Teaching Sociology, October, 1996

*Will that be on the exam? Schema theory and Testing in Sociology**

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> *The popular image ... is that a student whose primary object is a grade devotes himself ... to memorizing small, and comparatively unimportant, points in a course, and thereby makes a better showing than a classmate with ... a larger real command of the subject" (A. Lawrence Lowell in Frederiksen, 1984, p 193).*

Lowell, writing in the *Atlantic Monthly* in 1926, is describing the student who asks, "Will that be on the exam?" It's an upsetting question for most of us. It's even become a sort of joke among teachers—a shorthand for expressing frustration with students who work for grades rather than knowledge, or enjoyment, or wisdom. But why should the question bother us? Perhaps because we painfully recognize the disparity between our grading/testing and what we would like our students to learn.

If it's worthwhile, why *isn't* it on the exam?" My frustrated laughter with colleagues about the student's question is often a defensive laughter — the real butt of the joke is me, the teacher, not the student. Examinations are often defective in content; it is much easier to include what is easiest to test rather than what is most important. Even more troublesome, it is far too easy, and far too common, for us to teach what we can most easily test — not what we believe is most important for students to know and understand (Hilton, 1993). Indeed, when we don't test what we believe is most important, we teach that it is unimportant. "It won't be on the test" tells the student — *both* the poor, credential-motivated student *and* the excellent, self-motivated student — "that's not important" (Frederiksen, 1984; Gitomer, 1993; Wolf, 1993).

Terence Crooks' (1988) extensive review of hundreds of research studies on the impact of classroom evaluation on learning unequivocally demonstrates its powerful effects. He concludes that classroom evaluation is "one of the most potent forces influencing education" (447) Yet, he continues, it receives less attention than any other aspect of teaching. "Its power to affect students is not widely perceived or discussed" (447; see also Milton, 1982).

In his 1926 essay quoted at the beginning of this article, Lowell goes on to say,

> ... if all examinations were conducted as to be an accurate and complete measure of the education the course is intended to give, ... then there would

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* An earlier version of this paper was presented at the Annual Meetings of the Eastern Sociological Society, Philadelphia, PA, April 2, 1995.

> be no reason why the student should not work for marks, and good reason why he should. To chide a tennis player for training himself with a view to winning a match, instead of acquiring skill in the game, would be absurd because the two things are the same. ... if marks are not an adequate measure of what the course is intended to impart, then the examination is defective. (in Frederiksen, 1984, p 193).

As with the tennis player, it seems absurd for us to be blaming students for having the "wrong" motivations or to denigrate testing and assessment as somehow separated from our course. Indeed, to do so is to take ourselves off the pedagogical hook. This tendency reminds me of Michael Katz's (1977:111) comments about the early days of mass education:

Newly created systems of public education failed to meet the ends for which they had been established, and some explanation became necessary. The same problem faced the managers of newly created reform schools, prisons, and mental hospitals. In each case, including that of public education, they created a defense in terms of the inferiority of their inmates. ... [G]iven the inferior stock with which they had to content, what could one expect?

Speaking directly to sociologists, McGee, Vaughan, and Baker (1985:22) suggest that "if we started treating [our students] with some respect, as if they were competent human beings, we might be surprised at how frequently they would live up to our expectations." Despite its obvious importance, testing has received almost no attention in sociology. Although there are good and useful articles on "alternative" methods of evaluation (e.g. see materials in Turk, 1982 and numerous Teaching Notes in this journal), there is essentially nothing on the "normal" test—how to write it, how to think about it, how to administer it, etc.—except for a single chapter in Goldsmid and Wilson (1980).

The practical reality is that most teachers of introductory sociology give traditional in-class examinations (perhaps supplemented by other assessments). Publishers know this and provide a test bank of forced choice questions, generally written by testing novices just like you and me, so we can easily generate our tests. Generally, these ready-made test questions are perfect for Lowell's grade grubber, "memorizing small, and relatively unimportant, points." "The lowest level of learning, recognition, is the level tested most often" (Milton, 1982:53; Browne and Litwin, 1982:388; Jacobs and Chase, 1993:52).

I do not propose to debate the relative merits of various modes or formats of assessment— multiple-choice and other closed choice variants versus constructed (or

"free" or "open") response items ranging from filling in blanks to performance, "authentic," and portfolio assessments (Bennett, 1993). I suspect all these may have a role in introductory sociology. I also suspect that most of us are stuck, at least for now and for a variety of reasons including large classes, with using traditional examinations for a large chunk (almost half in my course) of our student assessment in introductory sociology. However, there is a large and changing literature on educational testing, cognitive theory, educational objectives, and the links between education and testing, which can inform and enrich our examinations.

