True/false test: Enhancing its power through writing

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ABSTRACT

This paper discusses how modifying the true-or-false (T/F) test, by requiring written explanations, reveals major weaknesses and hazards of the simple (unexplained) T/F tests popular among teachers. But, more important, the modification transforms the test into a very efficient formative assessment tool. It opens a window that allows a teacher to track how students think as they analyze questions. Yes, it takes up more time – for the students as well as the teacher. But being able to follow students' thought processes, and identify where things might be going wrong, can be immensely illuminating! For both the students and the teacher. While the examples presented may be specific to economics, the basic ideas and conclusions raised here may apply to other fields of study as well.

Keywords: true/false test, assessment, formative assessment, writing for assessment

BACKGROUND

In his very popular book, *Writing to Learn*, Zinnser (1988) offers this great insight: "Reading, writing, and reasoning – together they add up to learning ... Writing and thinking and learning are one process." It is therefore a true blessing that the writing-across-the-curriculum movement has spread throughout many colleges and universities. With this trend, Zinnser notes, "writing is no longer the sole possession of the English teacher but is an organic part of how every subject is taught."

Petr (1998) in his article, "Student Writing as a Guide to Student Thinking," develops Zinnser's idea further and extends it into the context of using writing to assess student learning. "Writing is a form of thinking," proposes Zinsser, and to which Petr adds, "to write economics requires the ability to think economics" (Petr, 1998, p.229).

This paper offers several specific illustrations of how student writing in a principles of economics class has served as a window that allowed the teacher to see and assess how students think as they analyze true/false questions. But while the examples may be specific to economics, the basic notion of "writing to assess learning" and its implications can apply to other fields of study as well. Teachers, regardless of area, often get surprised and disappointed by test results showing a disparity between the sage insights that were delivered in class and the blundering responses that the students give back in tests. Where, one wonders, have they--or the teacher--failed?

THE QUESTION & THE PROPOSED SOLUTION

Why do students give such mystifyingly wrong answers to simple questions in tests? Student writing could answer precisely that question. Asking students to make their thinking visible through writing opens a way to assess how they process concepts and ideas. "By tracking the errant mind through the thickets of misunderstood concepts, misapplied jargon and faulty relationships, we can locate the misapprehension and retrieve the misdirected thought," observes Petr (1998, p.230). This paper describes a simple and quick writing exercise that allows one to see not only final answers to short questions, but also the paths that students take in arriving at those answers. The latter may actually be the more important of the two.

As the examples are presented, some of the common pitfalls that trap students, or crossroads that confuse them, will be highlighted. These pitfalls and crossroads prevent them from reaching the level of understanding set for them in the study of economics. These examples will hopefully serve as useful markers for other economics professors teaching the principles courses, so that they too may put up warning signposts to guide their students through the quagmire and lead them along the path towards genuine learning. A corollary point that will be made at the end of this paper is that, as a measure of student understanding, those quick and easy-to-grade simple true-or-false tests beloved by some teachers can be really rife with problems. These problems can render the tests highly suspect as a gauge to assess student learning, but they can easily be enhanced by adding a writing component.

A QUICK AND SIMPLE WAY TO USE WRITING TO ASSESS LEARNING

This paper focuses the simple true-or-false (T/F) test, which has been modified by appending a writing part, for use as a diagnostic tool. Walstad (2006) talks about various

common ways of evaluating student understanding, and the different criteria that should guide the choice of test questions. Sometimes, quick-answer types, like T/F and multiple-choice questions, may be preferred due to their ease and objectivity of grading. Indeed, these questions are gradable by machines. But a common rap against these quick tests is that they are vulnerable to cheating or guessing, and that they are limited in their capacity to assess high-order thinking (Walstad 2001). For these reasons, sometimes other types of test questions that involve more writing by students are preferred. Both Walstad (2006) and Petr (1998) provide a detailed list of the common test questions employed in economics classes, including such examples as summary- or critique-writing, op-ed writing, essay tests, and the full-blown annotated case-study analysis .

But the T/F test can be enhanced by making students explain their final answers in writing. This modification transforms the test into a very efficient tool for assessing how students think. Yes, it will eat up more time. But being able to track students' thought processes, and identify where things are going wrong, can be immensely illuminating!

