DOCUMENT RESUME

ED 150 044 SO 010 576

AUTHOR Wetzel, James N.
TITLE Measuring Student Scholastic Effort: An Economic Theory of Learning Approach.
PUB DATE 29 Dec 77
NOTE 21p.; Paper presented at Annual Meeting of the American Economics Association (New York, New York, December 29, 1977)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Academic Achievement; Achievement Gains; Achievement Tests; College Students; Commuting Students; *Economic Education; Economics; Educational Research; *Evaluation Criteria; Higher Education; Intelligence Level; Learning Characteristics; Learning Theories; Low Achievement Factors; *Research Needs; School Demography; Statistical Studies; Student Attitudes; Student Characteristics; Student Employment; Student Evaluation; Student Evaluation of Teacher Performance; Student Motivation; *Teaching Methods; Teaching Models

ABSTRACT

Many research studies which deal with the teaching of economics at the college level conclude that different teaching methods do not lead to very different results in terms of student achievement. This paper suggests that one reason student achievement may fail to demonstrate the superiority of one teaching method over another is that achievement is a function of a student's intellectual ability and time put into the course. It is suggested that less effort and time studying economics and additional leisure time, instead of improved achievement, may be the dominant benefit of a different teaching method. To test this hypothesis, a dependent variable was designed to measure the change in a student's effort in economics based on an economic learning model developed by McKenzie and Staaf. Three effort variables were constructed and tested to determine if effort was correlated with grade expectation, student attitude, sex, age, hours worked, day or night classes, or having had or not had a high school course in economics. Results indicated that non-working students and those students who expect and/or receive high grades exhibit more effort. It is suggested that the effort variable be taken into consideration in evaluating teaching methods. (JK)

Measuring Student Scholastic Effort: An Economic Theory of Learning Approach*

James N. Wetzel
Assistant Professor of Economics
Virginia Commonwealth University
Richmond, Virginia

*Presented at the American Economics Association Annual Meetings, New York, December, 1977.

In recent years the number of studies dealing with the teaching of economics at the college or adult level has increased from about 240 in 1969 to over 700 by the spring of 1976 (2). A large percentage of these studies have discussed either general course evaluations or the controlled evaluation of various teaching methods such as computer-assisted instruction, personalized methods of instruction, the use of audio-visual materials, etc., (1,2,5,6,7, 14,15). Many of these studies have focused on trying to examine the factors affecting student achievement in a course under different teaching methods. Most economic education researchers have used the Test of Understanding in College Economics (TUCE) to measure student achievement in economics. In addition to the absolute achievement score on the TUCE, other dependent variables include such measures as absolute improvement, percentage improvement and gap-closing models (3,9). Many studies have concluded that different approaches to teaching do not lead to very different results in terms of the above measures of achievement (1,2,7,15).

However, there are several reasons that the "traditional" use of one of the four measures may fail to provide evidence of one particular teaching method being superior to another approach. In a recent article, Van Metre (16) points out that many studies fail to consider, much less try to measure, the different types of learning that take place in a course. Van Metre suggests that

most studies have not attempted to match the method of instruction with particular types of learning, with course objectives, or with the various testing devices or measures. The discussion presented by Van Metre suggests that the four TUCE scores may not match with the course objectives. Therefore, the TUCE scores may not be appropriate selections as dependent variables in the regression analysis.

A second reason the use of one of the four TUCE measures may fail to demonstrate the superiority of one method over another is the fact that student achievement is a function of a student's intellectual ability and the amount of time the student puts into the course. Several different researchers have suggested that changes in achievement may not be the sole or even the dominant benefit of a different teaching approach (1,7,11,12,13.) If we view the student as a decision-maker with various goals entering into his/her utility function the results of earlier studies are placed into a different context. Consider a representative student at point M on Indifference Curve I in Figure 1. For a given teaching technique A, the student can gain some maximum amount of achievement as given by the horizontal intercept of the budget line. An "improved" teaching technique B can implicitly be viewed as a pivot of the (time) budget constraint as shown by the dotted line. Given this improved teaching technique the student can utilize it to capture more leisure time, more achievement in economics or a combination of

the two, resulting in a move from M to M'. Decision making theory suggests that using levels of achievement as the dependent variable may miss the major benefits of a particular teaching method, namely, less effort and time spent studying economics and additional leisure time (assuming the student is willing to keep approximately the same level of achievement). The usual empirical research approach implicitly assumes that M' is horizontal to M: the student captures all the benefits from improved teaching method B in terms of higher achievement. It may be, given the student's preference function, that the gain is taken in more leisure: a more vertical movement to the new M'.

