughout this quarter you should ask yourself what technology really is. And, equally important, where is it taking you and how does it affect your life.

All men are not engineers or scientists. Not all men understand technology in its true perspective, yet technology has changed life both negatively and positively. Man takes the concept of technology for granted; probably because he does not understand it or because he is afraid of it. Yet the present revolution is the basis for understanding social change. Many questions must be answered. For example: What about the population explosion? Will the computer eventually do all of the thinking for man? How will we learn in the 21st century? Who should have more leisure time? Will technology eventually destroy man? Such questions are seemingly without end.

If we wish to place the term "technology" in the framework of a theoretical construct, we find that it does not exist in the abstract but exists to meet the needs and social goals of the people. Technology creates problems while it attempts to free man from burdens, pushing him further and further into an era of abundance, often at a pace with which he can not cope. Man must be able to analyze new situations, develop rational and feasible solutions and then be able to communicate the results to those concerned. Every member of society must be vividly aware of the influence, reactions, problems, and advancements of the highly industrialized era of which he is a part.

The course content of Industrial 192 has been organized to develop a broader background of knowledge and understanding of change -- change brought about through industry and her

technologies. As a result of this broadened scope, it is hoped that the individual student will be able to formulate a base for opinions, attitudes, and actions; thereby becoming a more informed and contributory member of our technological society.

Course Organization and Content

This course is divided into three distinct phases. Each phase has fourteen instructional units. The following is a listing of the phase and unit titles. (* Indicates major units)

Phase I - Technological Development

*Dynamics of Change
Development of Man Through Tools
*The History of Technology from the Industrial Revolution
The History of Labor
Techniques of Labor and Management
*The Industrial Organization
The Industrial Organization's Structure
*The Development of Mass Production
*Automation
*Computer Development and Basic Operation
Computer Applications and Implications
Oceanography
Education and Technology
Sources of Power

Phase II - American Industries

Forestry and Wood Products
The Paper Industry
*The Iron and Steel Industry
Extraction
*Synthetics and Plastics
*Machine Tools and Processes
Housing and Construction
*Air and Space Transportation
Rail Transportation
Water and Pipeline Transportation
Highway Transportation
*Telemobility
Printing and the Graphic Arts
*The Service Industries

Phase III - The Sociological Implications of Technology

Factors of Hard-Core Unemployment
*Production and the Worker
The Guaranteed Income Concept
*Leisure
Working Women
Moonlighting

*Unemployment and Underemployment
Population and Technology
Air Pollution
Water Pollution
Land and Noise Pollution
*The Social Costs of Cybernation
Control and Use of Technology
*The Future of the Future

Within each phase, the method of instruction and the order of unit presentation will be explained by your instructor. Those units that are not covered in class should be covered by the student through independent study.

Evaluation

Although classroom instruction can not be provided in all of the instructional units, the phase examinations will cover all the units within that phase. The examinations will be composed of sixty-two multiple choice questions.

Primary phase examinations will be held on the following dates: April 21 for Phase I, May 10 for Phase II, and June 2 for Phase III. These are the last scheduled class periods for each instructional phase.

Test grades will be assigned according to standardized scores in which a standardized score of 335.5 is required for a D, 432.5 for a C, 538.5 for a B, and 628.0 for an A.

If a student is dissatisfied with his achievement on the primary examination, he can elect to be retested in each phase a second time. The second chance phase examinations will be held according to the following schedule: April 27 for Phase I, May 18 for Phase II, and a time to be announced during final week for Phase III. Second chance examinations will be administered at the same scheduled class time on the indicated float days. The room for these examinations will be announced by your instructor.

If the student elects to take a second chance examination, it should be understood that it is the student's responsibility to make sure that his second chance examination is not of the same form as his primary examination. That is, a student who has taken Form A as his primary examination should take Form B on his second chance examination. If this procedure is not followed, the lowest score obtained will be recorded as the student's achievement level. No questions are exactly repeated between different phase examination forms. The last score achieved is also the recorded achievement score for that phase.

Final evaluation will be determined by the summation of the standardized achievement level received in each of the three phases. At least one examination must be taken in each phase. Grades will be assigned as follows: a total of 1006.5 points is required for a D, 1297.5 points for a C, 1615.5 points for a B, and 1884.0 points for an A.

General Reference List

The general educational breadth of this course is not adaquately covered in any one single reference. For this reason, each instructional unit has specific references. A list of the references sighted is listed below. Your instructor may add to this list.

American Machine Tool Builders' Association, Machine Tools Today, National Machine Tool Builder's Association, Washington, D.C. 1964.

Carpenter, M. Scott. Exploring Space and Sea. Washington, D. C., Smithsonian Institute Press, Smithsonian Publication 4726. 1967.

*Fabun, Don. The Dynamics of Change. Englewood Cliffs, N. J., Prentice-Hall, Inc. 1967.

Kirschner, Edwin J. Transportation Technology: The Decade Ahead. Department of Transportation, Washington, D.C., U. S. Government Printing Office.

*Lauda, Donald P. and Ryan, Robert D. Advancing Technology: Its Implications on Society. Dubuque, Iowa. Wm. C. Brown Company Publishers. 1971.

Monograph Paper, History of the American Labor Movement.

Nekoosa-Edwards Paper Company, Public Relations Department. Versatile Nekoosa in Action. Port Edwards, Wisconsin. ca. 1966.

