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ABSTRACT

A course in macroeconomics was used to investigate the cost effectiveness of computer-assisted instruction (CAI). The experimental design used an experimental section in which the students had the opportunity to use the computer to the intensity of their choice, choosing from tutorial lessons, games, and simulations. The students in the control section received their instruction by the traditional lecture-textbook method. Students were not randomly assigned to individual sections, but rather they selected a given section primarily on the basis of scheduled class times. Each instructor's experimental section, however, was randomly assigned. Results showed that under virtually all the conditions studied, gains in educational output did not outweigh the additional cost of CAI. Only when the costs of development of CAI materials was ignored did the CAI format appear marginally efficient. It was suggested that costs of CAI may be reduced when authors gain experience in writing CAI programs and that advances in computer technology may have an impact on CAI costs. (JY)

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HAS COMPUTER ASSISTED INSTRUCTION (CAI) BEEN A FINANCIAL FAILURE?

by

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Study No. 3

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TABLE OF CONTENTS

4

LIST OF TABLES

INTRODUCTION AND OVERVIEW

In general, evaluation of new instructional technology or delivery systems takes place according to three broad criteria. First, do the students exposed to the innovative mode of instruction "learn more" and/or "like it better" than the traditional mode of instruction? Educational psychologists would refer to the "learn more" and "like it better" features respectively as the cognitive and affective characteristics of the new instructional approach.[1] Second, does the new approach cost the same as the traditional alternative while producing greater "learning" and/or "liking"? Does it cost more while producing less, and so on? This type of criteria relates to relative cost and is the legitimate domain of the economist. Third, do the students retain what they have learned with the new approach longer than with the traditional alternative?

The authors are primarily concerned with the first two criteria in relation to the use of computer-assisted instruction (CAI) in economics. Specifically, we have developed an integrated set of interactive tutorial lessons and simulation games for use in the undergraduate principles of macroeconomics. These instructional materials have been implemented in a quasi-experimental context. The experimental results, in the form of student performance on cognitive and attitudinal measurement instruments,

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[1]Actually observable human behavior has been divided by some educational psychologists into three taxonomic structures; (1) cognitive domain--includes knowledge and developed intellectual abilities and skills, (2) affective domain--includes interests, attitudes, values, appreciations and psychological adjustment, and (3) psychomotor domain--includes manipulative or motor-skill aspects of behavior [4, p. 111].

cost, student characteristics, and instructional process characteristics, form a data base to be examined relative to the two criteria in question. Accordingly, our report on the results of an analysis of this data base is divided into two parts. This paper focuses primarily on the relative cost characteristics while a preceding paper [5] examined the cognitive and affective impact of the CAI materials.

We believe that our analysis of the relative cost of CAI in the introductory macroeconomics course has these unique characteristics: (A) a focus on the relative efficiency of the new approach as opposed to simply cost effectiveness, (B) use of attitudinal change as well as cognitive performance as a measure of educational output, and (C) the use of an experimental design and certain statistical techniques to derive a measure of the independent effect of the new approach on educational output. Each of these characteristics will be developed in turn.

A. Efficiency in Education

Several techniques have been developed in order to evaluate the merit of competing programs funded through the public sector. Each technique provides a ranking of alternative programs according to a single well-defined criterion. The two most frequently employed are cost-benefit analysis and cost-effectiveness analysis.

Cost-benefit analysis evaluates alternative programs through a two-stage process. First, the expected net future benefits (expressed in dollar terms) of each program are discounted to present value, Second, these present values are compared with the respective cost of each program and a ranking is formed on the basis of this comparison. For example, consider two competing programs A and B. Define the cost-benefit ratio (CBR) of a given program as

$$CBR = \frac{\$\ Benefits}{\$\ Costs}$$

Therefore, if $CBR_A > CBR_B$ a rational choice on the basis of the criterion would be program A.

Where benefits from alternative programs cannot be measured in dollar terms, but a decision has been made to allocate funds for the purpose of obtaining a specified objective, the cost effectiveness approach provides a criterion. In general, cost effectiveness ranks a program on the basis of its cost, given that the program attains threshold levels relative to the objective. Following through with the example using programs A and B, if both A and B attain the specified threshold and the dollar cost (C) of each program is known, then, if $C_A < C_B$ a rational choice on the basis of this criterion would be program A. Presumably, if the threshold were specified such that neither program attained it, there could be no basis for choice with cost-effectiveness. Similarly, if the threshold were such that only one program attained it, cost becomes irrelevant and that program is selected.

While cost-benefit and cost-effectiveness analysis have been useful in evaluating alternative programs in certain areas, there are certain problems associated with applying these techniques to alternative approaches in education. In order to employ cost-benefit analysis, the benefits must be expressed in dollar terms. Clearly, there is some difficulty involved in attempting to measure the dollar value of benefits from alternative instructional approaches. Because of this difficulty it appears that cost effectiveness would be the appropriate technique to employ in education. But there exists considerable dissatisfaction with this alternative. In particular, while educational benefits may not be measurable in value (dollar) terms, they are often subject to measurement in other units. The use of cost effectiveness analysis implies the loss of valuable information insofar as it ignores the degree to which alternative instructional approaches achieve threshold levels. Note that the issue here is an appropriate specification of the threshold and an ability to measure performance in relation to that threshold.

The outcome of such dissatisfaction with simple cost effectiveness analysis has been increased use in education of an efficiency ranking criterion. Over sixty years ago George Rogers Taylor defined increased business efficiency as an increase in productivity at the same cost [15]. Since then, educators have broadened the definition [3] by viewing it as a ratio of output to input:

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}}$$

Efficiency provides a ranking criterion for alternative programs provided that for the alternative programs the measures of output are stated in the same units, and measures of input are stated in the same units. Note however, that neither measure must necessarily be in dollar terms.

In 1972, Bowen and Douglas substituted "cost" for "input" in the efficiency ratio [2, p.3]. This concept of efficiency is in a sense midway between cost benefit and cost effectiveness analysis. Current benefits, interpreted as output, are measured but not in dollar terms.

With this background in mind, the educational efficiency ratio (EER) may be defined as follows:

$$EER = \frac{\text{Educational Output}}{\text{Cost}}$$

Used as a ranking criterion one would say that program A is educationally efficient relative to program B if $EER_A > EER_B$.

