Will Students Ever Learn Economic Principles? Are They Really That ObTUCE?

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ABSTRACT

The Test of Understanding in College Economics (TUCE), created in 1968 and revised in 1981, 1991 and 2007, is widely used to assess students' understanding of economics principles and for research into teaching methods. In this article, we examine the student scores used to "norm" the TUCE post-tests (taken at the end of the course) to assess their understanding of economic principles from 1968 to 2007. Our analysis yields two general conclusions. First, their understanding is extremely low—more than 70 percent of the students who normed the TUCE post-tests would have earned a D or F on these tests. Second, students' understanding has declined substantially—the proportion of students who would have earned a D or F has risen from 78 percent in 1968 to 93 percent in 2007.

Keywords: TUCE, student performance in economics principles, economic education

JEL Categories: A22

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When the American Economic Association was founded in 1898, Richard T. Ely (1886, 15) declared:

> "One aim of our association should be the education of public opinion in regard to economic questions and economic literature. In no other science is there so much quackery and it must be our province to expose it and bring it into merited contempt."

In 2006, 120 years after Ely's declaration, David Colander (2006, vii.) reemphasized this view:

> "Teaching is the most important thing that economists do. It's what we get paid for, and what has the largest long-run impact on society."

Unfortunately, there is considerable doubt that we can actually achieve Ely's goal. More than four decades ago, George Stigler (1970, 80) commented, perhaps facetiously, perhaps not, that "… economics belongs in everyone's education once we have learned how to teach it." Previously (Stigler 1963, 657, 659), he had even been more explicitly critical:

> " … [My] thesis that our present college courses … fail to impart any permanently useful economic training runs against faith, not evidence. I propose the following test: select an adequate sample of seniors (I would prefer men five years out of college), equally divided between those who have never had a course in economics and those who have had a conventional one-year course. Give them an examination on current economic problems, not on textbook problems. I predict they will not differ in their performance.

> … I proposed above a test of whether our present courses had any lasting value. … Let us hope that the test would reveal that our present elementary courses do not have a zero, or negative, value"

In recent years, state and federal education agencies, higher-education accreditation agencies, and prospective employers, among others, have become increasingly skeptical of the educational performance of colleges and universities. As a result, they are demanding—in many cases, mandating—"assurance of learning" assessments in higher education.[ii] What evidence can we cite to demonstrate that we can teach economics principles? How can we respond both to Stigler's assertion and to the ever-increasing demands for assessment of assurance of learning in economics? In this article, we don't respond to Stigler's longer-run thesis on the effectiveness of teaching economics.[iii] Instead we focus on the very short-run effectiveness of economics education. We examine what students knew at the end of their economics principles courses.

Since 1968, the Test of Understanding in College Economics (hereafter TUCE) has been widely used by economics departments and economics faculty to evaluate their economics programs and to examine the effectiveness of alternative approaches to teaching economics principles.[iv] Following its initial version in 1968, the TUCE has been revised three times: 1981, 1991 and 2007.

Its widespread adoption and use results from its three chief components: (1) a carefully developed set of questions that encompass the topics typically covered in college economics principles courses, (2) the availability of pre-tests and post-tests to measure performance gains by students taking these courses, and (3) a norming process that enables faculty to compare their students' performance on the TUCE relative to a national sample of economics principles students from a selected set of colleges and universities.[v] The number of students and institutions

used to establish these norms has grown over time. While TUCE-1 used test results from over 6300 students at 25 U.S. colleges and universities, TUCE-4 used test results from approximately 11,000 students at 70 U.S. colleges and universities.

In this article, we use the post-test norming scores to show how well students understood economics at the end of their principles courses. An examination of these scores from 1968 to 2007 yields two general conclusions. First, student performance in economics principles courses has been, and remains, quite low. Using a common academic grading scale (A: 90% - 100%; B: 80-90%, etc.), the mean scores on the TUCE post-tests were deep in the F range and more than 70 percent of the students would have earned a D or an F on these tests. Second, student performance has declined significantly since 1968. Mean scores have fallen and the proportions of scores in the D or F range have risen substantially. As we show below, Stigler's caveat about our inability to teach economics principles seems to be even more relevant now than it was over 40 years ago.