The Dilemma of Objectives

The first admonition of most discussions of testing and evaluation is that they need to be shaped by one's goals and objectives (e.g. Grundlund, 1988; Vaughan, 1980; Jacobs and Chase, 1992). Discussions of goals and objectives have ranged from broad examinations, such as Perry's (1970) model of development of college students in general, to quite focused examinations of concrete objectives for introductory sociology, such as Mayer (1986), Vaughan and Peterson (1975), Vaughan (1980). Baker (1981) and Browne and Litwin (1987) discuss critical thinking as an objective in sociology. In a broader vein, Roberts (1986) discusses and applies Perry's model to teaching sociology and Stauffer (1980) examines the role of sociology in a liberal education. It is beyond the scope of this paper to examine the various goals and objectives identified in these, and other, works.

Despite their different approaches, however, all of these authors emphasize the importance of clear and explicit objectives to guide teachers in their teaching—including their testing. For example, Logan (1976) found that, contrary to popular wisdom in the field, sociology courses do not enhance critical thinking skills except when they are carefully and explicitly focused on these goals. In discussing Logan's findings, Baker (1981:343-44) quotes Glaser to emphasize the same point:

> In general the research indicates that if the objective is to develop in pupils an attitude of "reasonableness" and regard for the weight of evidence and to develop ability to think critically about controversial problems, then the component attitudes and abilities involved in thinking critically about such problems must be set up as definite goals of instruction.

Similarly, Browne and Litwin (1987:385) conclude that unless attention to explicit goals and objectives, of critical thinking in this case, "is systematic and intentional, results are dubious."

The most widely used framework (see, for instance, Vaughan, 1980; Lovell-Troy, 1989; Jacobs and Chase, 1992; and Vaughan and Peterson, 1975; Angelo and Cross,

1993; Arter and Salmon, 1989; Wagenaar, *et al*, 1982) for discussing cognitive goals and objectives is a taxonomy developed in 1956 by Benjamin Bloom and others of the cognitive domain— "the cognitive area of remembering, thinking and problem solving" (1956:2). The levels identified are familiar to most educators: knowledge, comprehension, application, analysis, synthesis, and evaluation.

The most critical, and most used, distinction in the Bloom taxonomy is between knowledge—items simply memorized and recalled by rote—and the higher levels, sometimes referred to as "higher-order thinking skills." Beyond that, however, as Crooks (1988:441) points out, "many researchers and educators have found Bloom's six level taxonomy hard to apply in practice." Even categorizing the level of a specific examination question can be complex since it depends on the concrete context (e.g. what has been covered in class or in readings) and the student's expertise.

Most of the attempts to define global objectives and developmental schemes fall prey to this problem. They give us some valuable insights but have such a high level of abstraction that it is difficult to effectively link them to practical questions. A commitment to "overcome simple dualism" (see Perry, 1970; Roberts, 1986) or even to "encourage high-order thinking skills" leaves most of our pedagogical questions unanswered. These sorts of global objectives increase our overall awareness but they rarely answer questions such as "What do I teach today?" "How should I conduct my class today?" and "What should be on the examination?" These vague objectives make it too easy for us to "talk a good line but ... come up short at delivery time" (Baker, 1982:359).

The tendency to define global and highly abstracted teaching objectives has had an even more serious and destructive effect: creating a false dichotomy between skills and content. With the emphasis on higher order thinking skills, there is a troublesome tendency to discuss course objectives which are fairly content independent. For example, Angelo and Cross' (1993) "Teaching Goals Inventory" has a section labeled "Discipline-Specific Knowledge and Skills" and a separate and disconnected section labeled "Higher-Order Thinking Skills." This leads to debates between a "skills focused curriculum" and a "knowledge focused curriculum." I recently spent an evening listening to high school and college teachers diverted with the issue of skill development at the expense of substantive knowledge or substantive knowledge at the expense of skill development.