B. Affective and Cognitive Output

Evaluating a particular method of instruction on the basis of affective as well as cognitive output is appropriate in view of the ultimate objective of social science education in general and economic education in particular. That is, demonstrated cognitive ability is only meaningful to the extent that the student utilizes the acquired information or modes of analysis in examining social issues or problems. This is especially true of economics. However, before students consistently employ economic theory as a framework for the analysis of social problems with economic characteristics they must not only comprehend basic economic concepts, but in particular they must be favorably disposed to their use and appreciate the contribution they can make. But if in the process of learning about economics students develop a dislike for the subject, it is unlikely that they will retain and apply acquired analytical techniques. Given this overall objective, it would not be appropriate to measure the educational output of an instructional method in economics on the basis of cognitive achievement alone. It is necessary, therefore, for CAI in economics to be evaluated not only on the basis of cognitive output, but affective output as well.

Digressing briefly, it is noteworthy that although we will have little to say directly about the merit of CAI in economics in relation to retention (i.e. the third general evaluation criterion), it is highly probable that any instructional approach tending to foster favorable attitude and hence repeated use of a subject matter will also foster retention.

C. Measuring the Independent Output Effect of CAI

A primary objective in evaluating a new method of instruction is the identification of a causal relation between the new approach and a change in student cognitive performance and/or attitude (i.e. cognitive and affective output). Both our experimental design and statistical procedures were oriented toward such an identification.

In the experimental design, student subjects were divided into experimental and control groups, between which the only intended difference was experimental treatment. If there were no other differences between the respective groups, the new approach could be evaluated simply by a statistical test for difference in mean output between the groups. However, since other differences are almost always present, the statistical model most often used in economics education is least squares multiple regression. If the model is correctly specified, then the educational researcher is statistically controlling for group differences in variables other than experimental treatment. Since the experimental treatment is also a distinct variable, such control serves to isolate the independent effect of the treatment (i.e. the new approach) on output. Therefore, using this approach it is possible to derive a measure of output that is due solely to the new instructional approach being examined, in this case, CAI.

I

DESCRIPTION OF THE EXPERIMENTAL DESIGN

A. Control and Experimental Sections

The experimental design for a three credit introductory economics course emphasized the substitution of computer assisted instruction (CAI) for the traditional lecture-textbook assisted instruction (TAI). It involved two instructors each teaching a customary control and an experimental section. An experimental section differed from a control section in that students were given the opportunity to use the computer to the intensity of their choice. The design was quasi-experimental in the sense that the control sections (composed of students in the TAI Introductory Economics sections) and experimental sections (composed of students in the CAI Introductory Economics sections) did not have pre-experimental sampling equivalence. That is, students were not randomly assigned to individual sections, but rather they selected a given section primarily on the basis of scheduled class times. Each instructor's experimental section, however, was randomly assigned. There was no explicit information provided to the students, either prior to registration or during the semester, regarding their participation in an experiment.

Students in the experimental sections had access to a Hewlett-Packard 2000 C' time-sharing system through thirteen terminals on campus. Each week, students in the CAI sections were presented with a "menu" which consisted of tutorial lessons, games, and simulations. Students were allowed to select freely from the weekly menus, but were encouraged to proceed through the weeks in chronological order and, within a week, to begin with the lowest numbered lesson, game, or simulation. Tutorial lessons were completed on an individual basis while simulation games could be played on an indivudual or team basis (consisting of a maximum of four players to a team). Throughout the semester, students had the opportunity to complete fourteen tutorial lessons, five games and one simulation. The computerized games and simulation were written in Beginners All-Purpose Symbolic Instruction Code (BASIC) language and the computerized tutorial lessons utilized Hewlett Packard's Instructional Dialogue Facility (IDF).[2]

B. Scheduling of Sections

The four sections in experimental design met in the same classroom during the 1974-75 fall semester. The control section of instructor 1 met for fity minute periods on Monday, Wednesday and Friday at 1:00 P.M. while his experimental section met for fifty minute periods on Monday and Wednesday at 2:00 P.M. The Friday period was considered released time which students could utilize as they wished.[3] The control section of instructor 2 met for seventy-five minute periods on Tuesday and Thursday at 2:00 P.M. while his experimental

[2]IDF enables an instructor with no programming knowledge to write lessons for presentation to students at computer terminals. For futher information see reference (7). The original materials have been transferred from the HP 2000C' to the HP ACCESS System. They are continually being updated and revised on the basis of our student experiencs. The complete set of revised CAI materials (including the control package which routes, records, and reports student CAI activities) can be obtained from the Center for Economic Education, University of Wisconsin-La Crosse, La Crosse, Wisconsin 54601.

[3]If desired, students could have attended unstructured discussion sessions with the instructor during the released time.

section met for fifty minute periods on Tuesday and Thursday at 3:30 P.M. These shortened periods amounted to fifty minutes of released time per week resulting in similar released time for students in both experimental sections, but under different conditions. On several occasions, the weekly released class time was suspended due to exams or other extraordinary circumstances.

Both instructors attempted, as much as possible, to standardize classroom activities and grading policy. For example, class attendance was recommended, but not required. The same textbooks were used in all sections. Exams consisted of a common core of multiple choice items drawn from the UW-L Economics Principles Test Bank[4] and additional items selected by each instructor on an individual basis. Grades were based on total accumulated exam points. In addition, a maximum of ten bonus points could have been earned and were added to accumulated points after the grade boundary lines were drawn. Thus, the bonus points conceivably made it possible for a student to advance to a higher course grade. Bonus points were earned by students in the control sections by completing specified tasks outside the classroom. In the experimental sections, bonus points were earned by students primarily for undertaking CAI oriented tasks.

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[4]The UW-L Test Bank currently consists of over 2000 test items and is used by all instructors teaching principles sessions. Each item, when used by an instructor, is processed through a computer item analysis program at the UW-L computer center. The program provides a distractor, item difficulty, and item discrimination analysis for each item on an exam, as well as standard exam summary statistics.

C. Effectiveness Considerations

Effectiveness, as previously described, consisted of two components: affective and cognitive. In order to determine the change in economic understanding (cognitive change) which took place during the semester, students in all sections were administered both pre and post TUCE (Form I, A and B). The TUCE is a validated, nationally normed exam [10, p. 7].

To measure changes in the affective domain, attitude questionnaires were used. Pre and post instruments concerning student attitudes toward the subject matter were administered. Attitude toward the instructional process, however, was measured only in a post sense.[5]

In attempts to avoid the introduction of unnecessary bias, an agreed upon administration procedure was followed by both instructors before the measuring devices (TUCE and attitude questionnaires) were administered. Every attempt was made to secure information on, or hold constant, those characteristics which were thought to affect student performance on the measuring devices such as student characteristics, instructor characteristics, classroom environment and instructional approach.