THE TUCE: AN OVERVIEW

The initial version of the TUCE (TUCE-1) was designed 45 years ago by a select committee of economists for the Joint Council on Economic Education.[vi] The committee's purpose was to devise tests "(1) to evaluate introductory courses in comparison with those in other colleges, and (2) to serve as a research instrument for controlled experiments." (Fels 1968, 5).

> "The Committee recommended that there should be equal numbers of questions in three categories: recognition and understanding; simple application; and complex application. This decision, which puts more emphasis on use of economic principles than is common in American college teaching, accorded with the Committee's desire for a test of understanding." (Fels 1968, 5).

TUCE-1 (1968) consisted of two different 33-question, multiple-choice exams (versions A and B) for macroeconomics principles and a similar pair for microeconomics principles. Each question had four possible answers. These exams could be given at the beginning of the semester (pre-test), at the end of the semester (post-test), or both. Ostensibly, the pre-test results would indicate the students' understanding of economics principles at the start of the course, while the post-test results would show how well they understood these principles at the end of the course. Comparisons of the pre- and post-test results could be used to measure students' gains in economics understanding and, perhaps, to provide some measures of teaching effectiveness. More than 6300 students at 25 colleges and universities provided the nationwide norms for TUCE-1.

In the TUCE-2, released in 1981, the number of multiple-choice questions for the A and B versions of both the macro- and microeconomics tests was reduced to 30 due to an increased emphasis on realistic application questions, many of which contained fairly lengthy quotations. In addition, the authors explained that

> "The definitions of the 'simple application' and 'complex application' categories in the original TUCE proved to be somewhat difficult to interpret and use in practice, so we sought to revise and clarify these definitions *while still keeping the emphasis on encouraging the development of application skills.*
>
> Our new definitions of the three cognitive categories (each of which has an equal weight of 10 questions on each form of the test) are as follows: (RU): Recognizes and Understands Basic Terms, Concepts, and Principles …; (EA) Explicit Application of Basic Terms, Concepts, and Principles …; [and] (IA) Implicit Applications of Basic Terms, Concepts, and Principles …" (Saunders 1981, 3).

About 5000 students at 36 college and universities provided the norming standards for TUCE-2.[vii]

When the TUCE-3 was released in 1991, the A and B versions of the principles tests used in the previous TUCEs were replaced with one test each for both macroeconomics and microeconomics principles. Three additional questions covering international macro- and microeconomics concepts were added, restoring the 33-question format used in TUCE-1 for both the macro- and microeconomics tests. National norming results were reported both for students who took the 33-question tests and for others who took the same tests without the three international economics questions. About 5,450 students at 53 colleges and universities—including, for the first time, five two-year colleges—provided the norming data for TUCE-3.

Finally, when the TUCE-4 was released in 2007, the number of questions, including those covering international economics, was reduced again to thirty for both the macro- and microeconomics versions. The number of students used to norm the TUCE-4 scores increased to nearly 11,000 students at 72 colleges and universities—including nine two-year colleges.

The TUCE content changed with each revision to reflect changes in the specific topics covered in the textbooks and taught in the principles courses. Table 1 shows the content areas of the macro- and microeconomics TUCE tests for its four versions. It provides a concise view of the marginal changes that took place in the topics covered in economics principles courses over four decades. It also shows the common core of economics principles that has remained unchanged.

[INSERT TABLE 1 ABOUT HERE]

THE TUCE POST-TEST SCORES: WHAT DID THE STUDENTS KNOW?

> "An introductory economics course is not successful if half of the class understands the implications of downward sloping demand curves and half the class does not. Such a model of market behavior has an internal logic that every student should grasp and be able to apply …" (Greenwald 1991, 194)

The TUCE post-test norming scores are obtained from tests given late in the semester and, in some cases, included as part of the final exam. Table 2 shows the post-test mean number and proportion of correct answers for the students used to norm the TUCE scores. Results for the 33-question and the 30-question tests are shown separately for the macroeconomics and microeconomics tests.