*Scobey, Mary-Margaret. Teaching Children About Technology. 1st ed. Bloomington, Illinois. McKnight and McKnight Publishing Company. 1968.

U. S. Department of Agriculture, Forest Service. Forest Patterns: Beauty and Use. Washington, D.C., U. S. Government Printing Office, PA-679. 1965.

U. S. Steel Corporation. The World of Steel. Pittsburgh, Pennsylvania. 1966.

Wilkie Brothers Foundation. Tools That Created Civilization Now Show the Way to World Peace. Des Plaines, Illinois. ca. 1960.

You will find the references authored by Fabun, Lauda & Ryan, and Scobey to be those references most frequently sighted as the specific references for a unit. It is recommended that you purchase one of these texts. It is also recommended that student study groups be formed to provide each student with an access to these three main references. These study groups will also provide the opportunity to "learn from each other."

The other references sighted are available for your use in the School of Industry's P. G. Rawland Library. This room is located adjacent to the School of Industry's main office. These materials may not be checked out.

In addition, most encyclopedias will provide an excellent condensed reference source for those units that do not have any specified references.

Specific Unit References and Objectives

Unit 1 - Dynamics of Change
References:
Lauda and Ryan, pp. 259-275.
Fabun, Part I, pp. 1-9, 15-21, 26-32.
Objectives:
The student will be able to identify:
1. the major factors which tend to hinder the adaptation of technological change.
2. the major factors which accelerate and promote technological change.
3. various examples which are indicators as to the rate of technological change.
4. basic terms associated with technological change.
5. what needs to be done in order to adapt to change in our society.

Unit 2 - Development of Man Through Tools
References:
Wilkie Brothers Foundation.
Objectives:
The student will be able to identify:
1. the major events in the development of man through tools. This will include such items as the majcr eras, discoveries, inventions, innovators, etc.

Unit 3 - The History of Technology From the Industrial Revolution
References:
None specified - many good sources available.

Unit 3 - (continued)
Objectives:
The student will be able to identify:
1. significant historical events and individuals from the industrial revolution.
2. various industrial expansion terms associated with this period of time.

Unit 4 - The History of Labor
References:
Lauda and Ryan, pp. 92-114.
Monograph Paper.
Objectives:
The student will be able to identify:
1. the major developments in the history of labor in the United States. This will include such items as important labor leaders, large labor unions, government legislation, and major historical incidents.

Unit 5 - Techniques of Labor and Management
References:
None specified - any good text on labor relations.
Objectives:
The student will be able to identify:
1. the various types of union shops and their requirements.
2. various techniques used by labor such as standardization, jurisdictional limitations, picketing, boycotts, etc.
3. the difference between conciliation, mediation, arbitration and other labor-management terms.
4. the various techniques used by management such as employers' associations, injunctions, lockouts, and others.
5. the role and power of the federal government in labor-management differences.

Unit 6 - The Industrial Organization
References:
None specified.
Objectives:
The student will be able to identify:
1. the various organization types, such as private, partnership, etc.
2. methods of industrial expansion as aggregation, consolidation, and integration.
3. the basic industrial considerations when considering new plant development as labor, resources, etc.
4. basic industrial organizational trends.

Unit 7 - The Industrial Organization's Structure
References:
None specified.

Unit 7 - (continued)
Objectives:
The student will be able to identify:
1. the various types of industrial organization charts and their associated terms.
2. the major functional divisions of an industrial enterprise such as purchasing, manufacturing, marketing, etc.
3. the broad classifications of occupations within the divisions of an industrial enterprise.

Unit 8 - The Development of Mass Production
References:
None specified.
Objectives:
The student will be able to identify:
1. significant historical men and events in the development of mass production.
2. the basic elements of mass production.

Unit 9 - Automation
References:
Fabun, Part IV, pp. 1-9.
Lauda and Ryan, pp. 127-147.
Objectives:
The student will be able to identify:
1. the impact and trends of automation in the United States.
2. the difference between mass production, automation, and cybernation.
3. significant historical events in the development of automation.

Unit 10 - Computer Development and Basic Operation
References:
Fabun, Part IV, pp. 8-30.
Lauda and Ryan, pp. 114-120.
Scobey, pp. 77-78.
Objectives:
The student will be able to identify:
1. significant men and events in the development of the computer.
2. the basic types of computers.
3. the basic functional divisions within a computer.

Unit 11 - Computer Applications and Implications
References:
Lauda and Ryan, pp. 478-490.
Scobey, pp. 77-78.
Objectives:
The student will be able to identify:
1. some of the various uses of the computer.
2. social trends as a result of the computer.

Unit 12 - Oceanography
References:
Carpenter.
Fabun, Part II, pp. 16-19.
Objectives:
The student will be able to identify:
1. some of the problems of under sea explorations.
2. some of the future potentials of the ocean.

Unit 13 - Education and Technology
References:
None specified.
Objectives:
The student will be able to identify:
1. trends between education and its relationship to technological advancement.
2. the purposes of industrial education at the various levels of our educational system.

Unit 14 - Sources of Power
References:
Scobey, pp. 193-222.
Objectives:
The student will be able to identify:
1. natural sources of energy.
2. the steps in producing electricity.
3. methods of energy production, their source, and associated major implications.