D. Cost Considerations

The collection of cost information for the TAI sections did

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[5]An attitudinal analog to the TUCE was not available. Consequently we used instruments from various sources. These instruments are documented in Appendix A.

not require any special consideration in the experimental design. However, since the collection of cost information for the CAI sections was thought to present a more complex process, the experimental design included techniques for storing and retrieving data which related to operational cost such as computer time and data storage. Storage fees, obviously, depended on the amount of data stored. Computer time for each student was entered and stored in the CAI facility (along with other information) in order to calculate this part of the operational cost.

A second category of CAI cost, generally referred to as developmental, included all computer programming related to the experimental sections. For the most part, these programming costs were associated with the control package (BASIC), computerized games and simulations (BASIC) and tutorial lessons (IDF). Each individual responsible for some phase of programming was instructed to keep track of the number of hours worked.

Provisions for estimating other minor operational costs, such as administrative costs, were also included in the design. These costs were mainly in the form of "proctor" costs and were a function of the hours worked by the proctor and the hourly wage rate.

Collecting cost data in this manner allowed the cost of the CAI component of the experimental sections to be calculated on the basis of fixed cost (developmental cost), variable cost (operational cost) and total cost (developmental plus operational cost).

II

METHODS AND MEASUREMENTS

A. Effectiveness Considerations

In attempting to isolate either the affective or cognitive output associated with the experimental sections, the statistical model most often used is multiple regression analysis. The model is as follows:

$$Y = a_0 + \sum_{i=1}^{n} a_i X_i + bZ + e$$

where

Y = performance measure

X_i = control variable (i=1, ..., n)

Z = dummy variable representing the experiment

e = error term

The statistical results of this model determine which factors, other than experimental treatment, contribute to student performance. This determination depends on the statistical significance of the coefficient associated with each control variable.

1. Cognitive Performance

Economic education research literature contains a number of studies which employ the general model presented above. A review[6] of these studies reveal common elements with respect to model specifications.

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[6] See reference [5] for this review.

First, student performance is nearly always specified as some form of cognitive achievement (CA). Second, the explanatory variables are generally of two types: student characteristics (SC) and instructional process (IP). It is recognized that CA is likely to be influenced by an interaction between SC and IP. However, it is generally felt that both SC and IP should be explicitly recognized as being distinct although not independent. That is,

$$CA = f(SC, IP).$$

In terms of SC, the models appear to identify five distinct categories and one residual category:

(A) General cognitive ability

(B) Prior economic knowledge

(C) Maturity

(D) Motivation

(E) Effort

(F) Other (e.g., sex and major)

General ability is associated with a student's verbal quantitative or critical thinking aptitude. Prior economic knowledge may be related to previous formal academic work in economics or non-formally acquired knowledge from periodicals or newspapers. Maturity is very difficult to define and measure but is customarily associated with age or college class. Motivation is measured in terms of student attitude toward the subject matter and certain characteristics of the instructional process. Attitude toward the subject matter is measured both before and after the instructional process, while attitude toward aspects of the instructional process is measured only in a post sense. The post process attitudes as they relate to SC "motivation" are thought to be an important source of interaction between the IP and CA as they are "channeled through" a SC. Effort is related to the amount of time students spend studying as well a. the efficiency with which they utilize their time. Finally, the residual category includes those specific variables that empirical work has found significant but are not readily associated with the five specific categories.

In terms of the IP we may identify three categories:

(A) Instructor characteristics

(B) Classroom environment

(C) Instructional approach

Instructor characteristics include such things as the extent of his training in the subject matter, attitude and value associated with the subject matter and generally the skill with which the material is presented to the students. Classroom environment would relate to the physical characteristics of the instructional setting such as class size. Finally, the instructional approach is determined by the delivery system and technology employed. For evaluation, the experimental design and statistical procedure are used to isolate and measure the independent effect on cognitive performance of this last category of the IP.

2. Affective Performance

As previously mentioned, the additional specification of student performance in terms of affective performance represents one of the unique characteristics of this study. A review[7] of the economic education literature dealing with student attitudes led us to place student attitudinal components in four major categories: interest in economics, importance of economics, attitude toward the instructional process, and attitudes regarding specific issues in economics.

Our affective performance model assumes the same general form as our cognitive performance model:

$$AP = f(SC, IP)$$

where

AP = Affective Performance

SC = Student Characteristics

IP = Instructional Process

Previously four attitudinal dimensions of AP were identified. Of these, two were utilized; namely, interest in economics and importance of economics.

While the set of control variables used in the affective model is similar to the set employed in the cognitive model, it differs primarily in the area of SC. The IP variables are retained in their entirety and treated in exactly the same manner as in the cognitive model. SC, on the other hand, are grouped in four distinct categories and one residual category:

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[7] See reference [5] for this review.

(A) Prior Economic Knowledge

(B) Maturity

(C) Perception of the Instructional Process

(D) Dissonance

(E) Other (e.g., sex and major)

In our cognitive model we identified six categories compared with only five for our affective model. Three categories (prior economic knowledge, maturity and other) are common to both models, and as such, retain the same interpretation. Student perception of the instructional process is multi-dimensional involving attitudes toward the method of instruction, course content, and the instructor.

While the four mentioned categories involve a simple interpretation, the dissonance category is more complex. In general, it refers to the fact that through the educational process, students are freed from an illusion concerning their expected performance. We believe students enter a course with an illusion as to how they will perform relative to their peers, and that this expectation of personal performance is conditioned by the students' environment. If students do not achieve the expected performance levels in any given course they will tend to develop an unfavorable attitude posture toward the course in question.

As in the cognitive case, the experimental design and the affective regression model were used to isolate and measure the independent effect that CAI has on affective performance.

B. Cost Considerations

Since a clear specification of cost categories is crucial to any satisfactory cost study [6], we have attempted to identify each major cost category relative to our study. First, both the control and experimental sections involved direct operating costs. These costs are defined[8] according to the following categories:

1) Compensation (salaries, wages and benefits)

2) Supplies and services

3) Equipment paid for under operating budget

4) Department level administrative costs.