MODIFIED T/F QUESTIONS: EXAMPLES & REFLECTIONS

In the modified T/F test, students are required to explain each of their answers. The results from such tests have starkly revealed what could go wrong with simple (unexplained) true-or-false questions. To illustrate, consider the following cases, along with a reflective assessment of the answers received from students in each case.

a. "The Law of Demand states that if the price of gasoline increases, then the demand for gasoline will decrease (or shift left)."

Response1: "False; it states that if price increases, then the quantity demanded (not demand) will decrease. This is a movement along (not a shift of) the demand curve."
Assessment: This is an excellent answer; the student illustrates a solid grasp not just of the concept of the Law of Demand and the corresponding terminology, but also of the graphical representation of the law as well.

Response 2: "False, the Law of Demand states that if demand decreases, then the price would fall."
Assessment: If this were a simple unexplained T/F question, the "False" response would have been marked correct, and this student would have gone on with a wrong idea of what the Law of Demand is about. The given explanation, however, reveals a need to correct the student. It suggests the need to clarify the distinction between what the Law of Demand is about, versus the effects of a change in demand. Some students still have to clearly learn the notion of causation, or the logic underlying an "if/then" statement. Some students think that this logical relationship is commutative and are therefore careless about reversing it; yet, it is such a big part of economic thinking and analysis. This is an example of what Petr (1998) refers to as "faulty relationships".

Response 3: "False, if the price of gasoline were to rise, then buyers would want to buy more now."
Assessment: This student needs to review the distinction between a price-change now, versus an expected change in price (in the future).

These two responses (2 and 3) illustrate one thing that could go wrong in a simple T/F test – the response could be right, but for the wrong reason.

Response 4: "True, because buyers would buy less gasoline if it becomes more expensive."
Assessment: This is the more typical wrong answer that economics teachers would expect out of this question. Several students in a class giving answers like this would indicate the need to go back and spend more time in class distinguishing between demand and quantity-demanded.

b. "If sellers of gold expect its price to rise soon, then the supply of gold now will decrease and shift to the left."

Response1: "True, sellers will hold on to their gold now, in order to have more to sell later on when the price goes up."
Assessment: This is a good answer, indicating a clear understanding of how sellers might respond to a change in their expectations regarding future price.

Response2: "False, supply decreasing means that it would shift right."
Assessment: While this student apparently understands the behavior of sellers, he/she is wrongly thinking that a falling supply means that the supply curve shifts down and to the right. This hints at a need to go over this important point about the shifts in supply again with this student (or the whole class if several students erred in a similar way).

Response3: "True, rising prices will make buyers want to buy less, therefore supply decreases."
Assessment: In a simple T/F test, the "True" answer would be marked correct, but the given explanation indicates that this student is actually quite clueless. This student is missing two major concepts: the concept of supply (confusing it with buyers) and the idea of expectations or speculation in a market (as opposed to current price-changes).

Now, this last pair of answers (2 and 3) illustrates one serious defect of a simple unexplained T/F test. The first student's mistake is simpler – it's just on the graphical translation of the concept of a change in supply. The second student, on the other hand, does not at all understand the basic concepts of demand and supply. Yet, it would be this second student who would have received the point in the simple T/F test.

c. "If the government grants the auto-makers a huge subsidy or bailout, then the impact of this on the steel industry is that the supply of steel will increase."

Response1: "False, the subsidy to automakers will allow them to <u>buy</u> steel to produce more cars, thus the demand for steel will increase."
Assessment: Great answer. It reflects a clear understanding of the economic connection between steel and autos, and of the distinction between supply and demand.

Response2: "True, because a subsidy increases the supply of the good."
Assessment: This student apparently used rote memory in answering the question, and failed to comprehend that the question requires analyzing the link between two industries. Yes, the auto bailout would increase the supply of autos, but not of steel.

Response3: "True, because the subsidy will allow the automakers to produce more cars, and hence more steel will also be produced."
Assessment: This response indicates that the student is still not quite clear about the distinction between demand and supply, and between supply and quantity supplied or produced.

d. "If Brand X is very successfully advertised, the consumers of Brand X will perceive more value in it, and the demand for it becomes less elastic."