This is a false dichotomy. It is true that modern cognitive theory has attacked the traditional "view of learning as a passive, receptive process through which facts and skills are added to a learner's repertoire in much the same way as bricks might progressively be added to a wall" (Masters and Mislevy, 1993:220). This means,

among other things, that courses defined exclusively around the name, rank, and serial numbers of the three major dead white males in sociology must be questioned. It does not, however, mean that we shouldn't be able to tell the difference between an introductory course in sociology and one in psychology—there is still a content difference! Schema theory provides us with the conceptual tools to understand this interplay between skills development and content.

Schema Theory

Modern cognitive theory forges a connection between content and form, between information and architecture, neatly summarized in the notion of "schema." A schema is an organization of information—a network of information—which links "content" as we traditionally think of it ("facts") with concepts, principles, examples, strategies, and protocols (Marshall, 1993; Mislevy, 1993b). A schema is a "mental structure that relates facts and skills" (Mislevy, 1993b:27). In this view, content and skills cannot be separated since knowledge **is** schema, **is** both content and skill.[1]

To some extent, schema can be understood as maps or templates for activity. Sandra Marshall (1993:156) notes that the value of schema "lies primarily in problem solving. When the individual accesses the schema, it provides a template against which to evaluate a current problem and points to an appropriate response." For example, she continues, think of finding your way through a variety of tasks in a strange airport. You draw on your "previous knowledge" but this is not just (or even mostly) *facts*, it is *relationships*, concepts, and strategies which suggest, for instance, how to recognize various features, how to find information, etc. You don't know anything about the specific ariport, but you know how airports work—how they are structured—and this gives you a framework for proceeding.

Caroll (1993: 270) likens schema to plays which are a framework for activities. "The schema or idea of buying something, for example, can be thought of as carrying out a little play that involves a buyer, a seller, some merchandise, and a medium of exchange (money, or even clam shells)." Again, although you know little about the specific venue, the specific facts, you know a lot about how exchanges work, the relationships.

From these examples, it is clear that everyone has schema. Our students come to us with information, strategies, and organization (Masters and Mislevy, 1993:221). The

[1] Schema theorists can also fall into the form versus content trap. Marshall (1993:156) notes a split between the "architectural" perspective and the "information" perspective on schema. My understanding relies heavily on her compelling argument that "one needs to use both perspectives" and her excellent discussion of how to do so.

difference between the novice and the expert, in this view, is not merely a difference in knowledge, although this is usually a major element. The difference is in the size and complexity of the interconnections—the architecture—the network and "network of networks" (Marshall, 1993:158). Robert Mislevy (1993b:27) puts it:

> Interconnections overcome limitations of short-term memory; while the novice may work with seven distinct elements, the expert works with seven constellations that embody relationships among many elements ("chunking"). Moreover, experts organize their knowledge in schemas possessing not simply more connections, but qualitatively different ones.

Problem solving is often a matter of trying out different schema. The broader the array of schema, and the richer the connections among them, the deeper and more sophisticated the search and the solution. This is another difference between the novice and the expert. The "ability to select the right schema—at least eventually—is a salient characteristic of the expert problem solver" (Marshall, 1993:157).

Learning, in this view, is not just another brick on the pile, or even a "chunk" of information itself. Rather it is the process of integrating this new "chunk" of information into a reorganized schema. This is a key insight, I think. We do not really learn bit-by-bit. As I struggle reading the literature on schema, I struggle to relate the bits and pieces, figuring out connections here and there but still not really comprehending what's going on. Finally, slowly, it begins to "make sense"—the pieces and concepts and examples come together and "I see what they're getting at." Then that almost tentative sense of comprehension solidifies as I review back, now seeing how the bits and pieces fit (and don't fit). In other words, I really learn it in a chunk—or series of chunks.

This means that real learning necessarily modifies the structures themselves—the connections themselves. Mislevy (1993:30) discusses this as "tectonic plate theory" because there are "discontinuous patterns of change." Isolated and unintegrated tidbits are not learned—even though they may be crammed into short-term memory for a while.

More concrete objectives and assessment

Another implication of these ideas about knowledge and learning is that our objectives need to be formulated more inductively. The key question is "What does mastery *mean* in a particular domain?" More concretely, "what would be expected of a student who has mastery of the domain?" (Marshall, 1993:159; Snow and Lohman, 1993:9) Note that this is an active query; it does not ask what the student *knows*, it asks that the student can be expected to *do*. The argument is that in defining what

the student can *do*, we can then define what is/are the primary schema in the domain and figure out both how to help students learn them and how to assess this learning.