While the calculation of costs for the control sections was simply a summation of the above four categories, the calculation of costs for the experimental sections was more complicated. Experimental sections involved both a TAI and CAI component. The TAI cost components of the experimental sections could not be calculated as a single figure but rather were calculated under two different conditions and reported as lower and upper bound cost estimates. The lower bound cost figure was calculated as a two-thirds proportion of the control section costs while the upper bound figure required a four-fifths proportion. The two-thirds and four-fifths proportions were based on fifty and thirty minutes of released class time per week, respectively. Lower and upper bound figures were calculated because weekly released class time was suspended on several occasions during the semester (See Part I, B, of

[8]The definition used for direct operating costs is described by Leonard Romney, Jim Topping and Charles Manning [14].

this paper) which made an exact released time calculation uncertain.

The CAI component cost categories were grouped according to developmental and operational costs. Developmental costs included the following categories:

1) Instructional Design (Games, Simulations, and Tutorial Lessons)

2) Data Management Programming (Control Package and Reporting Files)

3) Game and Simulation Programming (BASIC)

4) Tutorial Lesson File Construction (IDAF)

5) Computer Usage (Time, Storage and Supplies)

Operational costs included the following categories:

1) Proctor Time

2) CAI Computer Usage (Time, Storage, and Supplies)

Whereas specification of these cost categories presented few problems, a number of conceptional problems were encountered when attempts were made to assign dollar figures to the cost categories. Each individual who was expected to make a major contribution to the development of the CAI materials was asked to keep a record of time expended. Obviously this information would be used to calculate the personnel cost (which was expected to constitute the major expense of CAI) associated with developmental costs of the CAI materials. At this point a question arises as to which dollar figures ought to be employed. If actual salaries of the participating personnel are used and these individuals tend to be in the higher (or lower) academic ranks with a large (small) number of experience years, the developmental cost would be over (under) stated. In this sense we might unintentionally be providing misleading information to those in the educational community who are considering producing and utilizing similar CAI materials. This problem can be avoided to some degree by using a salary which is a departmental average or some type of national average.[9] On the other hand, actual cost data both for reporting TAI and CAI components are important features of this study. Our cost data utilizes actual faculty salaries because the average salary of participating faculty was nearly identical to the departmental average, and within $100 of the national average for college and university faculty in general.

Another conceptual problem, more fundamental to CAI studies in general, involves the reporting of developmental costs. Basically, the CAI component of our experimental sections is composed of fixed costs (developmental costs) and variable costs (operational costs). The fixed costs represent a 'one time only' expenditure and probably should be spread over the life of the CAI materials. But this presents a problem since it requires a determination of the life expectancy of the materials. Such a determination is not a simple matter. For example, one can compare economic CAI materials with leading economic textbooks which are revised approximately once in every three years.

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[9] Some cost studies have attempted to avoid this problem by reporting the hours expended along with dollar figures (13). This procedure does not solve the problem entirely since the efficiency of the personnel involved in the project will influence the amount of hours expended. Furthermore, certain costs associated with CAI cannot be expressed in units of time which creates an aggregation problem.

In most cases, these revisions are minor, leaving most of the material intact. Hence three years would not represent the true life span of an economic textbook, nor would such a short duration represent the life expectancy of economic CAI materials. Obviously, a changing economic world and new economic theories mean a shorter life span for economic CAI materials than for, say, CAI materials dealing with a foreign language or mathematics. We were unable to specify the time period over which our CAI materials will be useful; therefore, two additional conditions were used for calculating cost for the experimental sections. One condition assumes infinite life for the CAI materials and excludes developmental cost, while the other assumes a one semester life for these courseware and includes developmental cost.

C. Estimations of Effectiveness and Costs

1. Effectiveness Estimates[10]

As indicated in Section I, one of the unique characteristics of this study is the use of an experimental design and associated statistical technique to derive a measure of the independent effect of a new instructional approach (CAI) on educational output. Student subjects were divided into separate treatment groups and parameters of linear models meant to explain their cognitive and affective performance

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[10] The Statistical foundations for this section are presented in Johnston [8, pp. 38-41 and 152-154].

were estimated by least squares multiple regression. For our purposes the salient characteristic of this approach is the presence of experimental treatment as a 0-1 dummy variable.

Recall from Section II, Part A, the linear model is specified as:

$$Y = a_o + \sum_{i=1}^{n} a_i X_i + bZ + e$$

where

Y = Output (performance) measure

X_i = Control (independent) variable

Z = dummy variable representing experimental treatment

e = error term

If the model is correctly specified, the coefficient (b) associated with the treatment variable (Z) may be interpreted as the amount by which educational output is altered because of experimental treatment <u>after</u> allowing for the effect of other output-determining variables (X_i) and random errors (e).

These estimated linear models were used to <u>predict</u> cognitive and affective educational output.[11] That is, our sample data set was used to make inferences concerning the mean value of educational output from our student population both with and without experimental treatment. Operationally, this involved setting the dummy variable equal to one

[11] See Appendix B for the regression statistics and mean values of the independent variables.

and setting all remaining independent variables equal to their mean sample values, and then generating an output prediction from the model on the basis of the estimated parameters. For purposes of comparison this procedure was repeated with the dummy variable set equal to zero. With the treatment dummy equal to one, the predicted value is interpreted as an unbiased estimate of the mean value of output for the average student (in our population) having been subject to the experimental treatment. Correspondingly, with the treatment dummy equal to zero, the predicted value is interpreted as an unbiased estimate of the mean value of output for the average student not subject to the experimental treatment.

Table II.1 presents these predicted output values ($\hat{Y}$) with both cognitive and affective output examined in terms of composite measures and certain distinct sub-measures.

The most noteworthy feature of the information contained in the table is the uniformly higher predicted output for the experimental sections. This result simply mirrors the fact that the estimated coefficients associated with the treatment dummy were positive.

If we assume that the random error term (e) in the model is normally distributed with zero mean and constant variance, the predicted output value will also be normally distributed. In the absence of exact knowledge of error variance, an estimate of error variance based on sample residuals may be used to specify a standard error for the predicted output value. These standard errors are also shown in Table II.1.

Table II.1
Predicted Educational Output[1]

Type of Output	No Experimental Treatment		Experimental Treatment	
	$\hat{Y}$	S.E.	$\hat{Y}$	S.E.
Cognitive Performance[2]				
Recognition & Understanding	7.35	0.19	7.44	0.19
Simple Application	4.73	0.22	5.72	0.23
Composite[3]	18.06	0.48	18.71	0.49
Affective Performance[4]				
Importance of Economics	11.85	0.21	12.21	0.21
Interest in Economics	10.59	0.27	10.72	0.27
Composite[5]	36.94	0.65	37.52	0.65

[1]Predicted educational output can be calculated using data supplied in Appendix B. However, rounding of regression coefficients will result in minor differences in output values in several cases.