Response1: "True, buyers desire the product more strongly, becoming more loyal to it, and thus would be more willing to pay its price."
Assessment: This answer reflects a solid practical understanding of the concept of elasticity of demand, correctly translating it as a willingness to pay premium prices.

Response2: "False, successful advertising would increase the demand for the product, but its elasticity-value becomes more negative. Therefore the demand becomes more inelastic."
Assessment: This student seems to actually understand the concept of elasticity, but simply fails to discern that "less elastic" is equivalent to "more inelastic". In a simple (unexplained) T/F test, though, this student would not have gotten the point.

e. "If a firm increases its output in the short run, then its average fixed costs (AFC) will stay constant."

Response1: "False; since TFC is constant and AFC=TFC/Q, thus AFC would fall if Q rises. This is also referred to as 'spreading the overhead'."
Assessment: This is a great response, offering two ways of analyzing the question – first an algebraic approach, and second an intuitive approach.

Response2: "True, fixed costs remain fixed no matter what."
Assessment: This student fails to grasp the distinction between "total" and "average", and probably does not yet even understand the true meaning of fixed costs. The concept of fixed costs is one that many students have a "prior misunderstanding" of, making this misconception quite difficult to dislodge. Economics defines fixed costs in terms of the response of those costs to a change in output. Yet many students define fixed in terms of being constant over time, or constant in an absolute sense (such as in the response above).

f. "If the government increases its spending on unemployment-benefits and other subsidies, then it increases the G component of GDP."

Response1: "False, those are examples of transfer payments, not G. Transfer payments enter GDP only when they are in turn spent by either households (C) or firms (I)."
Assessment: This is a good and comprehensive, albeit brief, answer.

Response2: "True, if the government increases its spending, then G increases."
Assessment: This is a typical mistake, illustrating another notion which students often come to an economics class with a "prior misconception" of. Many students think that G stands for government spending, not just government purchases. Alas, it is one misunderstood concept that

is deeply ingrained and hard to correct. But correcting it is necessary, if the student is to be able to attain a good understanding of GDP, including the factors that could change GDP and the implications of those GDP-changes.

g. "A 'recession' refers to a period when the general price level in the economy is rising."

Response1: "False, a recession occurs when real GDP is falling. When the general price level is rising, that's called inflation."
Assessment: This reflects a clear ability to relate and differentiate among the basic concepts of GDP, price level, recession, and inflation.

Response2: "True, a recession might occur when there's a negative aggregate-supply shock, and in this case, the price level would be rising."
Assessment: In a simple T/F test, this response would not have gotten the point. But the written explanation reveals that the student actually does understand, and can differentiate, the concepts of recession and general price level. Where the student fails is in misidentifying the logical essence of the question, which is simply checking whether or not the meaning of "recession" is understood. This illustrates yet a different weakness of the simple unexplained T/F test.

Response3: "False, a recession is when the general price level is falling."
Assessment: This student is simply answering from the rote memory of "something falls during a recession". More work needs to be done, to comprehend the notions of GDP and price level. In a simple T/F test, however, this response would have been marked correct, and such a great opportunity for true learning would have been wasted!

h. "Econland's annual real-GDP growth rate in 2008 is reported to be -2.5%. This means that the GDP in Econland shrank from 2007 to 2008."

Response1: "True, it means that Econland's output in 2008 was 2.5% less than in 2007; i.e., Econland was in recession."
Assessment: This response reflects a solid ability to interpret the numeric data about %-growth rates, as well as an understanding of the concept of "recession".

Response2: "False, it means that the GDP Econland was negative in 2008."
Response3: "False, it means that Econland's GDP grew at a slower rate in 2008."
Assessment: The last two responses (2 and 3) indicate a failure to interpret the meaning of a numeric datum in %-change form. Students often struggle with this concept. The teacher needs to spend some time in class to review both the computation, and the interpretation, of the notion of %-change. Some students can do the math and correctly answer a computation question, but still fail this T/F question here. This suggests that teachers must hone not just the 'rithmetic (computation) skills of students but also their reasoning (interpretation) skills as well. The former is done with math; the latter with writing.

i. "When a nation's budget deficit is becoming smaller, then its national debt would be decreasing also."