> "[A]cquiring and retaining a network of concepts and principles about some domain that accurately represents key phenomena and their interrelationships and that can be engaged flexibly when pertinent to **accomplish** diverse, sometimes novel **objectives**, is a reasonable definition of understanding that domain." (Fetovich, Spiro, and Coulson, 1993:181, emph. added)

This abstract language refers to rather concrete questions. I struggle with the concepts, principles, and examples of schema theory. When I say "ah-ha," when I say "I see what they're getting at," I mean that I am beginning to be able to *use* it. I begin to generate mental examples and try out the ideas. I mentally try them out on problems, issues, and experiences to see how they fit and what insight they give me. I reflect, as I am now, on my own learning processes in relation to this new set of insights. The content and the higher order skills are inseparable.

The concrete question, then, is "what do we want students to be able to do with a particular problem?" Figure One presents a particular problem. With a brief narrative introduction, it shows a simple cross-tabulation of educational attainment of parents and the educational level of their children—respondents to the 1993 General Social Survey in this case. The concrete question—the objective-setting question—is what do we want our students in Introduction to Sociology to be able to *do* with this table?

Figure 1:

The General Social Survey (GSS) is a national sample of adults in the United States conducted each year by the National Opinion Research Center at the University of Chicago. A sociologist used the GSS to create a simplified cross-tabulation of the educational attainment of survey respondents and the educational attainment of their fathers. This is what she found:

	Father's Highest Degree		
Respondent's (child's) Highest Degree	Less than High School	High School Only	College or More
Less than High School	28%	6%	4%
High School Only	60%	67%	38%
College or More	12%	27%	58%
	100%	100%	100%

We want them to be able to read the table. This involves a whole cluster of skills (a table-reading schema?) including understanding what we mean by "cross-tabulation" and a rudimentary sense of how we allocate cases to cells. We want a student to understand what a percentage means and how the table is percentaged. We want the student to be able to state the relationship in words. We want students to be able to correctly evaluate the following statements:

1. The number 28% in the table means that 28 out of 100 respondents whose fathers did not complete high school also did not complete high school.[2]
2. The number 12% in the table means that 12 out of 100 respondents who completed college or more had fathers who did not complete high school.
3. According to the table, there is no relationship between father's education and child's income.
4. The table shows that the higher the father's education, the higher the child's education is likely to be.

[2] The problem framed in this section and many of the items or statements appear in the test bank for the Fifth and Sixth editions of Stark, *Sociology* (©1994, 1995, Wadsworth, Inc.) by the author.

5. This shows that the higher your parents' education the lower yours is likely to be.

We could, of course, phrase these in lots of ways. They are framed as simple true-false statements.[3] The first and fourth are true and numbers 2, 3 and 5 are false. These could be the basis of short-answer questions. These could also become the stems and correct choices of multiple choice questions. For example:

The number 28% in the table means that

a) 28 out of 1000 respondents whose fathers did not complete high school also did not complete high school.

b) 28 out of 100 respondents whose fathers did not complete high school also did not complete high school.

c) 28 out of 100 respondents who did not complete high school had fathers who also did not complete high school.

d) none of these

The important point is that we actually developed these questions out of an objectives statement about what we wanted students to be able to do. The problem (which I am presuming is a new set of information for the student) is the table and we are beginning to ask students to solve the problem. Note also that there is no tension between skills and content here—we are actually presenting the student with new information. We are beginning to ask how well s/he can use existing schema knowledge to cope with, integrate, understand, and use the new knowledge.

We are also teaching at the same time we are testing. The examination becomes a learning experience for the student, not just in terms of "content" but as a way of modeling a part of the sociological enterprise. Nor is the examination disconnected from the rest of the course; it may well become the *basis* for further discussion and exploration.[4]

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[3] The statements presented below are generally in the form of true-false questions. On an actual examination, these could be used in a series. This format, called "multiple true-false" is an accepted and reliable form of testing (Jacobs and Chase, 1992:93) that is particularly useful to examining multiple elements of knowledge and reasoning (Kolstod, Wagner, Kolstod, and Miller, 1983).

[4] This also suggests that the most effective way to teach students is through practice—an active learning approach such as that discussed by Sernau, 1995.

We probably also want the student to be able to **link their methodological knowledge to the table** and evaluate statements such as the following:

6. This table demonstrates that father's educational level causes child's educational level.
7. In this research, "educational level" is a concept.
8. In this research, "father" is not a concept because it refers to a specific person.
9. The unit of analysis in this research is individuals.
10. This is an example of an experiment.
11. In this research, respondent's educational level is the dependent variable.
12. Inferring cause in this research would not confront a significant time-order problem.