Unit 15 - Forestry and Wood Products
References:
U. S. Department of Agriculture, Forest Service.
Scobey, pp. 100-108.
Objectives:
The student will be able to identify:
1. the six basic continental forests in terms of general location, type of forest, and products produced.
2. the basic methods and procedures in harvesting forest products.
3. some basic forest products by name, make-up, and use.
4. the importance of the forest industry to Minnesota and the nation.

Unit 16 - The Paper Industry
References:
Nekoosa-Edwards Paper Company.
Scobey, pp. 269-271.
Objectives:
The student will be able to identify:
1. the major steps in the paper making process.
2. the major raw materials used in paper production.

Unit 16 - (continued)
3. the importance of the paper industry to the state of Minnesota and the nation.
4. the historical origins of paper.

Unit 17 - The Iron and Steel Industry
References:
Scobey, pp. 109-112, 217.
U. S. Steel Corporation.
Objectives:
The student will be able to identify:
1. the major steps in the steel making process.
2. the major raw materials used in steel making.
3. the importance of the steel industry to the state of Minnesota and the nation.

Unit 18 - Extraction
References:
Fabun, Part II, pp. 1-11.
Scobey, pp. 86-88, 112-113, 149-151.
Objectives:
The student will be able to identify:
1. the relationship between resources and population.
2. how long our resources are apt to last.
3. methods of extraction.
4. major locations of aluminum and copper resources.
5. how salt is mined and its location in the United States.

Unit 19 - Synthetics and Plastics
References:
Scobey, pp. 117-119, 175-177.
Objectives:
The student will be able to identify:
1. the basic processes used in plastic production.
2. the major divisions of plastics.
3. common man-made fibers and their trade names.
4. major events in the development of plastics.

Unit 20 - Machine Tools and Processes
References:
American Machine Tool Builders' Association.
Objectives:
The student will be able to identify:
1. basic machine tool operations.
2. terms associated with the basic machine tool operations and related operations.

Unit 21 - Housing and Construction
References:
Fabun, Part II, pp. 20-25.
Scobey, pp. 88-94.

Unit 21 - (continued)
Objectives:
The student will be able to identify:
1. the present and future housing trends.
2. terms associated with housing trends.
3. the importance of concrete to construction.
4. various types of concrete.

Unit 22 - Air and Space Transportation
References:
Kirschner, pp. 15-19.
Scobey, pp. 226-227, 255-267.
Objectives:
The student will be able to identify:
1. the role of the government in air transportation.
2. major vehicles in air and space transportation.
3. terms and trends of aviation and space transportation.

Unit 23 - Rail Transportation
References:
Kirschner, pp. 8-13.
Scobey, pp. 235-241.
Objectives:
The student will be able to identify:
1. the importance of rail transportation.
2. terms and trends associated with the railroad industry in the United States.
3. major developments in rail transportation systems in the United States.

Unit 24 - Water and Pipeline Transportation
References:
Kirschner, pp. 21-24.
Scobey, pp. 226, 242-255.
Objectives:
The student will be able to identify:
1. major developments in water and pipeline transportation.
2. the importance of water and pipeline transportation to the United States.
3. major water transportation systems and vehicles.

Unit 25 - Highway Transportation
References:
Kirschner, pp. 1-8.
Scobey, p. 225.
Objectives:
The student will be able to identify:
1. the major classifications of highway carriers as common, contract, etc.
2. general trends in land transportation.
3. the economic impact of highway transportation in terms of taxes and consumer spending.

Unit 26 - Telemobility
References:
Fabun, Part III, pp. 1-30.
Objectives:
The student will be able to identify:
1. major developments in telemobility as well as their associated past, present, and future implications.

Unit 27 - Printing and the Graphic Arts
References:
Scobey, pp. 271-275.
The student will be able to identify:
1. the basic printing processes and associated terms.
2. the relationship between photography and printing.

Unit 28 - The Service Industries
References:
Lauda and Ryan, pp. 169-187.
Objectives:
The student will be able to identify:
1. the major service industries in the United States.
2. the trends of the service industries in the United States.
3. the productivity trend of the service industries.

Unit 29 - Factors of Hard-Core Unemployment
References:
Lauda and Ryan, pp. 77-91, 217-234.
Objectives:
The student will be able to identify:
1. the problems of the hard-core unemployed.
2. examples which indicate the inequalities between white and black America.
3. the training problems of the hard-core.

Unit 30 - Production and the Worker
References:
None specified.
Objectives:
The student will be able to identify:
1. the physical and mental effects of mass production on the worker.
2. the job characteristics and complaints of the man on the assembly line.
3. the meaning of such terms as job enlargement, job reduction, etc.

Unit 31 - The Guaranteed Income Concept
References:
Lauda and Ryan, pp. 187-202.
Objectives:
The student will be able to identify:
1. the background and psychological aspects of the guaranteed income.

Unit 32 - Leisure
References:
Fabun, Part V.
Lauda and Ryan, pp. 157-168.
Objectives:
The student will be able to identify:
1. the basic definitions of terms associated with leisure.
2. the sociological trends of leisure.
3. who will be most affected by the changes in leisure time.

Unit 33 - Working Women
References:
Lauda and Ryan, pp. 72-77.
Objectives:
The student will be able to identify:
1. the trends and implications of working women in our society.
2. statistical trends and factors of working women.
3. why women work.