In fact, one might argue that if one really believes B is a superior teaching method (one that enables the student to gain more achievement per unit of leisure time foregone) and if the researcher cannot demonstrate that the students are doing better in terms of achievement, then one might infer that the student must be taking the gains in terms of increased leisure time and holding their level of achievement constant. The issue then becomes one of finding an alternative to use as the dependent variable which will measure the change in the student's effort in economics. One such variable would be time spent on the course. However, this variable is complicated by the fact that students with different learning abilities may attain different levels of achievement even though they spend the same amount of time on the course.

McKenzie and Staaf (11) have developed a model which is derived from the work-leisure model of wage theory. The work-leisure model of wage theory assumes that a person's total income is composed of two parts. The first part is unearned income or wealth which is "given". The second part is earned income which is a function of wage rate and time effort. Unearned income and earned income combine to give the total income figure. Consider two individuals X and Y, both who earn $50. per hour. X starts out with $1,000 wealth. Y starts with $100 wealth. For both to achieve a wealth level of $2,000, Y is going to have to work more hours than X since Y has to earn $1,900 whereas X only has to earn $1,000. Thus, when both reach $2,000 of wealth we can say that Y has exhibited more time effort in the pursuit of that level of wealth than X did.

The Learning Model

McKenzie and Staaf used this wages fund model to develop an economic learning model. Achievement in economics is viewed as "wealth". The student's score on a TUCE pre-test represents the stock of knowledge of economics at the beginning of the course (10,11). That stock of economic achievement is probably a function of parental background, newspaper availability in the home, the level of social science instruction in high school, etc. The student's score on a TUCE post-test represents total "wealth" at the end of the course

which is composed of the stock of knowledge at the beginning of the course plus the addition to the stock of knowledge during the course. The student's I.Q. or SAT score represents the student's ability to translate time into increased knowledge (7,8,10,14,15). One would expect those students with a high SAT score to learn more per time unit of study in any type of intellectual endeavor. Consider two students: A and B. Both start their economics course with the same stock of economic knowledge as measured by a TUCE pre-test score. At the end of the course both students have improved to a stock of knowledge of 20. If A has a combined SAT score of 600 and B has a combined SAT score of 1000 it is argued by Staaf and McKenzie that A has put greater effort into the course than B since A has a lower learning rate than B. To summarize, an individual enters an economics course with some wealth of knowledge of economics (pre-TUCE score), generally leaves the course with some greater knowledge of economics (post-TUCE score). Brighter students need apply less effort to achieve the same gain in wealth as do less bright students.

Thus, the following utility and learning functions place the model into a decision-making framework. Equation (1) is a student utility function which

(1) $U = f(A,L)$

(2) $A = I + E(R)$

(3) $T = E + L$

(4) $M = U(A,L) + (T-E-L)$

(5) $\frac{\partial A}{\partial L} = R$

(6) $E = \frac{A-I}{R}$

where

U = Utility

A = Achievement (post-TUCE)

L = Leisure

I = Initial level of knowledge (pre-TUCE)

E = Effort

R = Learning rate (SAT score)

T = Time constraint

M = Constrained maximization function

is a function of achievement in economics and leisure, i.e., all time not spent on the subject of study. Equation (2) says that final achievement is equal to initial achievement plus effort times the learning rate. Equation (3) is the time constraint. Equation (4) is the constrained utility maximization problem using the "Lagrange" multiplier analysis. Equation (5) gives the first order condition for utility maximization. The first order condition states that the individual's indifference curve (his/her willingness to trade achievement in economics for leisure) will be tangent to the learning curve at the point of utility maximization. Equation (6) defines "scholastic" effort in the course to be the gain in knowledge of

economics divided by intellectual ability where ability is measured by the SAT or some equivalent measure. It is important to note that this scholastic effort is not the same as time spent studying economics.

