

Developments in Business Simulation & Experiential Exercises, Volume 9, 1982

DEVELOPMENT OF A SELF-PACED COURSE IN BUSINESS STATISTICS

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ABSTRACT

This applied research project addressed the problem of student attrition directly related to the graduate statistics course of a nontraditional graduate management program. Twelve self-paced learning modules, representing approximately 37.5 student working hours, were developed, implemented, and evaluated. Objective findings indicated modules' use accounted for 25 % higher achievement on a standardized statistics test. Subjective findings indicated students using the modules did not permanently leave the program and passed the quantitative sequence in the curriculum.

INTRODUCTION

Current trends in post secondary and higher education include modifications of the traditional delivery mode to meet needs of older adult students. Among these are variations in program format, e.g., evening or weekend classes; various combinations of directed individual study and student-instructor contact time; and learning activities to bridge the gap between theory and practice. Students in the nontraditional Graduate Management Program (Gte) at Nova University, Ft. Lauderdale, Florida must obtain a Master of Business Administration (MBA), Master of Science in Human Resource Management (HRM) or other masters degree options in a weekend program format scheduled over 18 months. Many of these students hold full-time jobs in management and return to school primarily to increase their organizational opportunities, since it is generally assumed these degrees affect upward mobility. Other graduates will seek career modification or change as a result of their participation in the program.

During the past four years, the director and several instructors noticed and became concerned over the increasing disparity of students' entry competencies in the quantitative courses, particularly apparent in the MBA/HRN statistics course. The program offered an introductory statistics course at the undergraduate level which presented concepts necessary for successful completion of the graduate level quantitative sequence. Program administration strongly recommended this course as a review to students not making day-to-day use of mathematics or quantitative methods. This course was consistently evaluated highly in meeting stated objectives by students. Unfortunately, the weekday evening schedule of the course was not convenient for all those needing the course. The diverse learning needs of students in this course resulted in some having to sit patiently through classroom explanations of concepts they may already understand, while others may be rushed by concepts before fully understanding them. This was definitely not the most effective format for an 8-week, 24 contact hour course in statistics.

Rushton (1, p. 2) observed three realities in teaching decision science courses in business schools across the nation:

1. at least one year of quantitative methods courses is required for most major areas of emphasis
2. large numbers of business majors are ill-prepared

for this sequence

3. the responsibility for implementing 1., given 2., has devolved upon the Decision Science Faculty.

Even in graduate programs with a traditional format, faculty must make it possible for students to make up deficits, to review, and to be successful in achieving terminal competencies of the course. All this must be accomplished while maintaining an acceptably high standard of performance and a realistic awareness of the increasingly competitive aspect of the educational market, which results in the "numbers game." Consequently, the emphasis of quantitative courses often is put on the students' ability to choose the right formula and demonstrate some knowledge of the erythematic necessary to solve problems. Even with the advantage of modern, multi-function, hand-held calculators, little or no time remains for genuine understanding or appreciation of concepts underlying formulae use. Such an appreciation would ensure more frequent correct applications of statistical techniques, even after course completion. Anxiety over basic mathematical difficulties often results in resistance to learning quantitative methods for better decision making.

Student attitude toward the subjects of math and statistics is an influencing factor that Instructors must consider. Most graduate students, regardless of major, speak less than favorably of their statistics experience. Student demonstration of course objectives, after course completion and with the passage of time, is poor. The nontraditional program's modified delivery format, of once a week evening meeting far prerequisite courses and every third weekend for graduate level courses, and the target population's characteristics may present additional difficulties of learning needs not encountered in traditional programs.

Statement of the Problem

The purpose of this project was to address the problem of student attrition in the GMP directly related to the MBA/HRN statistics course. Initial focus, stemming from the observed disparity of learning needs presented by students enrolling in the course, was the development of an instructional product that would effectively and economically reduce extreme differences in student entry competencies.

Significance of the Problem

This problem is significant to all graduate management programs choosing to ensure educational quality and program viability in the changing environment of the educational market. Even beyond the area of graduate management education, this problem has significance for all upper division educational programs, since most contain some quantitative requirement in their curriculums.

Hypotheses

The specific null hypotheses tested in this research project are:

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than the other two. The quality of the second level's interaction may be more authoritarian like the first, while the third may be laissez-faire, and the fourth more democratic.