Response1: "False, as long as there is a budget deficit, the government will have to borrow additional funds, and therefore the national debt will increase, though maybe at a slower rate than before."
Assessment: This student fully understands the fiscal concepts of debt and deficit.

Response2: "True, when the deficit shrinks, the national debt should shrink as well."
Assessment: This indicates a failure to distinguish between the debt and the deficit, or even perhaps a failure to understand the basic meaning of budget deficit or national debt.

This last response, along with many of the other examples discussed above, illustrates a case of what Petr (1998) in the quotation earlier calls "misapplied jargon". Each field of study, including economics, possesses a set of specialized terminology or jargon that is used in communicating about ideas or issues that pertain to the field. Business majors, for example, have to learn the specialized vocabulary and master the rhetoric of business and economics, in order to later on be able to communicate effectively as professionals. And these skills are best taught by teachers in the School of Business, not in English classes. The development of "such professional discourse skills are educational assets not likely to be achieved in a basic composition course," Petr (1998, p.229) asserts. Writing is one, maybe even the most, important element of professional communication.

The examples presented in this paper all show the immense potential benefits from using student-writing as a way to assess their learning, even by such a simple step as modifying the common T/F test into one that requires explanations in writing.

RESPONDING TO WHAT IS REVEALED

As the examples above illustrate, using writing as a tool to assess students' learning can shine a light on the thought-pathways that students take in answering even the common true-or-false test. And such insight can, in turn, inform the way one teaches various concepts in one's classes. Indeed, what is learned about how students think may provide a major impetus for revamping syllabi from one semester to the next.

Common pitfalls of reasoning are always there to trap some students. Pointing out those pitfalls in the course of discussing the relevant concepts would foster student learning. But some errant students, one finds, would still somehow fall into them in tests. In those instances, the concepts may need to be reviewed either with students individually, or with the whole class when the test is returned to them. More illustrative examples may have to be brought up. An extra tutorial session may even be called for. Pitfalls that trap students in one semester may also need to be noted down as a reminder to one's self for the next time one teaches the concept again.

At times, some students would take surprising turns that lead them astray. Bringing up these unusual misconceptions in class when the test is returned to them (without identifying those who committed the novel mistakes) is a great learning opportunity. And filing these newly-identified pitfalls into a personal "common-pitfalls list", to be pointed out the next time one teaches the course, is a useful teaching resource.

If a mistake is committed by a significant number of students, this might indicate a need to revisit the topic in class and address the misconception and do another short test on the concept to make sure that the idea has indeed gotten across. This might also suggest a need to

re-think the way the topic is taught the next time around. Indeed, it might even point to a need to reconsider the inclusion of the topic in the syllabus.

Then, too, students sometimes take unexpected ways of analyzing a question and reveal an unforeseen perspective on things. These discoveries are delightful experiences when they occur. And they call out to be quickly incorporated in one's own teaching-notes for future use.

In some cases, students' answers may also reveal weaknesses in the way the test questions are written. For example, some questions may be expressed rather loosely, allowing for more than one interpretation. In those instances, students' writing ends up helping one to edit and sharpen the focus of those questions.

HOW DO STUDENTS FEEL ABOUT THE MODIFIED T/F QUESTIONS?

Aside from the concern that adopting the modified T/F test format would take up more time, there's also the worry that students might rebel against it. Yes, some students might whine about it at first, but in the end, most of them actually appreciate the huge benefits from it.

Using a three-option feedback system suggested by Brill (2007), an end-of-term survey was conducted on a class of 28 students in Fall 2009 that asked them to evaluate different teaching tools that have been used in their Principles of Macroeconomics class. The students were asked to give a rating for each tool in a short list, with their rating-choices narrowed down to three: "keep it as is", "keep, but modify, it", and "toss it". They were also required to explain in detail the reasoning behind each rating that they give. One item included in that list is the modified T/F tests.