According to the model outlined here scholastic effort is empirically revealed by the terms on the right hand side of Equation (6). This is analogous to the time effort of the wage theory model which states that time effort is the change in wealth divided by the wage rate. This is seen in Figure 2, which is a graphical representation of the above model. It is this last term from Equation (6) which is the relationship considered in the paper.

An Empirical Test of the Model

The main question addressed by an empirical test of a new model is whether one can construct an effort variable such as the one discussed by Staaf and McKenzie. If so, then a second question is the extent to which that dependent variable correlates with some hypothesis about its relationship to other variables. An important part of this second category is whether different subgroups of students (male-female) exhibit different levels of effort. The issue is related to the following type of statement: "It is a real pleasure to teach older students since they are better motivated and put more effort into this course than students just out of high school." Thus, the purpose of the empirical results reported here are narrowly defined to (a) construct such an effort variable and (b) to examine its relationship to selected student characteristics.

All students at Virginia Commonwealth University who were taking the basic economics course in the Fall Term (1975) were asked to fill out a questionnaire which asked the students for their age, sex, year in school, hours of outside work, etc. In addition, the students were given an attitude towards economics test (4) and a pre-TUCE in the first week of the course. At the end of the semester, the same attitude toward economics test and a post-TUCE were administered. Finally, the students' SAT scores and final grade in economics were obtained. The combined SAT scores may be regarded as a measure of the student's ability to translate time into knowledge. However, it may be argued that the analytical nature of economics may be more strongly related to mathematical ability and that only SAT math score should be used (8). In order to consider this possibility, three different effort variables were constructed and studied. One of the effort variables used the mathematics SAT score, another effort variable used the verbal SAT score, and the third used the combined SAT score as a proxy to the learning or aptitude or rat

These three effort variables were tested in two different ways. The first way was to use regression analysis to determine the statistically significant factor. The three effort variables were regressed on four course related factors: the student's expected grade upon entering the course, the actual final grade, the pre-attitude score and post-attitude score. The rationale for picking these course related factors was to ascertain if effort was correlated with either

of the two grade variables or with either of the two attitude variables. In addition to these course related factors, several demographic variables were included in the set of independent variables. These demographic variables include sex, age, hours worked, year in school, day or night class and having had or not had an economics course in high school. The rationale for picking the demographic factors was to try and determine if students with different demographic characteristics exhibited different levels of effort as defined by the learning theory model. Using a stepwise procedure with the most significant variables entering the equation first, the only statistically significant variables found were (1) the hours worked and (2) the expected grade upon entering the course. The more hours the student was employed the smaller was the effort that was demonstrated in the basic economics course. This result is to be expected since having a job places other obligations upon the student. The coefficient on the expected grade variable was positive indicating that the higher the expected grade in the course at the beginning of the semester, the greater would be the level of effort demonstrated in the course. The remaining variables were not found to be statistically significant.

A second approach was to divide the total data set into more distinctive groups in order to determine if there was a statistically significant difference in the effort scores generated by different subgroups. This procedure enables the researcher to examine subgroups in a more specialized manner. Again, the subgroupings were

classified as either course related or demographic.

The course related factors that were subdivided were (1) expected grade upon entering the course, (2) final grade, (3) pre-attitude score, and (4) post-attitude score. With respect to grades it is thus possible to examine the level of effort exhibited by those students receiving an "A" in the course as compared to those receiving a lower grade. This provides a somewhat different perspective than regression analysis where effort is regressed on all grades. In a similar fashion the researcher can divide the data into those receiving a "B or better", "C or better", etc. It was hypothesized that higher grades, both expected and actual, as well as higher attitude scores, both pre- and post-, would exhibit higher levels of effort in the course. With respect to both grade variables this hypothesis was substantiated only for those students who did very well in the course for the verbal effort and math effort variables but not for the cumulative effort variable. Those students who received a final grade of "A" exhibited more effort than the rest of the students. However, the grouping of "A" and "B" students did not exhibit a higher level of effort than those who scored lower grades. Nor did the opposite low grade (F) exhibit a statistically significant lower level of effort. A similar result is obtained for the expected grade variable: Those who expected an "A" exhibited more effort than those who expected a lower grade.