Summarily, the relationship of teaching to learning is one of providing the climate for and managing learning activities. The instructor is most effective when s/he understands the operational levels required for mastery of learning tasks, and then uses his/her relationship with the learner to promote the required operational levels. Knowledge of student's learning needs can help instructors to assist students to know, accept, and meet those needs. Instructor skills required to accomplish this task include the use of multiple teaching strategies.

Non-lecture Teaching Strategies for Statistics

Gormley (6) suggests statistics courses should combine individualized instruction, self-pacing, and discussion with the traditional lecture method of instruction. Independent study involves varying degrees of direction often through instructional learning packages, to promote memory level learning. When this involves structured or interactive notes, understanding level may be accomplished. Adults can be expected to do well with this teaching strategy, since it allows material to be mastered on a variable time schedule, primarily under control of the learner. Independent study can include working on a project that involves creativity, thereby, promoting autonomous development level learning.

Visual materials, e.g., films, slides, filmstrips, videotapes, and television, will increase understanding and promote memory retention. For increased effectiveness, they should be combined with discussion for reflective level learning. Discussion and personal expression can be used to promote learning on both autonomous development and reflective levels. There are four basic discussion types--Socratic, problem-solving, case-oriented, and group-centered. The instructor should handle discussion by acting as a resource rather than controlling totally the group's interaction.

Criteria for Effective Individualized Format

A review of studies of non-computerized individualized instruction in mathematics and statistics (1, 9, 10, 11, 12, 13, 14) yielded the following criteria for an individualized format expected to be effective:

1. Presented different degrees of instructional support, based on student's prior familiarity with each concept, rather than simply varying the time allowed for content mastery.
2. Used some method of determining student's prior familiarity with each concept as a basis for providing the required level of instructional support.
3. Employed mechanism(s) to increase student motivation to master module concepts.
4. Employed mechanism(s) to counteract reported difficulty of lack of student-instructor interaction, while somewhat controlling the role of the instructor.
5. Provided for student self-pacing with appropriate measures to reduce procrastination and provide for self-evaluation of concept understanding.
6. Used a mechanism for continuous evaluation and revision of modules to meet evolving needs of students.

METHODOLOGY AND PROCEDURES

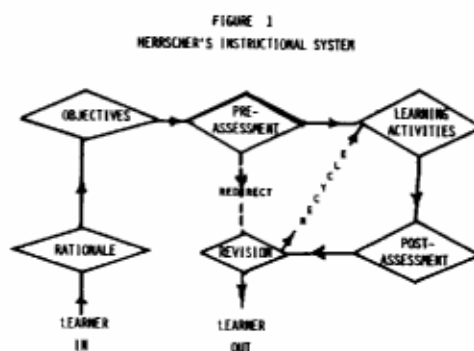
The design of this project was developmental, including three phases:

1. Development of a self-paced modular course in business statistics for an undergraduate prerequisite/review course based on Rushton's PSI course.
2. Implementation of this product into the program's existing curriculum.
3. Description of plans for initial and continuous evaluation of the product's use in the CMP.

Of necessity these three phases are interactive. The initial development used Herrscher's (15) Instructional System Model as a framework to integrate the characteristics of the GMP and the PSI and to incorporate the identified criteria of an effective individualized format. Only one of the five features of the PSI was not compatible with the GMP's format. Use of student proctors had to be met with an alternate teaching strategy providing the function of the proctors.

Herrscher's Instructional System Model

Herrscher's Instructional System involves six basic steps: (a) a rationale, (b) specific instructional objectives, (c) pre-assessment, (d) learning activities, (e) post-assessment, and (f) revision. Figure 1 presents an operational view of the system. A theoretical discussion of each step follows. A rationale explains the expected real world use of the statistical concept presented. This is followed by a list of specific things, behaviorally stated, the student will be able to do upon successful module completion. Pre-assessment questions allow the student to determine prior familiarity with the module's concept. The learning activities direct students to textbook readings, provide additional discussion of the concept or interactive notes, give supplementary problems for practice, and provide step-by-step problem solution and explanation. The post-assessment is similar to the pre-assessment and allows the student to assess his/her knowledge after completing the module. Revision refers to the feedback mechanism for students to communicate the helpful and/or confusing aspects of the modules.



Implementation and Evaluation of Nodules

Implementation of the modules into the existing curriculum was by arrangement with the program director. Essentially a three step sequence was followed. Developed modules were pilot-tested by a group of 12 students in the prerequisite course in spring 1979. Modules were revised based on feedback from this group. The second step was a pretest-posttest control group experimental

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1. Based on a standardized statistics test, students using self-paced statistics learning modules to supplement traditional instruction in basic statistical concepts will not score significantly different from students not using the modules.