[2]Cognitive performance is measured on the basis of post-TUCE score. See references [10] and [12] for a description and evaluation of this instrument.

[3]Includes score on complex application question.

[4]Affective performance is based on attitude instruments documented in Appendix A.

[5]Includes attitudes toward the subject matter of economics in general which includes importance, interest and other factors.

Furthermore, on the basis of the sample standard error, the t distribution may be employed to establish "prediction intervals". In other words, confidence intervals may be formed for the population mean on the basis of the predicted values from the sample. Upper and lower bounds for these prediction intervals will be of use in parametrically examining the educational efficiency (or lack of it) of the CAI materials. Table II.2 displays the upper and lower bounds of 95% prediction intervals for the sample predicted output values in Table II.1.

Table II.2
Predicted Educational Output at 95% Prediction Intervals[1]

Type of Output	No Experimental Treatment		Experimental Treatment	
	Upper	Lower	Upper	Lower
Cognitive				
Recognition & Understanding	7.73	6.97	7.82	7.06
Simple Application	5.17	4.29	6.18	5.26
Composite	19.01	17.11	19.68	17.74
Affective				
Importance	12.27	11.43	12.63	11.79
Interest	11.12	10.06	11.25	10.19
Composite	38.23	35.65	38.81	36.23

[1]No. of OBS. = 113; No. of Indep. Var. = 11; Prediction Interval = $\hat{Y} \pm t_{\varepsilon/2} \cdot$ Standard error; $\varepsilon = 0.05$.

The most noteworthy feature of Table II.2 is the non-overlap of the prediction interval for the simple application question on the cognitive instrument. All other prediction intervals between the treatment groups overlap at the 95% level. Therefore, it would appear on a predicted output basis, at the five percent level of significance, the experimental treatment is statistically significant only for cognitive output of the simple application type.

2. Cost Estimates

Estimating costs for the two control sections presented few problems since these sections involved only a TAI component. Therefore, the relevant costs were secured directly from the UW-La Crosse budget. Using the categories identified in Part III, B, Table II.3 was constructed.

TABLE II.3

Estimated Costs of Control Sections

Cost Categories	Costs	Costs/Student
Compensation	$4612.00	$57.65
Supplies and Services	175.00	2.19
Equipment	22.14	.28
Administration	153.83	1.92
TOTAL	$4962.97	$62.04

Table II.3 presents both total dollar costs and per student costs. This latter cost figure, $62.04, was based on 40 students per section, meeting 150 minutes each week.

In order to check on the validity of these costs figures, a per student credit cost was calculated by dividing the cost per student by 3, the number of credits. This cost, $20.78, compared very favorably with per student credit costs calculated by the University's administration for lower division economic courses.

The measurement of costs for the experimental section was not as straight forward as the calculation of costs for the control sections. Since the experimental sections involved both TAI and CAI components, costs of the two experimental sections naturally reflected both types of costs. Likewise, a greater degree of difficulty was encountered in estimating the costs associated with the experimental sections. Table II.4 presents the costs associated with the TAI component of the experimental sections and utilizes the same cost categories as the control sections. The lower bound costs per student were based on a 40 student section with fifty

TABLE II.4

Estimated TAI Costs of Experimental Sections

Cost Categories	Lower Bound Costs/Student	Upper Bound Costs/Student
Compensation	$38.43	$46.12
Supplies and Services	1.46	1.75
Equipment	.19	.22
Administration	1.28	1.54
TOTAL	$41.36	$49.63

minutes of weekly released class time. Therefore, the lower bound cost figures were simply calculated as two-thirds of the control section costs for each category. Likewise, the upper bound cost figures were calculated as four-fifths of the control section costs and represents thirty minutes of released class time. Table II.4 presents both lower and upper bound cost estimates of $41.36 and $49.63, respectively.

The cost estimates of the CAI component of the experimental sections utilized the cost categories previously identified, and involved the use of hourly calculations for all categories except computer storage and supplies. Table II.5 indicates that the CAI component of the experimental sections cost an estimated $9187.00. Of this figure, developmental costs were $7269.00 (or approximately 80 percent of the total cost) and operational costs were $1918.00. As expected, Table II.5 reflects the fact that personnel cost constitute the major share of developmental costs. Personnel costs, in the form of salaries, wages and fringe benefits amount to $6421.00, or approximately 88 percent.

While the developmental costs of our CAI courseware represented 80 percent of total costs, Rogers and Weinstein (13) indicated 61% of total costs were in the form of developmental costs. On the other hand, Littrell's study (11) reported developmental cost as 95% of total costs. The relatively low figure reported by Rogers and Weinstein may be explained by the fact that their project was actually computer managed instruction (CMI) rather than CAI, and a rather high hourly computer usage rate ($6.09/hour). Since a time sharing system was used at UW-La Crosse, our relatively lower operational costs probably reflect the significantly lower computer usage rate ($1.75/hr.). Littrell's developmental costs reported CAI costs, but also included costs for the development of films, graphics and audio materials. In comparing personnel costs as a percent of developmental costs,

TABLE II.5

Estimated CAI Costs of Experimental Sections

Type of Costs	Estimated Time in Hours	Total Hours	Estimated Costs	Total Costs
DEVELOPMENTAL COST				
Instructional				
Design[1]				
Faculty @ $8.20	243	243	$1993.00	$1993.00
Programming[2]				
Faculty @ $8.20	91		746.00	
Students @ $1.90	138	229	262.00	1008.00
File Construction[3]				
Faculty @ $8.20	173		1419.00	
Classified Personnel @ $5.00	10	183	50.00	1469.00
Data Management				
Design[4]				
Faculty @ $8.20	35		287.00	
Classified Personnel @ $5.00	26	61	130.00	417.00
Programming[5]				
Faculty @ $8.20	164		1345.00	
Class. Per. @ $5.00	6		30.00	
Student @ $1.90	84	254	159.00	1534.00
Computer				
Usage[6] @ $1.75	454	454	794.50	
Storage[7]			50.00	
Supplies[8]			3.00	848.00
Total Developmental Costs				$7269.00

(Table II.5 continued on following page)

TABLE II.5 (continued)

Type of Costs	Estimated Time in Hours	Total Hours	Estimated Costs	Total Costs
OPERATIONAL COST				
Proctor[9]				
Student @ $1.90	70	70	133.00	133.00
Computer				
Usage @ $1.75	857	857	1500.00	
Storage			233.00	
Supplies			62.00	$1785.00
Total Operational Costs				$1918.00
TOTAL COST OF CAI				$9187.00

[1]Instructional designing included the development and/or modification of 14 tutorial lessons, 4 games and 1 simulation.