The division of the data set into different subgroups by both

preattitude and post-attitude scores was also done. The data set scores were divided into two groups picked from the tails of the distribution to observe if those who had very negative (or very positive attitudes) toward economics exhibited a different level of effort than the rest of the data set. The results seem to indicate that neither of the extreme subdivision (positive or negative) exhibited a statistically significant different level of effort from the students in the remaining part of the data set.

With regard to the demographic subgroups, the classifications that were significant were age and the student's number of hours the student was employed. The age factor suggested that younger students exhibited a higher level of effort. The work variable indicated that those who did not work exhibited a higher level of effort. The significance of the work factor is not surprising. The age factor was more interesting. If a larger percentage of older student's worked, then these two patterns would complement each other. However, this is not the case at VCU. VCU is basically a commuter school. Most VCU students come from low and middle income families. Consequently, many VCU students have part-time or full time jobs.

The two statistical methods, the regression analysis and the difference between means, both seem to indicate that non-working students exhibit higher levels of effort; and that those students who expect and/or receive high grades exhibit more scholastic effort in economics as defined by the learning theory model (11). However,

neither the preattitude nor the post-attitude measures offered support to the hypothesis that those students with favorable attitudes toward economics would exhibit more effort in economics than those students with less favorable attitudes.

Educational Significance

This study indicates an important redirection that evaluations of different teaching techniques or studies of student evaluations of teachers may want to consider. The results indicate that the effort variable as defined in the learning theory model of Staaf and McKenzie (11) can be constructed and empirically tested. Although this study is only a pioneering effort in developing and testing a more complete model of learning behavior, the following statistical results are important: (1) employed students reveal less effort than non-working students or than students who work fewer hours, (2) demographic factors such as the year in school or the sex of the student do not suggest any difference in effort revealed.

The principle finding of this study is the direction it suggests for future research. The implications would appear to be strongest for studies dealing with different teaching techniques. The incorporation of decision-making theory into the evaluation process and its implications for the student's trade-off between achievement and leisure are quite important. The real advantage of systems such as TIPS, personalized instruction, or teaching through the use of A-V materials may not be higher achievement in the course under consideration. The real advantage of a teaching method may be that

less time effort needs to be spent on a particular subject to achieve a given course grade.

Table 1

Regression Analysis of the Relationship
between Effort and Selected Variables

1. Verbal Effort	=	- .00056	- .00019 (3.152)	Hours Worked + .00388 (2.504)	Expected Grade R^2 = .111 F = 8.704
2. Math Effort	=	- .00175	- .00017 (3.144)	Hours Worked + .00387 (2.816)	Expected Grade R^2 = .12 F = 9.58
3. Cumulative Effort	=	- .00056	- .00009 (3.192)	Hours Worked + .00191 (2.675)	Expected Grade R^2 = .18 F = 9.33

"t" values in parenthesis

Table 2

Differences in Means of Effort for
Selected Subsets of Students

	Math Effort	Verbal Effort	Cumulative Effort
Male	.0090	.0107	.0050
Female	.0099	.0105	.0060
	(.58)	(-.09)	(-.65)
Age-20 or more	.0073	.0078	.0054
Under 20	.0106	.0121	.0056
	(-2.17)	(-2.48)	(-.08)
Day Class	.0094	.0105	.0057
Night Class	.0089	.0101	.0047
	(.25)	(.17)	(.78)
Working Student	.0075	.0083	.0039
Non-working	.0116	.0132	.0076
	(-2.61)	(-2.62)	(-2.27)
Expected Grade = A	.0121	.0135	.0084
Expected Grade < A	.0081	.0092	.0043
	(2.35)	(2.17)	(1.84)
Final Grade = A	.0132	.0147	.0105
Final Grade < A	.0085	.0096	.0045
	(2.24)	(2.13)	(1.66)
Preattitude Score-High	.0095	.0106	.0095
Preattitude Score-Others	.0088	.0097	.0046
	(.31)	(.38)	(1.08)

Post-attitude Score-High	.0108	.0122	.0056
Post-attitude Score-Others	.0085	.0095	.0045
	(1.33)	(13.2)	(1.31)

"t" values in parenthesis

References

1. Elizabeth Allison, "Self-Paced Instruction: A Review," Journal of Economic Education 7 (Fall 1975), 5-12.

2. George G. Dawson, "Special Report: An Overview of Research in the Teaching of College Economics," Journal of Economic Education 7 (Spring 1976), 111-116.