2. Based on a standardized attitude scale, there will be no significant difference in attitude toward statistics held by students using the self-paced statistics learning modules to supplement traditional instruction in basic statistical concepts compared to attitude held by students not using the modules.

Definition of Terms

To provide common understanding of terminology used in this project, the following definitions are offered:

Attitude Toward Statistics refers to feelings about the subject of statistics as measured by a modification of Aiken and Dreger's Revised Math Attitude Scale (2).

Basic Statistical Concepts include descriptive statistical measures of central tendency and variability; probability and normal distribution; sampling and hypothesis testing; and simple linear correlation and regression analysis presented by Rushton (3).

Individualized Instruction is a teaching strategy that considers background, individual learning styles, and students' past successful learning experiences in instructional design, specifically for selection of content, learning materials and resources, and preferred learning environment.

Learning Modules are individual units of study comprising a singular statistical concept to be mastered.

Nontraditional Education refers primarily to an attitude that places the student in first priority and the institution in second; it views the purpose of education to be providing students with skills and resources to fully develop their unique potentials; and thereby, encourages diversity of individual opportunity and de-emphasizes time and space requirements in deference to competence and/or performance requirements (4).

Personalized System of Instruction is a teaching strategy similar to individualized instruction, but must contain five critical features: (a) self-pacing, (b) unit mastery for progression, (c) motivational lectures, (d) written communication between student and Instructor, and (e) use of Proctors (5).

Self-paced Instruction is a teaching strategy allowing students to begin, progress, and complete a course at their own rate of learning. Different from individualized instruction, it can be used singularly or in conjunction with an individualized format (6).

Standardized Statistics Test refers to a test constructed by Rushton to measure achievement of basic statistical concepts (3).

Assumptions and Limitations

Assumptions in this project were: the pilot group and control and experimental groups were representative of the masters program student population; participants would comply with instructions regarding use of the modules; and in the absence of sufficient undergraduate enrollment, graduate students in the first month of the course would be a satisfactory substitute, given constraints of the nontraditional format. This research is limited to outcomes in the statistics courses of the GMP. It is limited to samples available to me as an

instructor for the introductory statistics course; and to a sample consisting of Nova graduate students; and other limitations that may result from the previously stated assumptions.

Relationship of Teaching to Learning

Nontraditional education assumes education's purpose to be providing learners with skills and resources to develop their full and unique potentials. It places the learner in the role of self-directed inquirer and the instructor in the role of resource person and learning facilitator. Thus, effective faculty in a nontraditional program must be able to operationalize knowledge of the relationship of teaching to learning.

Burton (7, p. 55) describes the ideal learning situation as one placing the learner in the position of knowing what skill or knowledge s/he needs to acquire, so s/he can accept those needs. Therefore, teaching is related to learning by its provision of activities that help the learner to identify what is to be learned and to accept the need to learn. The instructor-student relationship is the vehicle for providing the climate for learning.

Bigge (8, p. 281) discusses the relationship between the learner and instructor, classifying it as authoritarian, laissez-faire, or democratic in nature. Each has specific implications for the degree of learning task responsibility assumed by instructor and learner and the interaction between them. Beliefs about how students learn, and therefore, how instructors teach-- or manage the learning situation-- determine the instructional style used.

Another description focuses on a continuum of mental operation modes, ranging from "thoughtless" to "thoughtful." This continuum is divided into four broad modes: memory level, understanding level, autonomous development level, and reflective level.

Memory Level refers to commission to memory of factual material. It involves no other mental operation on the material to be learned. Teaching on this level seeks to promote the student's recall of facts learned.

Understanding Level is conceptualization of individual facts in relation to a general principle. It requires the learner to see material as useful in goal attainment. Thus, teaching seeks to acquaint the learner with relationships between generalizations and particulars, and their application to further learning.

Autonomous Development Level essentially involves the learner in a search for information, with his/her own feelings constituting the final authority for his/her "discovered truth." Teaching on this level consists of promoting the learner's self-awareness and expression of self-actualization.

Reflective Level refers to careful examination of an idea or supported article of knowledge, in view of testable, supported evidence, and conclusion development based on the examination process. Teaching on this level involves problem raising and problem solving. It requires the most thoughtfulness from learners, since they must draw from previous memory and understanding levels, and often from autonomous development learning, to achieve learning at this level.