Of the 28 students, only 2 rated the modified T/F test a "toss it". Their reasons: "it can be very confusing" and "it is hard enough for us to figure if it is true or false, much less explain it". Five students rated it a "keep, but modify". Their common suggested modification: to not have to explain the true statements, because, as one of them said, "having to explain our answers take up too much time, and so if we already knew that it was true I feel that maybe it didn't need an explanation."

But a clear majority, 21 students, rated the test a "keep" and some of their explanations are quoted below.

They confirmed the huge benefits that they derived from the test. "The modified T/F eliminates guessing on the question as you have to explain the answer. For you the professor, it shows which students truly understand the material, and for me the student it forces me to truly learn the material", wrote one. Another one concurred: "It is beneficial to the students if we can back up why we say what we say, instead of just guessing true or false". Yet another one said, "These are unique because they force me to explain why I came to my conclusion, so basically they force me to know the material well."

Other comments reflected the initial anxiety that the modified T/F test might cause. "Keep it, although they can be intimidating and seem tedious, answering those questions really tests whether or not I completely understand the concept," said one student. Another one wrote, "At first I was strongly for modifying this but when I thought about it, being able to identify a T/F statement and correct or prove it shows that you fully understand the material. So keep it as is." A third one wrote, "The true-false is one thing, but explaining why makes it difficult and challenging. This is not a bad thing."

A couple of students appreciated the fact that being required to write down their logic actually helps them from a grading point-of-view. "I like them because they give me an

opportunity to give a reason why I answered the question the way I did," wrote one. "Keep it. I like that we can receive at least partial credit for explaining ourselves," wrote the other.

One perceptive student came up with this comment: "I am sure that some of my classmates were able to devise some sort of way to criticize these questions, but while they are difficult, these questions really do ensure that we have a solid understanding of the material. Keep those modified T/F questions."

A better concluding statement for this paper than that would be hard to conjure up.

CONCLUSIONS AND RECOMMENDATIONS

Some teachers, in the pursuit of time-saving and ease-of-grading in tests, will at times prefer the simple true-or-false questions. They are easy to write, quick to administer, and convenient to grade. Then when students get poor scores in these tests despite very careful prior dispensation of wisdom and insights in class, one wonders, "where did things go wrong?" And when they do score high in those tests, one feels gratified that students are getting it. But … are they?

This paper proposes that one way to get an answer to both these questions is to use student writing, in order to assess their learning. The proposed tool: a modified true-false test, requiring students to add written explanations for their true or false answers. This boosts the power of the simple T/F test as a gauge of student learning.

The sample cases presented in this paper illustrate several major weaknesses of the traditional (unexplained) T/F test. Students can give wrong answers, but for different reasons. Yet, teachers will have no way of discerning this in a simple T/F test. Or students could give wrong final answers, even though the understanding of concepts is mostly there. It may just be a simple misreading of a word (say, increase instead of decrease) or a misplaced focus that led them astray. But the worst weakness of the traditional T/F test shows up, this study reveals, when the student gets an answer correctly even though he/she arrived at that answer using faulty reasoning. This is even worse than if the student arrived at that answer out of a completely blind guess. This causes harm to the student's learning progress, because he/she will get the impression that nothing is wrong with the reasoning, if it led to the correct final answer. In such cases, a traditional T/F test wastes a tremendous learning opportunity.

But with a simple twist or modification – requiring students to write down their reasoning -- the T/F test can be charged up to allow teachers to track students' thinking. True, more time would be taken up. But this paper contends, and many students were found to concur, that the benefits derived from this simple enhancement are well worth doing it.

This simple modification can in fact be applied to other short tests. One can set up a modified multiple-choice test, requiring students to explain in writing why one choice is correct while the others are not. One can give annotated short-answer questions or context-rich questions, requiring students to write down the logic that they used in arriving at their answers.

The point here is that, using even a simple writing exercise as described in this paper, teachers can get a window into how students think and learn. Through such writing, one is able to feel, like Petr (1998), the exhilaration of seeing how students arrive at their answers in tests, locating where precisely the failures of understanding might occur, thereby getting the opportunity to correct those misunderstandings.

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