[2]Instructional programming involved only the games and simulations and was in BASIC.

[3]Instructional file construction concerned only the tutorial lessons and utilized IDAF.

[4]Data management designing included the development of the Integrated Tutorial and Game Management System (ITGMS). ITGMS consists of 9 programs and 3 files.

[5]Data management programming of ITGMS.

[6]Computer usage charge for the 2000C' Hewlett Packard Time Sharing Computer were established at $1.75/hr. by the UW-L Computer Center.

[7]Computer storage charges were assessed at $.03/block/month by the UW-L Computer Center.

[8]Computer supplies consisted of terminal paper and ribbons.

[9]The duties of the proctor included the opening of necessary files, entering and dropping students for the course, requesting various reports, entering daily messages if necessary, clearing the News file, and the assisting of students at computer terminals.

Rogers and Weinstein reported 82 percent and Littrell reported 81 percent. Our figure (88 percent) is slightly higher and probably reflects the fact that our personnel costs include fringe benefits while the other two studies excluded these benefits.

The estimated costs per student for the three major areas of CAI are presented in Table II.6. These costs were calculated

TABLE II.6

Estimated CAI Costs Per Student of Experimental Sections

Major Area	Cost	Cost/Student
Developmental	$7269.00	$ 91.00
Operational	1918.00	24.00
TOTAL	$9187.00	$115.00

using the same number of students used for calculating costs per students for the control sections.

Given the difficulty of calculating the exact amount of released class time and the conceptual problems associated with the developmental costs of CAI courseware, costs of experimental sections were estimated under four separate conditions. Table II.7 presents the cost per student under each of these conditions:

1. Condition I assumes fifty minutes of released class time per week and infinite life for CAI materials (i.e., developmental costs excluded),

2. Condition II assumes the same released class time as Condition I, and a one semester life for CAI materials (i.e., developmental costs included),

3. Condition III assumes thirty minutes of released class time per week and infinite life for CAI materials,

4. Condition IV assumes the same released class time as Condition III and a one semester life for CAI materials.

TABLE II.7

Estimated Costs of Experimental Sections Under Various Conditions

Component	Conditions I	II	III	IV
TAI				
Lower Bound	$41.36	$ 41.36		
Upper Bound			$49.63	$ 49.63
CAI**				
Operational	24.00		24.00	
Total		115.00		115.00
	$65.36	$156.36	$73.63	$164.63

No matter which set of assumptions we use, the estimated costs of the experimental sections exceed the cost of the control sections. When comparing Table II.3 and Table 11.7, it is found that under Conditions I and III, the costs per student exceeds the control sections by $3.32 and $11.59, respectively. Under Conditions II and IV, the costs per student are over twice as high as for the control sections. Therefore, solely on the basis of educational input costs, CAI is more expensive than TAI. This is not to say, however, that TAI demonstrates greater efficiency. In order to assess the efficiency of the two teaching strategies, educational efficiency ratios must first be calculated.

III.

RESULTS OF THE INVESTIGATION

One of the unique characteristics of this study is the calculation of education efficiency ratios (EER) for the purpose of evaluating instructional delivery systems. As previously defined, an EER is the ratio of educational output to cost. For the purpose of this study, educational output included both cognitive and affective performance.

A. Efficiency and Cognitive Performance

Efficiency results associated with cognitive performance under CAI and TAI delivery systems are presented in Table III.1. Cognitive EERs were calculated for three categories: recognition and understanding, simple application, and composite (overall TUCE score). Table III.1 presents EERs for both upper and lower bounds of 95% prediction intervals and for various cost estimates associated with the CAI delivery system.

A comparison of EERs indicates that TAI is of equal or greater efficiency than CAI for both upper and lower bounds under all cost conditions, with one exception. In the area of simple application under the assumption of fifty minutes of released class time per week and excluding developmental costs (Condition I), CAI was found to be more efficient. In addition, TAI and CAI were found to be equally efficient in the areas of recognition and understanding under the assumption of Condition I, and simple application under the assumption of Condition III (assumes thirty minutes of released class

TABLE III.1

Educational Efficiency Ratios[1]
(Cognitive Performance)

TYPE OF OUTPUT	CONTROL	EXPERIMENTAL Condition I	Condition II	Condition III	Condition IV
RU[2]					
Upper Bound	.12	.12	.05	.11	.05
Lower Bound	.11	.11	.05	.10	.04
SA[3]					
Upper Bound	.08	.09	.04	.08	.04
Lower Bound	.07	.08	.03	.07	.03
Composite					
Upper Bound	.31	.30	.13	.27	.12
Lower Bound	.28	.27	.11	.24	.11

[1] EERs were calculated from cognitive data presented in Table II.2 and cost data presented in Tables II.3 and II.7.

[2] RU = Recognition and Understanding.

[3] SA = Simple Application.

time per week and excludes developmental costs.)[12] When using costs for CAI under Condition II (assumes fifty minutes of released class time per week and total cost of CAI materials) and under Condition IV (assumes thirty minutes of released class time per week and total cost of CAI materials), TAI was found to be more efficient in all cases.

[12] While CAI under cost Condition I was of greater or equal efficiency for simple application, it was less efficient for the composite. The reason for this apparent paradox is that the composite includes a number of test items which supposedly evaluates the students' ability to apply two or more concepts simultaneously.

B. Efficiency and Affective Performance

While the EERs concerning cognitive performance suggested somewhat mixed efficiency results between TAI and CAI delivery systems, Table III.2 indicates that in the area of affective performance CAI

TABLE III.2

Educational Efficiency Ratios[1]
(Affective Performance)

TYPE OF OUTPUT	CONTROL	EXPERIMENTAL Condition I	Condition II	Condition III	Condition IV
Importance[2]					
Upper Bound	.20	.19	.08	.17	.08
Lower Bound	.18	.18	.08	.16	.07
Interest[3]					
Upper Bound	.18	.17	.07	.15	.07
Lower Bound	.16	.16	.07	.14	.06
Composite					
Upper Bound	.62	.59	.25	.53	.24
Lower Bound	.57	.55	.23	.49	.22

[1] EERs were calculated using affective data presented in Table II.2 and cost data presented in Tables II.3 and II.7

[2] Importance refers to importance of economics

[3] Interest refers to interest in economics

failed to achieve an efficiency level greater than TAI for all cases considered. Under Conditions II and IV, CAI achieves especially low EERs relative to the EERs associated with TAI.