Unit 34 - Moonlighting
References:
Lauda and Ryan, pp. 209-217.
Objectives:
The student will be able to identify:
1. the trends and implications of moonlighting in our society.
2. significant statistical trends and facts on moonlighting.
3. why people moonlight.

Unit 35 - Unemployment and Underemployment
References:
Lauda and Ryan, pp. 235-256.
Objectives:
The student will be able to identify:
1. trends of unemployment and underemployment in our society.
2. various significant statistics which depict unemployment.
3. major terminology associated with unemployment and underemployment.

Unit 36 - Population and Technology
References:
Fabun, Part I, pp. 10-13, Part III, pp. 27-31.
Lauda and Ryan, pp. 314-345.
Objectives:
The student will be able to identify:
1. present and future population trends and associated problems.
2. the population of the United States in terms of world percentage and numbers.
3. the relationships between population and pollution.

Unit 37 - Air Pollution
References:
Lauda and Ryan, pp. 396-403.

Unit 37 - (continued)
Objectives:
The student will be able to identify:
1. major sources, causes, types, costs, and terms associated with air pollution.

Unit 38 - Water Pollution
References:
Fabun, Part II, pp. 12-14.
Lauda and Ryan, pp. 403-409.
Objectives:
The student will be able to identify:
1. the major sources, causes, types, costs, and terms associated with water pollution.

Unit 39 - Land and Noise Pollution
References:
Lauda and Ryan, pp. 409-423, 431-446.
Objectives:
The student will be able to identify:
1. the major sources, causes, effects, and terms associated with land use and pollution.
2. major sources, causes, effects and terms associated with noise pollution.

Unit 40 - The Social Costs of Cybernation
References:
Lauda and Ryan, pp. 148-156.
Objectives:
The student will be able to identify:
1. the trends in unemployment caused by cybernation.
2. significant statistical trends and facts on cybernation.

Unit 41 - The Control and Use of Technology
References:
Lauda and Ryan, pp. 386-395, 461-477, 516-525.
Objectives:
The student will be able to identify:
1. various arguments for and against the control of technology.
2. methods and terms associated with the control of technology.

Unit 42 - The Future of the Future
References:
Fabun, Part VI.
Lauda and Ryan, pp. 491-516, 525-536.
Objectives:
The student will be able to identify:
1. some of the predicted trends for the future.
2. basic adjustments that will be needed to be made for the predicted world of the future.

APPENDIX C:

UNIT SCHEDULE CALENDAR

PHASE I - TECHNOLOGICAL DEVELOPMENT

Date	Topic in Headley Hall Room 230	Topic in Stewart Hall Room 228
March 29	Course Orientation	Course Orientation
April 3	Pretest for Even Numbered IDs 132-200	Pretest for Even Numbered IDs 62-130
April 4	Development of Man Through Tools	*Dynamics of Change
April 5	*History of Technology From Ind. Rev.	Industrial Organization's Structure
April 7	*The Industrial Organization	The History of Labor
April 10	*History of Technology From Ind. Rev.	Techniques of Labor and Management
April 11	*The Industrial Organization	*Dynamics of Change
April 12	*Computer Development & Basic Operation	*The Development of Mass Production
April 14	Computer Applications & Implications	*Automation
April 17	Sources of Power	*The Development of Mass Production
April 18	Education and Technology	*Automation
April 19	*Computer Development & Basic Operation	Oceanography
April 21	Phase I Exam for IDs 131-200	Phase I Exam for IDs 61-130
April 27	Optional Second Chance Examination on Phase I - Location to be Announced	

*The starred units are repeated twice. These units are considered of greater importance and will have 25% more questions than a nonstarred unit on the phase examination.

PHASE II - AMERICAN INDUSTRIES

Date	Topic in Headley Hall Room 230	Topic in Stewart Hall Room 228
April 24	Extraction	*Synthetics and Plastics
April 25	*The Iron and Steel Industry	Forestry and Wood Products
April 26	*Machine Tools and Processes	The Paper Industry
April 2	*The Iron and Steel Industry	Housing and Construction
May 1	*Machine Tools and Processes	*Synthetics and Plastics
May 2	*The Service Industries	*Air and Space Transportation
May 3	Rail Transportation	*Telemobility
May 5	Water and Pipeline Transportation	*Air and Space Transportation
May 8	Highway Transportation	*Telemobility
May 9	*The Service Industries	Printing and the Graphic Arts
May 10	Phase II Exam for IDs 131-200	Phase II Exam for IDs 61-130
May 18	Optional Second Chance Examination on Phase II - Location to be Announced	

*The starred units are repeated twice. These units are considered of greater importance and will have 25% more questions than a nonstarred unit on the phase examination.