[INSERT TABLE 2 ABOUT HERE]

Table 3 shows the proportions of the normed TUCE scores that would fall in the D/F and F ranges if grades were assigned using the typical grading scale.

[INSERT TABLE 3 A HERE]

While specifically discussing the TUCE-4, Walstad et al. (2007, 7) have suggested that "The general goal is for the total score on the TUCE … to be a useful measure of students' ability to understand and, even more, apply economic terms, concepts, and principles." If so, examination of the scores shown in Tables 2 and 3 provide discouraging evidence on these students' understanding of, and ability to apply, economics principles at the end of their principles courses. First, student performance has been and remains uniformly low. In Table 2, the mean percent of correct answers ranges from 46 to 58 percent for macroeconomics and from 43 to 58 percent for microeconomics.[viii] In Table 3, the proportions of TUCE scores in the F category range from 47

to 77 percent for macroeconomics and from 52 to 84 percent for microeconomics. Extending the scores to the D/F category, the resulting proportions ranged from 65 to 90 percent for macroeconomics and from 74 to 93 percent for microeconomics.

Second, there is a persistent downward trend in student performance since 1968. Table 2 shows that the mean percent of correct answers for the 33-question TUCE declined from 58 percent in 1968 to 46 percent in 1991 for macroeconomics and from 58 percent to 50 percent for microeconomics. For the 30-question TUCE, the mean percent of correct answers declined from 58 percent to 47 percent for macroeconomics and from 56 percent to 93 percent for microeconomics from 1981 to 2007.[ix]

Concurrent with these declining mean TUCE scores are the rising proportions of scores in the D/F and F ranges from 1968 to 2007 shown in Table 3. The D/F proportions for the 33-question TUCE rose from 78 percent in 1968 to 90 percent in 1991 for macroeconomics, while remaining virtually unchanged at about 80 percent for microeconomics. For the 30-question TUCE, the D/F proportions rose from 65 percent to 86 percent for macroeconomics and from 74 percent to 93 percent for microeconomics from 1981 to 2007. Similar increases occurred in the proportion of scores in the F range. The results shown in Tables 2 and 3 indicate that, in general, student knowledge of economic principles has gone from bad in 1968 to worse by 2007.

THE TUCE POST-TEST SCORES: WHAT DO WE KNOW?

We know that the TUCE macro- and microeconomics scores are low and have declined steadily from 1968 to 2007. If these scores represent a reasonable snapshot of students' general understanding of basic economic principles in 1968, 1981, 1991 and 2007, it is apparent that students have failed generally to achieve this understanding by the end of their principles courses—and this problem is getting worse.

What do these results indicate about our ability to teach economics principles? The answer to this question depends on how we interpret the TUCE approach to assessing student knowledge of these principles. Economists who developed and subsequently amended the TUCE over the past decades and those who have used it have offered two alternative views of what the TUCE represents and how its scores can be interpreted and used.

One view is that the raw scores in the TUCE exams are not appropriate for grading purposes and, presumably, no inferences can be made about individual student learning. For example, Saunders (1991, 7) commented:

> "Compared to classroom tests used by most instructors for grading purposes, the posttest mean scores … are low … It is important to emphasize that the TUCE-3 is designed to be a *norm-referenced* test that can be used to discriminate among students across a broad range of intellectual ability and knowledge. … but in most circumstances it is not appropriate to use unadjusted raw scores on a norm-referenced test for grading purposes."

Referring specifically to the TUCE-3 post-test scores compared to TUCE-1 and TUCE-2 scores, Saunders (1991, v) offered a conjecture (albeit, untested) for this phenomenon:

> "In the norming process, TUCE-3 yielded lower raw scores than earlier editions. This reflects, we believe, the greater variety of student abilities represented in the cross section of colleges and universities included in the norming sample for this edition of the test."

Perhaps his conjecture also explains the continuing decline since 1991.