Learner-instructor interaction can be expected to differ significantly with each of the four modes. Minimal interaction is required by memory level, while autonomous development level requires more interaction of a non-directive nature. Understanding and reflective levels require much greater degree of interaction

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design evaluation of the modules. All students were given a test booklet containing the two measurement instruments and an answer sheet. Complete privacy was achieved through use of social security numbers to identify pre and posttest scores. Following pretest completion, the students were randomly assigned to experimental and control groups. Those in the experimental group were instructed in modules' use. Assistance was provided via telephone and group conference. All students were given the same test as a posttest four weeks after the first. Results of the test and copies of the modules were made available to all participants.

Following a satisfactory evaluation, the modules became a part of the undergraduate course beginning with fall 1979. Scheduled class time was used for conferences, group-centered discussion, and/or group-individual tutoring, as needed by the specific class. The modules were also used as a supplement in the graduate level course in the school year 1980-81.

PRESENTATION OF RESULTS

Self-paced Modules' Development

A total of 12 self-paced learning modules, representing approximately 37.5 student working hours, were developed. Each module dealt with a single concept presented in the 8-week, 24 contact hour course. Topics included (a) Algebra Pretest, (b) Use of Statistics, (c) Graphic and Tabular Presentation of Data, (d) Frequency Distributions, (e) Measures of Central Tendency, (f) Measures of Variability, (g) Probability (h) Normal Distribution, (i) Decision Theory, (j) Sampling, (k) Introduction to Hypothesis Testing, and (l) Simple Correlation and Linear Regression. Using Rush-ton's modules as a basis, adaptations were made to meet criteria of an effective format previously stated

Summary of Implementation and Evaluation

Procedures previously described were followed. Of the 47 students in the summer 1979 evaluation, seven were excluded because of participation in the spring 1979 pilot-test. The remaining 40 were randomly assigned to the two groups. Two students in the experimental group dropped the graduate level course and registered for the undergraduate course. Three students were lost from the control group: one was transferred by his employer out of the area, while the other two withdrew from the program. See Appendix for summary of results.

There was no significant difference between the pretest scores, so a t test was used to determine the experimental group had a 25 % higher achievement post- test score which was significant for $\alpha = 0.20$ to 0.01 . While, the mean attitude score was not significantly more positive, the experimental group's mean attitude gain score was significantly greater for $\alpha = 0.20$ to 0.02 . A chi-square test of independence supported a dependent relationship between module use and high achievement, but not positive attitude, significant for all levels of α .

Following one year of class testing at both graduate and undergraduate levels, overall feedback from students and instructors was overwhelmingly positive. Frequent unsolicited student comments of the "life saving " nature of the modules, course enjoyment, work applicability of concepts presented, and/or general self-satisfaction with performance/achievement have been received by me and the program administration. The quantitative faculty have found students having

used the modules are able to achieve at least a passing C, depending upon their mathematical abilities and time constraints for studying. In December 1980, the program director observed no students having used the modules had permanently withdrawn from the program.

INTERPRETATION, CONCLUSIONS, AND RECOMMENDATIONS

An unexpected trend appeared between attitude toward statistics and achievement on the standardized tests. Using both pretest and posttest scores, an inverse correlation, significant for $\alpha = 0.10$, was found to exist between experimental group's pretest attitude and achievement. The combined groups' inverse correlation on pretest scores was also significant for $\alpha = 0.10$. Posttest scores individually and combined were direct, but not significant for $\alpha = 0.10$ or less,

This observation implies that prior to modules' use, students with a positive attitude toward statistics had low achievement, while those with high achievement had negative attitudes. Subsequent module use, the relationship became direct. Combining this with the results of the attitude hypothesis tests, the modules can be expected to be effective in developing more positive attitude toward statistics if combined with effective student-instructor interaction promoting understanding and reflective learning.

Conclusions

Conclusions that can be drawn from this study derive from the tested hypotheses. They are:

1. Based on a standardized statistics test, students using the self-paced learning modules to supplement traditional instruction scored 25 % higher than students not using the modules. This difference was significant for $\alpha = 0.20$, 0.10 , 0.05 , 0.02 , and 0.01 .
2. Based on a standardized attitude scale, students using the modules did not have significantly more positive attitudes toward statistics; however, the mean attitude gain score was significantly high for $\alpha = 0.10$, 0.05 , and 0.02 .
3. The distribution of high achievement scores was dependent upon module use, based on a chi-square test of independence for all levels of α .
4. The distribution of positive and negative attitudes toward statistics was independent of module use for $\alpha = 0.10$ to 0.005 .
5. Prior to use of self-paced modules, an inverse relationship was found between attitude and achievement, significant for $\alpha = 0.10$. Use of modules changed the relationship to direct. The change could become significant with increased student-instructor interaction.
6. Use of self-paced modules to provide structure in directed self-study activities of the nontraditional program's statistics course was demonstrated effective in dealing with the problem of student attrition related to the course and in managing the disparate entry competencies.
7. As a result of this project, all students are required to have a prerequisite statistics course to enter the graduate course.
8. It has been demonstrated that teaching strategies directed toward maximizing student learning on memory, understanding, autonomous development, and reflective

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levels enhances student achievement and attitude toward statistics.