PHASE III - THE SOCIOLOGICAL IMPLICATIONS OF TECHNOLOGY

Date	Topic in Headley Hall Room 230	Topic in Stewart Hall Room 228
May 12	Factors of Hard-Core Unemployment	*Leisure
May 15	*Unemployment and Underemployment	The Guaranteed Income Concept
May 16	*Production and the Worker	Working Women
May 17	*Unemployment and Underemployment	Moonlighting
May 19	*Production and the Worker	*Leisure
May 22	*Population and Technology	*The Social Costs of Cybernation
May 23	Air Pollution and Technology	*The Future of the Future
May 24	Water Pollution and Technology	*The Social Costs of Cybernation
May 26	Land and Noise Pollution	*The Future of the Future
May 30	*Population and Technology	Control and Use of Technology
May 31	**Instructor Wrap-Up for IDs 131-200	**Instructor Wrap-Up for IDs 61-130
June 2	Phase III Exam for IDs 131-200	Phase III Exam for IDs 61-130
June _	Optional Second Chance Examination of Phase III - Time and Location to be Announced	

*The starred units are repeated twice. These units are considered of greater importance and will have 25% more questions than a nonstarred unit on the phase examination.

**Your attendance is very important at this session!

PLEASE NOTE:

Pages 126-137, Appendix D, "Pretest", and pages 138-207, Appendices E-G, "Phase I, II and III Examinations", not microfilmed at request of author. Available for consultation at the Iowa State University Library.

UNIVERSITY MICROFILMS

APPENDIX H:

QUESTION EVALUATION QUESTIONNAIRE

To:
From: Duane R. Gimmel
Subject: The Evaluation of Unit Questions

Enclosed you will find the references, objectives, and questions developed for those units listed in Phase I, Phase II, and Phase III of our experimental Industrial 192 study. Feel free to comment on the references and objectives, but your primary function will be the evaluation of the questions. In return for your time, these test question booklets will be returned to you for your future use after the study is completed. However, it is requested that these question booklets be given to Regis to be held for me until my next visit. The evaluation forms should be returned to me in the self addressed stamped envelope provided.

Each unit has an average of about fifteen questions per unit. From each unit, you are to select the questions that you feel are valid questions for that unit. Yor are to record your selections by circling the corresponding numbers on the form provided. You are also to eliminate any questions you feel are poor or invalid measures by Xing them out on the form provided. Those questions that you wish to reserve judgement upon, you may leave blank. It would be desirable for you to select about TEN questions which you feel are valid within each unit. This does not mean you are limited to or must select ten questions. It is only a guideline.

Example:
Unit 1 - Title of Unit
Question Numbers
(1) (2) 3 (4) 5 (6) (7) (8) (9) 10 11 X12 X13 (14) 15 (16) (17) X18

This example shows those ten questions circled (1, 2, 4, 6, 7, 8, 9, 14, 16, and 17) are the questions the evaluator thought to be the most valid questions for this unit. The questions that are crossed out (12, 13, and 18 are questions which were considered poor. Judgement was reserved on those questions left blank (3, 5, 10, 11, and 15).

Your cooperation is sincerely appreciated in this evaluation. Thanks again for accepting this evaluation task.

EVALUATION RESPONSE FORM PHASE I

TECHNOLOGICAL DEVELOPMENT

Instructions:
Select the questions from the list below that you would use to test a student's knowledge in these units by circling your responses on this form. Eliminate any questions that you regard as poor by Xing them out.

GROUP 1

Unit 1 - Dynamics of Change
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Unit 2 - Development of Man Through Tools
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Unit 3 - The History of Technology From the Industrial Revolution
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Unit 4 - The History of Labor
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Unit 5 - Techniques of Labor and Management
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Unit 6 - The Industrial Organization
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13

Unit 7 - The Industrial Organization's Structure
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

GROUP 2

Unit 1 - The Development of Mass Production
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

Unit 2 - Automation
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Unit 3 - Computer Development and Basic Operation
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

Unit 4 - Computer Applications and Implications
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

Unit 5 - Oceanography
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13

Unit 6 - Education and Technology
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Unit 7 - Sources of Power
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Evaluated by _____

EVALUATION RESPONSE FORM PHASE II

AMERICAN INDUSTRIES

Instructions:

Select the questions from the list below that you would use to test a student's knowledge in these units by circling your responses on this form. Eliminate any questions that you regard as poor by Xing them out.

GROUP 1

Unit 1 - Forestry and Wood Products
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Unit 2 - The Paper Industry
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Unit 3 - The Iron and Steel Industry
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Unit 4 - Extraction
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Unit 5 - Synthetics and Plastics
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13

Unit 6 - Machine Tools and Processes
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Unit 7 - Housing and Construction
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

GROUP 2

Unit 1 - Air and Space Transportation
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Unit 2 - Rail Transportation
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

Unit 3 - Water and Pipeline Transportation
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Unit 4 - Highway Transportation
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Unit 5 - Telemobility
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Unit 6 - Printing and the Graphic Arts
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Unit 7 - The Service Industries
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

Evaluated by _____

EVALUATION RESPONSE FORM PHASE III

THE SOCIOLOGICAL IMPLICATIONS OF TECHNOLOGY

Instructions:

Select the questions from the list below that you would use to test a student's knowledge in these units by circling your responses on this form. Eliminate any questions that you regard as poor by Xing them out.