An alternative view is that TUCE scores can be used to measure student learning performance in economics principles. The Committee (1968, 12) that developed TUCE-1 stated that "Although TUCE was not designed primarily for evaluating achievement of individuals,

economics instructors may wish to use the Test as part of their course examinations." Similarly, Walstad et al. (2007, 3) commented that

> "The main purpose of these content specifications is to ensure that items on the test cover the core content in a 'typical' principles course. If that is done successfully, the total raw score on the exam provides a useful measure of students' general understanding of basic economic principles"

Recently, Balassi (2012, 40) reiterated the same conclusion: "While the TUCE was not designed to evaluate the achievement of individual students, the test can be used in this way."

Regardless of which view is favored, the evidence presented in Tables 2 and 3 demonstrates that there has been a significant and persistent decline in the post-test TUCE scores since 1968. This result is especially puzzling because it has taken place amidst the increasing availability of internet study aids (e.g., YouTube and Khan Academy videos), online learning platforms (e.g., Connect and MyEconLab), efforts by publishers and authors to reduce their books' contents to bare minimum levels (e.g., textbook titles that begin with "Brief" or "Essentials") and a plethora of attempts to find new strategies to teach economics.[x]

Of course, there are numerous potential and complementary explanations for the decline in TUCE scores over this 40-year period. Perhaps, as Saunders suggests, the colleges and universities used to norm the TUCE revisions have been of progressively lower quality (as suggested by the addition of two-year colleges). Perhaps, the efforts by publishers and authors to "shrink" their coverage of economics principles has reduced the students' exposure to the full range of topics covered in the TUCE.[xi] Perhaps the sequential revisions in the TUCE have inadvertently made the tests increasingly more difficult. Or, perhaps, as Stigler hinted, we don't know how to teach economics principles.

SUMMARY

Keynes (1922, v) once described the theory of economics as "… a method rather than a doctrine, an apparatus of the mind, a technique of thinking, which helps its possessor to draw correct conclusions." In this article, we provide evidence that students have considerable difficulty in drawing correct conclusions using basic economics principles and that this problem is getting worse.[xii] While we probably suspected this result from our own teaching experience, analysis of the TUCE scores from 1968 to 2007 provides strong confirmation of the broad extent of the problem. After viewing the decades-long disappointingly low and persistently declining TUCE scores, we might now be prepared to seriously consider Stigler's assertion regarding our inability to teach economics.

Or, perhaps, the prospect of finding better and more effective methods to teach economics principles is simply a chimera. Keynes also once remarked that "Education is the inculcation of the incomprehensible into the indifferent by the incompetent."[xiii] If that applies to economics education and educators, where does that leave us or our students?

NOTES

[i] The authors are Associate Professor, Professor, Emeritus Associate Professor, and Associate Professor of Economics, respectively, at Ball State University, Muncie, IN. Courtenay Stone would like to thank his wife, Sandee, for providing the impetus for this study. After listening to his complaints about low student scores in general, and the low nationwide norming scores on the TUCE-4 in particular, she asked "Are they any different from the scores in the previous versions of TUCE?" And, so, another "Aha!" moment was created. The authors would also like to thank session participants at the 2013 Eastern Economic Association's Annual Conference for their helpful comments on an earlier draft of this article.

[ii] See Belkin (2013) for the latest concerns and efforts in the higher education assurance of learning assessment arena.

[iii] Bach and Saunders (1965, 1966) and Saunders (1980) provided mixed evidence on Stigler's longer-run thesis. Bach and Saunders' studies confirmed his thesis while Saunders concluded that his study "cast some doubts on Stigler's hypothesis…" (p. 12).

[iv] Economics departments may also use the Major Field Test in Economics and/or the Economics portion of the Major Field Test in Business, both given to students just prior to their graduation, for assessment purposes. We do not discuss these tests in this article.

[v] The widespread use of the TUCE is demonstrated by a Google Scholar search for "Test of Understanding in College Economics," which yielded 384 articles since 1967, including 26 articles in the past two years.

[vi] The initial committee included G. L. Bach, William G. Bowen, Rendigs Fels, R. A. Gordon, Paul Samuelson and George Stigler.