3. Frank W. Gery "Is There a Ceiling Effect to the Test of Understanding in College Economics," in Arthur L. Welsh, Editor, Research Papers in Economic Education New York: Joint Council on Economic Education, 1972, pp. 35-49.

4. Lewis Karstensson, "A Study on the Validity and Reliability of a Questionnaire on Student Attitude Toward Economics," unpublished research paper, Department of Economic Education, Ohio University, 1972.

5. Allen C. Kelley, "An Experiment with TIPS: A Computer-Aided Instructional System for Undergraduate Education," American Economic Review, 58 (May, 1968) 446-457.

6. Allen G. Kelley, "The Economics of Teaching: The Role of TIPS" in Keith G. Lumsden, Editor, Recent Research in Economic Education, Englewood Cliffs, N.J. Prentice-Hall, 1970, pp. 44-66.

7. Allen C. Kelley, "Individualing Instruction Through the Use of Technology in Higher Education," Journal of Economic Education 4 (Spring 1973), 77-89.

8. Allen C. Kelley and Caroline Swartz, "Student-to-Student Tutoring on Economics," Journal of Economic Education, 8 (Fall 1976), 52-55.

9. Paul H. Kips, Howard M. Wilhelm and Daniel R. Hall, "A Note on the Use of Multiple Regression Analysis in Studies of Achievement in Economics," Journal of Economic Education 7 (Spring 1976), 130-132.

10. Darrell R. Lewis, Donald R. Wentworth and Charles C. Orvis, "Economics in the Junior Colleges: Terminal or Transfer," Journal of Economic Education 4 (Spring 1973), 100-110.

11. Richard B. McKenzie and Robert J. Staaf, An Economic Theory of Learning, Blacksburg, Virginia: University Press, 1974.

12. Richard B. McKenzie and Gordon Tullock, The New World of Economics: Explorations into the Human Experience. Homewood, Illinois: Richard D. Irwin, Inc. 1975.

13. Ansel M. Sharp, Richard H. Leftwhich and Donald L. Bumpass, "An Examination of Trade-Offs in Teaching Economics Principles," Journal of Economic Education 7 (Fall 1975), 56-58.

14. John C. Soper, "Programmed Instruction in Large-Lecture Courses," Journal of Economic Education 4 (Spring 1973) 125-129.

15. John C. Soper and Richard M. Thornton, "Self-Paced Economics Instruction: A Large-Scale Disaggregated Evaluation," Journal of Economic Education 7 (Spring 1976) 81-91.

16. Dale Van Metre, "A Learning Theory of Economics Instructional Development." The Journal of Economic Education 7 (Spring 1976), 95-103.

Figure 1

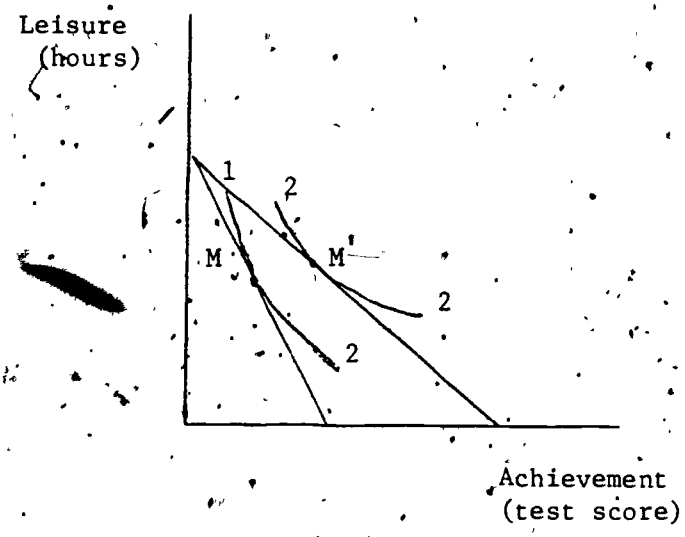

Figure 2