This set of questions asks students to *link* their table-reading with a variety of other schema. They are asked about causal inference but not in terms of abstract definitions; they are asked to link that knowledge to a concrete problem. Similarly, they are asked to apply their research design understanding in a similar way. We are now asking about not only particular clusters of knowledge and skill, but the linkages among those clusters or networks.

As experts, we are probably anxious to get to what *we* think of as substantive "analysis." Before we do, however, it is important to note that the tasks elicited in the previous series of questions are analytic. Indeed, their simplicity is deceptive; some of them actually ask for quite high level evaluative skills—bringing elements together and making judgments about the relationships.

This set of questions also models an important element of these new ways of conceptualizing learning: the importance of process and, thus, the importance of examining intermediate solutions. Examining intermediate solutions allows us to understand (and value) not just the answer but the steps towards that answer. It also allows us to fairly directly observe, and hence evaluate and improve, the schema linkages which we are trying to foster and assess (Feltovich, Spiro, and Coulson, 1993; Lohman and Ippel, 1993; Mislevy, 1993b).

Returning to the table and the student problem, we probably want the student to be able to **link their knowledge of stratification to the table**. First, at the level of naming or recognizing the relationship between these data and various concepts, models, and comparative relationships, we might ask:

13. We would expect to find less of a relationship in an agrarian society.

14. This suggests that education, at least in part, is an ascriptive status.
15. In a society in which status were primarily ascriptive we would expect less of a relationship than this.
16. This suggests that status in American society is a wholly achieved status.
17. This finding suggests that we would find a relationship between father's and son's occupational prestige.
18. This table is a good indication of mobility in American society.
19. This table suggests a high rate of exchange mobility in American society.
20. This table tends to support structured inequality as a reasonable description of stratification in the United States.
21. This table tends to support cultural, rather than social, theories of assimilation and mobility.

These are enough examples to convey the range of possible linkages between this concrete task and concepts, etc. in stratification. Many teachers will want to use these sorts of simple statements as the basis for writing short essay questions. Another option is to add a second element to a true-false question:

T F We would expect to find less of a relationship in an agrarian society.

Briefly explain your answer:

We may want to go even further in what we want students to be able to do with the problem. It presents an opportunity to ask about some of the implications of the table, both in terms of its possible causes and its effects. For example:

22. These findings seem inconsistent with what Kohn found in his investigations of differential socialization.
23. Barbara Heyns' work on summer learning might help us understand these findings.
24. This illustrates one of the primary ways in which status attainment is related to family background
25. This research illustrates the long term effects of discrimination.
26. Assuming that educational status is an indicator of class position, this table suggests that the gap between rich and poor is narrowing in our society.

Once again, these questions may be formatted in a variety of ways. Consider the following examples of essay questions formulated out of the same process:

- Identify one possible cause of the relationship found in this table. Explain it.
- Identify one possible effect of the relationship found in the table. Explain it.
- Explain the concept of role. Explain how the concept of role can help us understand the relationship found in the table.
- Explain the concept of differential socialization. Explain how the concept of differential socialization can help us understand the relationship found in the table.

These are more than enough examples to illustrate the point: we can ask the student to mobilize a broad array of concepts, principles, information, and analytic skills in a rather straightforward way. At the same time, the point is that the process of asking ourselves the concrete question, "What do we want students to be able to do with this problem?" creates an opportunity for us to clarify our educational objectives in a way that can enrich both our teaching and our testing.

Conclusion

New developments in cognitive theory can help us to move away from a simple, linear, additive understanding of learning as well as provide us with models which help us to avoid the false dichotomies of content and skills. The idea of learning as building and rebuilding schema, and forging increasingly rich and complex relationships among schema, also gives us insight into how to develop as more concrete and practical understanding of educational objectives by asking a concrete question: "What do I want students to be able to do with this problem?" This question, implied (and even demanded) by schema theory, also gives us concrete guidance in how to develop assessment instruments which correspond to our objectives.

Taken seriously, schema theory and the approach taken here suggest a continuity between teaching and assessment which more directly *incorporates* testing into the learning enterprise. It also provides us with a theoretical rationale and framework for emphasizing active learning approaches in our classrooms in which students practice *doing* sociology, *using* the concepts, and *trying out* strategies for making sense of their social world.

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