[vii] TUCE-2 also included A and B versions of a 30-question combined macro/micro test. We do not consider these tests in this article.

[viii] The median TUCE post-test percent scores range from 43 to 58 percent for macroeconomics and from 43 to 55 percent for microeconomics.

[ix] Two-sample hypotheses tests for the difference in the post-test mean scores strongly reject the equality of the mean scores except for the 30-question macroeconomics tests for 1991 and 2007, for the 33-question macroeconomics 1968 A and B pair and for the 1981 30-question microeconomics A and B pair—the latter two results are not unexpected because each A and B pair represents a different version of the same test. Surprisingly, however, the analysis strongly rejects the equality of means for the 1981 33-question A and B pair. These results are shown in Appendix Table A.2.

[x] For example, the AEA's Committee on Economic Education sponsored a poster session at the 2011 ASSA Meetings "devoted to active learning strategies across the economics curriculum." They asked presenters to "emphasize the originality of their strategy and provide sufficient information so that session participants may apply the technique in their own classrooms." Oddly, they also commented that "we do not require quantifiable evidence …that their strategy enhances learning."

[xi] Examination of textbook adoptions, course syllabi, and course examinations would shed some light on this conjecture.

[xii] At our university (and, perhaps, at others as well), this problem has led to pressure on the Economics department to reduce the D/F/W rate in economics principles classes. We have even received funding for increased tutorial help for our "at risk" students

[xiii] While widely attributed to J.M. Keynes, the source of this quotation remains unknown.

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APPENDIX

Table A1: TUCE Post-test Scores: Sample Statistics

TUCE Version	Sample Statistics	Macro	Micro
33 Questions			
1968 A	Mean	19.22*	19.08
	SD	5.48	4.79
	n	966	1014
B	Mean	19.08*	18.19
	SD	4.90	4.61
	n	958	980
1991	Mean	15.15*	16.67*
	SD	5.40	6.25
	n	1324	1426
30 Questions			
1981 A	Mean	17.35	16.66
	SD	5.62	4.94
	n	1163	1447
B	Mean	15.35	16.50
	SD	5.03	4.78
	n	1108	1364
1991	Mean	14.31*	15.36*
	SD	5.24	5.67
	n	2724	2726
2007	Mean	14.19*	12.77*
	SD	5.29	4.68
	n	2789	3255

Note: The "*" indicates that these students took both the pre- and post-tests. The data are taken from Committee (1968), pp. 17-8; Saunders (1981), p. 21; Saunders (1991), pp. 17, 19, 21 and 23; and Walstad et al. (2007), pp. 11-2.

Table A2. P-values for Tests of Differences in TUCE Post-Test Mean Scores

TUCE Version		Macro			
		33 Questions			
		A	B	1991	
1968	A	1.0000			
	B	.5549	1.0000		
1991		.0000	.0000	1.0000	
		30 Questions			
		A	B	1991	2007
1981	A	1.0000			
	B	.0000	1.0000		
1991		.0000	.0000	1.0000	
2007		.0000	.0000	.3976	1.0000
		Micro			
		33 Questions			
		A	B	1991	
1968	A	1.0000			
	B	0.0000	1.0000		
1991		0.0000	0.0000	1.0000	
		30 Questions			
		A	B	1991	2007
1981	A	1.0000			
	B	0.3834	1.0000		
1991		0.0000	0.0000	1.0000	
2007		0.0000	0.0000	0.0000	1.0000