Proponents of CAI can find little comfort in Table III.2 with two minor exceptions. In the area of Importance of Economics, under Condition I, CAI was found to be equally efficient at the lower bound. Likewise, Interest in Economics was found to have the same EERs of .16 at the lower bound for both CAI and TAI.

IV. CONCLUSION

In evaluating the relative educational efficiency of CAI we have adopted what might be called a "parametric" approach. Essentially we have attempted to determine under what conditions CAI is educationally efficient (cognitively and affectively) in relation to TAI. Our results indicate that under virtually all circumstances considered, gains in educational output did not outweigh the additional cost of CAI. In fact, the only circumstances in which CAI appeared marginally efficient required us to ignore the developmental cost of the CAI materials; a cost component generally acknowledged to represent the principal share of total CAI cost. Therefore, on the basis of our results we are forced to answer the question posed in the title of this paper affirmatively.

Given that our set of CAI materials was not cost efficient, the next logical step is to consider the following question: Are there any areas where CAI costs might be significantly reduced? First, it is known that experience in the construction of CAI materials has a significant impact on developmental cost. Therefore, a reduction in this cost component would be expected as authors of CAI materials gain relevant experience. In our case, efficiency in writing computerized tutorial lessons and simulation games had improved markedly by the end of the project.

Second, advances in computer technology may have an impact on CAI costs. Conceivably, new hardware and methods could reduce both the developmental and operational costs of CAI.

With respect to educational output in economics, we feel that our models of cognitive and affective output represent the current state of the art in modeling of the learning process in Principles of Economics. However, this is not to say that the current state is satisfactory in all respects. If the models are fundamentally mis-specified or the variables are subject to serious measurement error it is conceivable that our outputs are under (over) estimated.

Finally, it must be stressed that CAI is not monolithic. That is, there are significant differences in the quality of CAI materials. While we naturally feel that our materials are relatively "good", as educators gain experience in instructional computing the quality of CAI materials will improve. Furthermore, it must be stressed that our results pertain in particular to the educational efficiency of CAI in the Principles of Macroeconomics. While we believe that the logical structure of economic theory naturally lends itself to CAI there may be other disciplines for which such a claim is stronger.

APPENDIX A

Attitude Survey

Appendix A

The Course Evaluation Questionnaire was based on the Illinois CEQ:

Aleamoni, L.M., "Illinois Course Evaluation Questionnaire (CEQ) Results Interpretation Manual Form 66 and 32." Report #331. Urbana, Illinois: Office of Instructional Resources, University of Illinois, 1972.

The Atttitude Evaluation Instrument was based on the Karstensson instrument documented in:

Karstensson, L., "A Study of the Validity and Reliability of a Questionnaire on Student Attitude Toward Economics." Athens, Ohio: Department of Economic Education, Ohio University, 1973.

COURSE EVALUATION

INSTRUCTIONS:

I. Print the instructor's name, the course number, section, and the semester at the top of the IBM answer form. It is NOT necessary to include your name.

II. This form is being used to evaluate the instructional process and to aid in the determination of faculty merit pay increases. Please do your best to give a considered, objective response to each item.

III. Please indicate your agreement or disagreement with the statements below according to the following FOUR POINT scale:

- A if you strongly agree with the item
- B if you agree moderately with the item
- C if you disagree moderately with the item
- D if you strongly disagree with the item

---

1. I would take another course that was taught this way.
2. The instructor seemed to be interested in students as persons.
3. I would have preferred another method of teaching in this course.
4. It was easy to remain attentive.
5. The instructor did NOT synthesize, integrate or summarize effectively.
6. NOT much was gained by taking this course.
7. The instructor encouraged the development of new viewpoints and appreciations.
8. I learn more when other teaching methods are used.
9. The course material seemed worthwhile.
10. More courses should be taught this way.
11. The instructor demonstrated a thorough knowledge of the subject matter.
12. The way in which this course was taught results in better student learning.
13. It was a very worthwhile course.
14. Some things were NOT explained very well.
15. I would prefer a different method of instruction.
16. The course material was too difficult.
17. This is one of my poorest courses
18. Another method of instruction should have been employed.
19. It was quite interesting.
20. I think that the course was taught quite well.
21. The course content was excellent.
22. Some days I was NOT very interested in this course.
23. It was quite boring.
24. Overall, the course was good.
25. On the basis of the factors considered above, and compared to all other instructors I have had at [illegible], I rate this instructor:
    - A. Poor
    - B. Below Average
    - C. Average
    - D. Above Average
    - E. Excellent

ATTITUDE SURVEY

INSTRUCTIONS:

I. Write the following information at the top of an IBM answer form:

Name
Course
Section
Date
Attitude Survey

II. Enter your six-digit Alpha number in the ID block according to your Professor's instructions.

III. Your frank response on each item of this opinion survey will aid the instructor in the improvement of this course.

Please indicate your agreement or disagreement with the first ten statements according to the following scale:

A = Strongly Agree
B = Moderately Agree
C = Neither Agree nor Disagree
D = Moderately Disagree
E = Strongly Disagree

1. How would you rank economics in comparison to other subjects you have studied on the basis of your personal interest in the subject?

   A. one of the most interesting subjects
   B. Among the more interesting subjects
   C. Undecided or indifferent
   D. Among the less interesting subjects
   E. One of the least interesting subjects

2. How would you rank economics in comparison to other subjects you have studied on the basis of its contribution to your general education?

   A. One of the most important subjects
   B. Among the more important subjects
   C. Undecided or indifferent
   D. Among the less important subjects
   E. One of the least important subjects

3. How would you rank economics in comparison to other subjects you have studied on the basis of its contribution to your occupational preparation?

   A. One of the most important subjects
   B. Among the more important subjects
   C. Undecided or indifferent
   D. Among the less important subjects
   E. One of the least important subjects

4. Is the knowledge which you obtain from studying economics worth the time and effort that you put into studying the subject?