Implications

Implications arising from this study reflect on the issue of accountability in the educational process. Adult students in a nontraditional graduate level program expect to be provided with practical knowledge and marketable skills. Accepting the philosophy that instructors should be effective managers of student learning behavior, the responsibility for achievement in education is shared by students and faculty. Provision of standardized curriculum syllabi with behavioral objectives and exit (terminal) competencies is not sufficient to meet the diverse quantitative learning needs of adult students. The answer to education's dilemma of maintaining consumer appeal while ensuring educational quality and program viability must come from the instructors' operationalization of their programs' educational objectives. In other words, how instructors manage student learning experiences. Programs employing intensive instructor-student contact with considerable independent study should look critically at the structuring of independent study time to promote student achievement of the course's exit competencies.

Results of this project suggest expanded use of self-paced modules to enhance effectiveness of self-study activities in quantitative courses in nontraditional graduate management programs. The instructor's role in these programs requires instructional skills additional to the traditional lecture method. Skill in the use of individualized instructional methods and discussion and a working knowledge of the mental operations needed to accomplish learning task are important additions to an instructor's repertoire.

This problem of disparate quantitative skills is significant to all graduate management and all upper division educational programs, since all contain some quantitative requirement. It seems that the addition of self-paced learning modules in the quantitative area can contribute to maintaining both program viability and quality of education.

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APPENDIX SUMMARY OF RESULTS

EXPERIMENTAL GROUP	ACHIEVEMENT			ATTITUDE		
	PRE	POST	GAIN	PRE	POST	GAIN
EX OR E	18	18	16	18	18	13
MEAN	43.67	69.11	28.75	34.28	41	13.38
STANDARD DEVIATION	18.50	6.58	21.66	20.83	20.89	10.11
<hr/>						
CONTROL GROUP						
EX OR E	17	17	12	17	17	12
MEAN	38.47	43.24	10.82	38	35.06	3.58
STANDARD DEVIATION	20.35	18.73	11.81	17.31	14.87	6.87

PRETEST ACHIEVEMENT	$t = 0.06117$	CRITICAL t	D.F. = 33	D.F. = 23
POSTTEST ACHIEVEMENT	$t = 4.68400$	0.20	1.30772	1.319
		0.10	1.69016	1.714
PRETEST ATTITUDE	$t = -0.04427$	0.05	2.03486	2.069
POSTTEST ATTITUDE	$t = 0.03560$	0.02	2.44560	2.500
GAIN ATTITUDE	$t = 2.71800$	0.01	2.73434	2.807

THERE WAS NO SIGNIFICANT DIFFERENCE BETWEEN GROUP'S PRETEST SCORES, BUT THE DIFFERENCE BETWEEN POSTTEST ACHIEVEMENT SCORES WAS SIGNIFICANT FOR ALL LEVELS. ATTITUDE GAIN WAS SIGNIFICANTLY DIFFERENT FOR ALPHA LEVELS OF 0.20 TO 0.02.

ACHIEVEMENT POSTTEST SCORES			ATTITUDE POSTTEST SCORES		
GROUP	High ≥ 60 %	Low < 60 %	GROUP	Positive ≥ 40	Negative < 40
EXPERIMENTAL	18	0	EXPERIMENTAL	12	6
CONTROL	5	12	CONTROL	7	10
	23	12		19	16
		35			35

$$\chi^2 = 18.0 \quad D.F. = 1$$

$$\chi^2 = 1.84 \quad D.F. = 1$$

CRITICAL χ^2
0.10 = 2.71
0.05 = 3.84
0.025 = 5.02
0.01 = 6.63
0.005 = 7.88

HIGH ACHIEVEMENT IS DEPENDENTLY RELATED TO MODULE USE FOR ALL LEVELS. POSITIVE ATTITUDE AND MODULE USE ARE INDEPENDENT FOR ALL LEVELS.