GROUP 1

Unit 1 - Factors of Hard-Core Unemployment
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13

Unit 2 - Production and the Worker
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13

Unit 3 - The Guaranteed Income Concept
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13

Unit 4 - Leisure
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Unit 5 - Working Women
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13

Unit 6 - Moonlighting
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

Unit 7 - Unemployment and Underemployment
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

GROUP 2

Unit 1 - Population
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Unit 2 - Air Pollution
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

Unit 3 - Water Pollution
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Unit 4 - Land and Noise Pollution
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Unit 5 - The Social Costs Of Cybernation
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

Unit 6 - Control and Use of Technology
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12 13

Unit 7 - The Future of the Future
Question Numbers
1 2 3 4 5 6 7 8 9 10 11 12

Evaluated by _____

QUESTION EVALUATION TALLY

Phase _____ Group _____ MU _____ Unit _____

Question	Valid	Invalid	Blank	Score	Rank
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					

APPENDIX I:

COURSE EVALUATION QUESTIONNAIRE

COURSE EVALUATION QUESTIONNAIRE

This course evaluation questionnaire has been designed as a research tool to gather data that may lead to the improvement of this course. Since this is an in depth study, we are concerned about your ratings. It is only for this reason that it is requested that you record your name and identification number on the IBM answer sheet provided. You can be assured that your ratings will in no way affect your grade. Indicate your level of agreement with the following statements by the following scale:

1=strongly agree 2=agree 3=disagree 4=strongly disagree

1. There was little continuity in the course.
2. This course was a waste of time.
3. Overall, the course was good.
4. I would take another course that was taught this way.
5. Ideas and concepts were developed too rapidly.
6. More courses should be taught this way.
7. Generally, the course was well organized.
8. I would have preferred another method of teaching in this course.
9. Good use of class time was made.
10. It was quite boring.
11. Not much was gained by taking this course.
12. It was easy to remain attentive.
13. The content of the course was satisfactory.
14. The course was poorly organized.
15. Some days I was not very interested in this course.
16. Another method of instruction should have been employed.
17. The material was irrelevant.
18. Held my attention throughout the course.
19. About the right amount of material was covered.
20. The course increased my general knowledge.
21. The course was quite useful.
22. The direction of the course was clear to the students.
23. It was difficult to remain attentive.
24. The organization of the course was difficult to follow.
25. It was a very worthwhile course.
26. The course held my attention.
27. The way in which this course was taught results in better student learning.
28. The material was too difficult.
29. One of my poorest courses.
30. Excellent course content.
31. Uninteresting course.
32. I learn more when other teaching methods are used.
33. I did not like the way the course was organized.
34. Course was not very helpful.
35. The course objectives were clear to the students.
36. I think that the course was taught quite well.
37. I would prefer a different method of instruction.
38. It was quite interesting.
39. The instructional units were unsatisfactory.
40. The course content seemed worthwhile.

APPENDIX J:

CLASS RECORDING FORM

ST. CLOUD STATE COLLEGE - INDUSTRIAL 192 CLASS RECORDING FORM

Instructor ____________________ Experimental Section _______

Primary phase examination scores are to be recorded in RED in the appropriate form column. Second chance phase examination scores are to be recorded in BLUE in the appropriate form column. Raw scores are to be recorded on the top line with standardized scores recorded on the bottom.

Stud. No.	Name	Pre-Test	Phase I		Phase II		Phase III		Totals	
			A	B	A	B	A	B	Primary	Second Chance

APPENDIX K:

PERSONAL DATA QUESTIONNAIRE

INDUSTRIAL 192

1. PERSONAL DATA QUESTIONNAIRE OF ID NUMBER _____

2. Name _____ 3. Date of Birth _____

4. Local Address:

_____

_____

Telephone _____

5. Permanent Address:

_____

_____

Telephone _____

6. Sex: ___male ___female 7. Major _____
_____ check if undecided

8. The high school from which you were graduated had approximately _____ total students in _____ grades.

9. Enter the number of college quarters that you have completed up to (but not including) the beginning of this quarter.
_____ quarters

10. If you have had any other post high school educational experience such as vocational school, industrial school, etc., please list.

Institution	Location	Quarters

11. Enter the number of months of military experience you may have had. If none, enter none. _____ months

12. List any industrially related work experience that you may have had.

Type of Work	Institution of Employment	Months of Experience

13. According to the response scale below, circle your personal reason for taking Industrial 192.

1 2 3 4 5 6 7 8 9

Requirement — Personal Desire

APPENDIX L:

INSTRUCTIONS FOR THE IMPLEMENTATION OF THE EXPERIMENT

INSTRUCTIONS FOR THE IMPLEMENTATION OF THE EXPERIMENT

You will have an assistant to aid you during the first day of the experiment. Your assistant will be _____.

Before the first day of the experiment you should:

1. have obtained the following materials:

   a. a sufficient number of course syllabi.

   b. a sufficient number of Personal Data Questionnaires.

   c. a stack of Random Number Identification Cards. The order of these cards MUST NOT be altered. The cards are printed on white paper and look like this:

      Identification Number _____

      Print your name immediately on this card.

      Name _____
      last first middle

   d. a stack of Student Information Recording Cards. These cards are printed on yellow paper and look like this:

      Name _____

      Identification Number _____

      Primary Examination Form _____

      Secondary Examination Form ___

      Advisory Instructor _____

      Office and Hours _____

   e. a sufficient number of course schedules. (The control group does not require a schedule).

INSTRUCTIONS FOR DAY 1 - MARCH 29, 1972

1. Take to class with you:

   a. course syllabi.
   b. Personal Data Questionnaires - PDQ.
   c. Random Number Identification Cards - RNIC.
   d. Student Information Recording Cards - SIRC.
   e. these instructions.