   A. Definitely yes
   B. Mostly yes
   C. Undecided or indifferent
   D. Mostly no
   E. Definitely no

5. To what extent are you interested in learning (or learning more) about economics?

   A. Very interested
   B. Somewhat interested
   C. Undecided or indifferent
   D. Not too interested
   E. Not at all interested

6. To what extent are you interested in taking additional course work in economics?

   A. Very interested
   B. Somewhat interested
   C. Undecided or indifferent
   D. Not too interested
   E. Not at all interested

7. Do you intend to take additional course work in economics within the next two years?

   A. Definitely yes
   B. Probably yes
   C. Undecided or indifferent
   D. Probably no
   E. Definitely no

8. What is your present inclination toward recommending a course in economics to a fellow student who has never studied the subject?

   A. Definitely would recommend course
   B. Probably would recommend course
   C. Undecided or indifferent
   D. Probably would not recommend
   E. Definitely would not recommend

9. Do you agree or disagree with the following statement? "Economic understanding is essential if we are to meet our responsibilities as citizens and as participants in a basically private enterprise economy."

   A. Strongly agree
   B. Agree
   C. Undecided or indifferent
   D. Disagree
   E. Strongly disagree

10. How would you describe your present attitude toward the subject of economics?

A. Very favorable
B. Mostly favorable
C. Undecided or indifferent
D. Mostly unfavorable
E. Very unfavorable

APPENDIX B

Regression Results

TABLE B.1

COGNITIVE ACHIEVEMENT MODELS - REGRESSION STATISTICS
(t-value in parentheses)[a]

Equation Number	Dependent Variable	Adj R^2	Constant Term	Independent Variables[b]										
				HSRANK	PRE-	AGE	EVALTT	CURCRE	SEXF=1	SBAM=1	LABM=1	SSM=1	INSI=1	EXP=1
1	Recognition and Understanding	.39	.56 (.31)	.03 (4.83)	.28[c] (3.52)	.06 (1.11)	.03 (3.07)	-.02 (.24)	-.98 (-2.98)	-.13 (-.43)	-.33 (-.79)	-.12 (-.21)	.97 (3.37)	.09 (.33)
2	Simple Application	.45	-5.00 (-2.43)	.03 (3.52)	.26[d] (2.48)	.14 (2.07)	.03 (2.49)	.12 (1.42)	-.52 (-1.33)	-.56 (-1.53)	.94 (1.92)	.95 (1.40)	1.59 (4.70)	.99 (3.05)
3	Composite	.50	-6.16 (-1.37)	.08 (4.67)	.30[e] (2.78)	.27 (1.87)	.09 (3.79)	.20 (1.12)	-1.87 (-2.20)	-1.03 (-1.28)	-.40 (-.38)	1.75 (1.19)	4.07 (5.54)	.65 (.94)

a/ Critical t-values: 10% = 1.66, 5% = 1.98, 1% = 2.62; b/ See following page for definitions of abbreviated independent variables; c/ PRETRU; d/ PRETSA
e/ PRETUC

TABLE B.2

AFFECTIVE ACHIEVEMENT MODELS - REGRESSION STATISTICS
(t-values in parentheses)[a]

Equation Number	Dependent Variable	Adj R^2	Constant Term	Independent Variables[b]											
				PRE-	DISSON	PRETUCE	AGE	EVALTT	SEXF=1	SBAM=1	LBAM=1	SSM=1	INSI=1	EXP=1
1	Importance of Economics	.57	1.30 (.71)	.43[c] (4.20)	-.01 (-.75)	.06 (1.39)	-.08 (-1.28)	.09 (7.58)	.17 (.46)	.81 (2.32)	.54 (1.16)	-.98 (-1.56)	-.38 (-1.19)	.36 (1.20)
2	Interest in Economics	.57	-3.65 (-1.69)	.56[d] (5.17)	-.02 (-2.64)	.14 (2.37)	.01 (.08)	.08 (5.72)	-.32 (-.70)	1.54 (3.46)	1.17 (1.99)	-.01 (-.02)	.26 (.32)	.12 (.32)
3	Composite	.66	-5.52 (-.97)	.55[e] (5.26)	-.04 (-2.02)	.27 (1.93)	-.12 (-.64)	.28 (7.88)	-.56 (-.50)	4.07 (3.72)	3.60 (2.50)	-1.00 (-.51)	-.42 (-.43)	.58 (.62)

a/ Critical t-values: 10% = 1.66, 5% = 1.98, 1% = 2.62; b/See following page for definitions of abbreviated independent variables; c/PREIMP; d/PREINT;
e/ PREATT

DEFINITIONS OF ABBREVIATED INDEPENDENT VARIABLES

HSRANK
High School Rank in Percentile

PRETUCE
Pre-Test of Understanding in College Economics

PRETRU
Recognition and understanding component Test of Understanding in College Economics

PRESTA
Simple application component of Test of Understanding in College Economics

AGE
Chronological age in years

EVALTT
Course evaluation composite
(Higher score, better evaluations)

CURCRE
Current semester credit hour load

SEXF=1
Sex - 0=Male, 1=Female

SBAM=1
School of Business Administration major=1
Non School of Business Administration major=0

LABM=1
Science major=1
(Includes: Biology, Chemistry, Physics, Math)
Non-Science major=0

SSM=1
Social Studies major=1
(Includes: Psychology, Sociology, Anthropology, Geography, Political Science)
Non-Social Studies major=0

INSI=1
Instructor Dummy Variable
Instructor A=1
Instructor B=0

EXP=1

Experimental treatment - Dummy Variable
Control Sections=0
Experimental Sections=1

DISSON

Dissonance: The difference between where a student thinks he ought to rank on exams based on previous experience, and where he actually ranks based on exam scores.

PREATT

Pre-test of Attitude Toward Economics. Composite includes importance, interest, and intent to take more classes in economics.

PREIMP

Importance of economic component of pre-test of Attitude Toward Economics.

PREINT

Interest in economic component of pre-test of Attitude Toward Economics.

TABLE B.3

Mean Values for Independent Variables
Used in Cognitive and Affective Models

Independent Variable	Mean Value	
	Cognitive	Affective
HSRANK	64.9823	---
PRETRU	4.4159	---
PRETSA	3.7522	---
PRETUC	11.1239	11.1239
PREIMP	---	12.4425
PREINT	---	11.6637
PREATT	---	39.5398
AGE	19.5044	19.5044
EVALTT	68.6372	68.6372
CURCRE	14.9469	14.9469
SEXF=1	.2655	.2655
SBAM=1	.3982	.3982
LABM=1	.1416	.1416
SSM=1	.0708	.0708
INSI=1	.4690	.4690
EXP=1	(0 or 1)[1]	(0 or 1)[1]
DISSON	---	14.703

[1] 0 = Control; 1 = Experimental

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