TABLES

Table 1. TUCE Macro- and Microeconomics Content Coverage: 1968-2007

1968 33 Questions	1981 30 Questions	1991 30 and 33 Questions	2007 30 Questions
Macroeconomics Topics (percent of all questions asked)			
A. Scarcity; Functioning of Economic Systems; Bare Elements of Supply and Demand (18%)	A. Measuring Aggregate Economic Performance (13%)	A. Measuring Aggregate Economic Performance (10% / 9%)	A. Measuring Aggregate Performance (13%)
B. Macroeconomic Accounting (9)	B. Aggregate Supply, Productive Capacity, and Economic Growth (17)	B. Aggregate Supply, Productive Capacity, and Economic Growth 13/12)	B. Aggregate Supply and Demand (25)
C. Determination of GNP (income-expenditure theory) (12)	C. Income and Expenditure Approach to Aggregate Demand and Fiscal Policy (23)	C. Income and Expenditure Approach to Aggregate Demand and Fiscal Policy (25/23)	C. Money and Financial Markets (13)
D. Money, Banking and Monetary Policy (21)	D. Monetary Approach to Aggregate Demand and Monetary Policy (23)	D. Monetary Approach to Aggregate Demand and Monetary Policy (30/27)	D. Monetary and Fiscal Policies (28)
E. Government Fiscal Policies (15)	E. Policy Combinations and Practical Problems of Stabilization Policy (23)	E. Policy Combinations (20/18)	E. Policy Debates and Applications (10)
F. Determinants of Economic Growth (6)		F. International Economics (0/11)	F. International (macro) (10)
G. Policies for Stabilization and Growth (18)			
Microeconomics Topics (percent of all questions asked)			
A. Competitive Markets (including supply and demand, elasticity, and agriculture) (18)	A. The Basic Economic Problem (13)	A. The Basic Economic Problem (13/12)	A. The Basic Economic Problem (7)
B. Theory of the Firm, Markets and Anti-Monopoly Policy (30)	B. Markets and the Price Mechanism (23)	B. Markets and the Price Mechanism (23/21)	B. Markets and Prices 22)
C. Factor Markets and Income Distribution (15)	C. Costs, Revenue, Profit Maximization, and Market Structure (23)	C. Costs, Revenue, Profit Maximization, and Market Structure (22/20)	C. Theories of the Firm (28)
D. Government and the Allocation of Resources (9)	D. Market Failure, Externalities, Government Intervention and Regulation (20)	D. Market Failure, Externalities, Government Intervention and Regulation (22/20)	D. Factor Markets (10)

E. International Economics (18)	E. Income Distribution and Government Redistribution (20)	E. Income Distribution and Government Redistribution (20/18)	E. Micro Role of Government (23)
F. Comparative Economic Systems (9)		F. International Economics (0/9)	F. International (micro) (10)

Table 2. Mean TUCE Post-test Norming Scores

TUCE Version		Post-Test Mean Scores and (Percent of Total Questions)	
		Macro	Micro
33 Questions			
1968	A	19.22* (58.2%)	19.08 (57.8%)
	B	19.08* (57.8%)	18.19 (55.1%)
1991		15.15* (45.9%)	16.67* (50.5%)
30 Questions			
1981	A	17.35 (57.8%)	16.66 (55.5%)
	B	15.35 (51.2%)	16.50 (55.0%)
1991		14.31* (47.7%)	15.36* (51.2%)
2007		14.19* (47.3%)	12.77* (42.6%)

Note: The "*" indicates that these students took both the pre- and post-tests. The data are taken from Committee (1968), pp. 17-8; Saunders (1981), p. 21; Saunders (1991), pp. 17, 19, 21 and 23; and Walstad et al. (2007), pp. 11-2. More comprehensive descriptive statistics are shown in Appendix Table A.1.

Table 3. Proportions of TUCE Scores in the D and F Ranges: 1968 - 2007.

TUCE Version	Maximum Score for D Grade	Percent of Scores at or Below Maximum Score for D Grade	Maximum Score for F Grade	Percent of Scores at or Below Maximum Score for F Grade
Macro				
33 Questions				
1968	23	78%	19	50%
1991	23	90	19	77
30 Questions				
1981 A	20	65%	17	47%
B	20	80	17	62
1991	20	84	17	70
2007	20	86	17	74
Micro				
33 Questions				
1968	23	84%	19	57%
1991	23	81	19	64
30 Questions				
1981 A	20	74%	17	53%
B	20	74	17	52

1991	20	76	17	61
2007	20	93	17	84

Note: The data are taken from Committee (1968), pp. 14-5; Saunders (1981), p. 22-3; Saunders (1991), pp. 17, 19, 21 and 23; and Walstad et al. (2007), pp. 11-2.