Time	Instructor's Actions	Assistant's Actions
8:50	Positioned at door - hands the student the top random number identification card as he passes through the door.	Positioned at door - hands the student a PDQ after he has received his RNIC.
9:05	Hands out SIRC and provides necessary information. (yellow card) stress importance of information. Note: primary examination Form A; 1-30, 61-95, 131-165 Form B; 31-60, 96-130, 166-200	Collects PDQ and begins to check for ID number recordings.
9:10	Collects random number identification cards. (white cards)	Gathers missing ID number information for PDQ.
9:12	Tells the students to immediately report to the following rooms according to their random identification numbers: 1-60 Headley Hall 116 61-130 Stewart Hall 228 131-200 Headley Hall 230	
9:15	Passes out a syllabus *(and schedule) to each student remaining in the room.	Positioned by door - passes out syllabus *(and schedule) to students entering room.
	* - experimental sections only	
9:25	Explains course syllabus. Emphasizes 1) course organization and content, 2) method of instruction, 3) evaluation, 4) references, and 5) schedule.	

Instructions for Day 1 - (continued)

Time	Instructor's Actions	Assistant's Actions
9:45	Explains that only those students with EVEN random identification numbers are required to attend class on April 3. But stress they must be in attendance.	
9:50	Dismiss the class.	

After the completion of day 1, the following items should be returned to Gimmel: 1) the completed Personal Data Questionnaires, and 2) the returned Random Number Identification Cards.

PREPARATIONS FOR DAY 2

1. To facilitate the procedures on day 2, a packet should be made for those students who missed day 1. Keeping the random numbers in order, the packet should be made as follows. For each Random Number Identification Card that remains in your stack:
   a. fill in a Student Information Recording Card with the necessary information for that random number;
   b. enter the random number on a Personal Data Questionnaire; and
   c. using a paper clip, fasten the Random Number Identification Card, Student Information Recording Card, Personal Data Questionnaire, and a course syllabus together. (For those random numbers above 61, add a schedule to the packet).

Preparations for Day 2 - (continued)

2. Secure from Gimmel a day 1 class listing.

3. Obtain from Lacroix a sufficient number of pretest booklets and answer sheets.

INSTRUCTIONS FOR DAY 2 - APRIL 3, 1972

1. Take to class with you:

   a. the assembled packets.
   b. the pretest booklets and answer sheets.
   c. these instructions.

2. Give any new students an assembled packet. Have the students complete the Personal Data Questionnaire and place their name on the Random Number Identification Card.

3. Collect the Personal Data Questionnaires and Random Number Identification Cards.

4. Briefly inform the new students of their room assignments for the next class meeting according to their random identification numbers. Note: 1-60 Headley Hall 116, 61-200 either Headley Hall 230 or Stewart Hall 228.

5. Dismiss any students who may have ODD random identification numbers.

6. Administer the pretest to all students in your room that have an EVEN random identification number.

   a. Pass out the test booklets and answer sheets.
   b. Instruct the students to read the directions on the cover of the test booklet and to follow them accordingly.
   c. Orally check to make sure that the directions on the test booklet have been followed.
   d. Allow the students to proceed on the examination only after all of the students have completed the preliminary information.
   e. As the students complete their examination, check their answer sheets to make sure that they have included their identification number.
   f. After the examination, arrange the answer sheets according to the student identification number in numerical order.

7. Note any first day identification numbers that were missing (meaning which students were absent).

8. Arrange the test booklets into numerical order and note if any of the test booklets are missing.

9. As soon as possible, give the answer sheets, information pertaining to missing students or test booklets, and all but five test booklets to Lacroix.

10. Update your class list as necessary and inform other instructors of the students who were sent to them.

INSTRUCTIONS FOR DAY 3, 4, & 5 - APRIL 4, 5, & 7

1. Take your assembled packets with you to class.

2. Inquire if there are any new students who have not received an identification number. If there are new students, give them a packet and instruct them to complete the Personal Data Questionnaire and to place their name on the Random Number Identification Card. Instruct them that these items will be collected after class.

3. Inform all new students and also any student with an EVEN identification number who has NOT been pretested to see you after class.

4. Conduct the presentation for the day. If you have students to meet after class, terminate the presentation two or three minutes early.

5. Dismiss the class and meet with those students mentioned in numbers 2 and 3 above.

6. Collect the Personal Data Questionnaires and Random Number Identification Cards from any new students. Make any new room assignments as necessary.

7. Make any necessary appointments for those EVEN identification numbers who need to be pretested.

8. Update your class list as necessary and inform other instructors of the students who were sent to them.

9. After the class presentation for day five (April 7), give the remaining pretest booklets and completed answer sheets, Personal Data Questionnaires, and Random Number Identification Cards to Lacroix.

APPENDIX M:

TEST COORDINATION AND ADMINISTRATION PROCEDURES

TEST COORDINATION INSTRUCTIONS FOR THE PRIMARY EXAMINATIONS

1. Duplicate the phase examinations about one week before the scheduled date of examination.
   A. Duplicate Form A on colored paper.
   B. Duplicate Form B on white paper.
   C. Have 115 copies of each form duplicated and collated.
   D. Have 110 copies of each form numbered.

2. Obtain from computer services a box of IBM scoring sheets with numbered responses.

3. On the afternoon before the primary examination, each instructor will pick up enough booklets and answer sheets.
   A. Give each experimental instructor 37 test booklets in each form.
   B. Give the control instructor 32 test booklets in each form.
   C. Give each of the participating instructors a personal copy of both examination forms with an answer key.
   D. Provide the answer sheets necessary.
   E. Remind each instructor that both the test booklets and answer sheets are to be returned to you immediately after the examination.

4. Take the answer sheets to computer services and have them scored; ie, one run for Form A and one run for Form B. Request scoring formula A (rights) and scoring option B.

5. From the scoring and analysis, compute grades as follows:

   A = (mean) + (standard deviation)(1.281) = low score for A
   B = (mean) + (standard deviation)(.375) = low score for B
   C = (mean) + (standard deviation)(-.675) = low score for C
   D = (mean) + (standard deviation)(-1.645) = low score for D

6. Post the class list and grade assignment sheets for each form by the general office.

7. Send the answer sheets to:

   3143 Story Street, Apt. #2
   Ames, Iowa 50010

8. In about a week each instructor will receive a class listing with both raw and standardized scores for their records.

PRIMARY TEST ADMINISTRATION PROCEDURES FOR INSTRUCTORS

1. On the afternoon before the primary examination, obtain from Lacroix a sufficient number of test booklets and answer sheets.

2. At this time you will also receive a personal copy of both phase examination forms with answers.

3. For your particular room, try to make some type of arrangement so that students taking the same form will not be sitting next to one another.

4. When you are going to administer the examination, pass out the examination booklets first.

5. Orally check to make sure that everyone has the correct form.

6. Pass out the answer sheets.

7. Instruct the students to read the directions on the cover of the test booklet and to follow them accordingly.

8. Orally check to make sure that the directions on the test booklet have been followed.

9. Allow the students to proceed on the examination only after all of the students have completed the preliminary information.

10. As the students complete their examination, check their answer sheets to make sure that they have identified their test form and have included their identification number.

11. After the examination, arrange the answer sheets according to Form (A or B) and place them in numerical order according to student identification number.

12. Note any identification numbers that were missing (meaning which students were absent).

13. Arrange the test booklets into numerical order and note if any of the test booklets are missing.

14. As soon as possible, give the test booklets, answer sheets, and information pertaining to missing students or test booklets to Lacroix.

15. Lacroix will have the tests scored and will post the results by the main office. The answer sheets will be sent to Gimmel for analysis. In about a week you will receive a class listing with both raw and standardized scores for your records.

PHASE _____

RAW TO STANDARDIZED SCORE CONVERSIONS

Form A Raw Score			Form B Raw Score
_____	= A =	628.0 or above	_____
_____	= B =	538.5 or above	_____
_____	= C =	432.5 or above	_____
_____	= D =	335.5 or above	_____
	E =	below 335.5	

Your exact standardized score can be calculated by the formula:

$$\left(\frac{X - \overline{X}}{S}\right) 100.0 + 500.0$$

Where:

X = your raw score

$\overline{X}$ = _____ for Form A

_____ for Form B

S = _____ for Form A

_____ for Form B

If you desire to be retested, your second chance phase examination will also be based upon the above criterion.

The second chance examination will be held at 9:00 a.m. on the date _____ in room _____ of _____ Hall.

TEST COORDINATION INSTRUCTIONS FOR THE SECONDARY EXAMINATIONS

1. Double check to make sure that the examination room is still reserved.

2. Notify the experimental instructors that they are responsible for the administration of the second chance examination.

3. Provide the examiners with sufficient copies of the examination booklets and answer sheets.

4. Remind the administers that both the test booklets and the answer sheets are to be returned to you immediately after the examination.

5. Take the answer sheets to computer services and have them scored; ie, one run for Form A and one run for Form B. Request scoring formula A (rights) and scoring option B.

6. Rotate the class listing of scores to the instructors so that they may record them for their records.

7. Post the class listing of scores with the primary examination grade assignment sheets.

8. Send the answer sheets to:

   3143 Story Street, Apt. #2
   Ames, Iowa 50010

SECOND CHANCE TEST ADMINISTRATION PROCEDURES FOR INSTRUCTORS

1. On the afternoon before the second chance examination, the instructors in charge of the experimental sections should obtain from Lacroix a sufficient number of test booklets and answer sheets.

2. For the assigned second chance examination room, try to make some type of arrangement so that students taking the same form will not be sitting next to one another.

3. When you are going to administer the examination, pass out the examination booklets first.

4. Orally check to make sure that everyone has the correct form.

5. Pass out the answer sheets.

6. Instruct the students to read the directions on the cover of the test booklet and to follow them accordingly.

7. Orally check to make sure that the directions on the test booklet have been followed.

8. Allow the students to proceed on the examination only after all of the students have completed the prelininary information.

9. As the students complete their examination, check their answer sheets to make sure that they have identified their test form and have included their identification number.

10. After the examination, arrange the answer sheets according to Form (A or B) and place them in numerical order according to student identification number.

11. Arrange the test booklets into numerical order and note if any of the test booklets are missing.

12. As soon as possible, give the test booklets, answer sheets, and information pertaining to missing test booklets to Lacroix.

13. Lacroix will have the tests scored and will rotate a listing of scores to the instructors so that the test scores can be recorded for your records.

14. Lacroix will also post the results for the students by the general office.