11. COURSE DEVELOPMENT TOOLS AND APPLICATIONS

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A ToolBook computer program to develop course objectives and assessment measures

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College courses are generally developed because of current fashion in the field and/or student and faculty interest in some topic without reference to departmental or programmatic goals. Current calls and needs for accountability in higher education demand a more organized approach. A computer program, ToolBook 1.53, which provides information to the instructor about systematic development of courses and assessment of student outcomes, is described. The program supports the construction of outcome-oriented learning objectives and corresponding assessment techniques. Instructors who used this program to learn about how to construct such objectives showed an increase in knowledge and evaluated the program positively. Using the information provided in this program leads to an integrated approach to course design and development in which course objectives are linked to the college mission statement through departmental or program objectives.

In 1986, the General Assembly of the Commonwealth of Virginia passed a bill requiring all postsecondary educational institutions to submit a comprehensive plan to measure student learning outcomes. Two years before, the Southern Association of Colleges and Schools assumed a leadership role among accreditation associations by implementing its "institutional effectiveness" criterion, requiring all accredited institutions to provide evidence that faculty and administrators have developed a clear, concise mission statement, formulated educational objectives consistent with the mission for all departmental programs, evaluated attainment of those objectives through outcomes measures, and used those results as feedback to improve the educational value of their programs (Southern Association of Colleges and Schools, 1984).

Because of these outside mandates, Hampton University set about to develop a model of program development and assessment that would provide the greatest possible benefits to the classroom instructor so that some of the faculty

resistance to assessment of student learning outcomes could be eliminated and faculty would be rewarded for their participation. The greatest possible impact on student learning variables can be accomplished through the improvement of individual learning experiences that become the fabric of the students' education. Improvement interventions and curriculum alignment on the level where "the rubber meets the road," or the actual learning takes place, assures a match between course and departmental objectives, program objectives, and the institutional mission statement, significantly increasing curriculum coherence. This approach to program and course structure results in clear, continuous relationships between the outcome competencies implicit or explicit in the institutional mission, program objectives, and any given instructor-designed learning experience. Ideally conceived, any college curriculum should be the result of an organic, holistic process that begins with the institutional mission and eventuates in the specific objectives of the courses that constitute the program. This creation process must be characterized by maximum possible faculty involvement at every level and in every aspect. Clearly, a sense of ownership and commitment on the part of faculty is vital to the success of

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Figure 1. The tree model of the common frame of reference from institutional mission statements to learning assignments.

any effort to make the curriculum more coherent and the educational enterprise more effective. Figure 1 graphically depicts a properly balanced curriculum as it grows out of the institutional mission through the major limbs of schools or colleges, the secondary limbs of departments, and the tertiary branches of courses, to the leaves of specific learning experiences where, for better or worse, education actually takes place.

Although the literature does acknowledge the need for program objectives to reflect institutional goals (Adelman, 1986; Astin, 1985; Boyer, 1987; Nichols, 1991), it offers no models as to how this relationship should be structured (Stark & Lowther, 1986; Stark, Lowther, Sassen, & Shaw, 1990), let alone how instructors can actually develop objectives for their courses, units within courses and specific learning activities that derive directly from departmental or program objectives and ultimately from the institutional mission. Most curricula in higher education have been developed in an incoherent manner (Coleman, 1991). Departments institute courses for any number of reasons that include current fashion, student requests, arrival of an instructor with recognized expertise in a given subject area, or even desire on the part of an instructor to explore a subject of interest to him or her. The negative impact of lack of coherence that arises at these levels can scarcely be exaggerated.

Until now, there has emerged no clear method for effective, comprehensive assessment of different levels of a program or curriculum in relation to one another or for attainment of departmental objectives in relation to objectives for courses within the department or units in a

particular course. The basic feature of our model (Petty, 1992) starts with the development of a matrix for each course in a particular department or program. As illustrated in Figure 2, departmental/program objectives are placed vertically on the left side of a page or transparency. These objectives derive from rigorous analysis of the specific role that the department or program in question should play in achieving the institutional mission. After having been defined by an analogous process, the course objectives are then put across the top of the page. In the cells formed by the intersection of departmental/program objectives and course objectives, checks indicate where course objectives contribute to the attainment of departmental/program ones. Once such a matrix has been completed for every course in the department or program, it is possible to determine the extent to which department or program objectives are being addressed by individual courses. Likewise, courses constituting different levels (such as those at the 200 level as distinct from those at the 300 level) or sequences can be examined for similar purposes. Putting these matrices on transparencies and superimposing them on one another provide a kind of X-ray of the entire curriculum or of any given set of courses that need to be viewed in relation to one another. The second matrix in Figure 2 represents the next level. Course objectives are listed on the left side and unit or chapter objectives across the top right. A check mark is then put in each cell where a unit/chapter objective furthers a course objective. In practice, most courses require from 6 to 12 of these second-level matrices, which, among their other purposes, help to ensure that all course objectives are appropriately addressed. Finally, the third matrix in Figure 2 has unit/chapter objectives on the left side and the objectives for each learning activity at the top. Again, a check is placed in each cell shared by a unit/chapter objective and a learning activity designed to achieve it. Most courses require 25 to 36 third-level matrices—that is, as many matrices as there are lectures, discussions, out-of-class projects, and other learning experiences required to complete the course. Planning for course and program evaluation should be closely coordinated with development of the courses and programs themselves. To do otherwise is the equivalent of going to sea without adequate means of navigation. After matrices with outcome-oriented objectives have been generated, appropriate assessment measures can then be developed to determine the extent to which these objectives have been achieved. Analysis of outcome-oriented, behaviorally defined course objectives and related content normally suggests a variety of methods to provide data necessary to determine student achievement in any one of the three behavioral domains: cognitive, affective, and psychomotor (Bloom, 1956). Actual choices are best made with a view to how particular assessment vehicles relate to desired outcomes. For example, some objectives can be tested efficiently by means of a multiple-choice format, whereas others require performance measures such as oral presentations, essays, portfolios, or other demonstrations of competency. The matrix system described here represents

CURRICULUM MATRIX: DEPARTMENT OBJECTIVES BY COURSE OBJECTIVES PSYCHOLOGY PSY208: METHODS I	PSY208: Course Objectives						
	1. Analyse how psychologists formulate and test theories of behavior.	2. Assess the effects of individual perception or experimenter bias on research findings.	3. Explain the basic components of an experiment (eg. hypotheses, variables, control)	4. Conduct three studies according to good scientific practice.	5. Describe the role of statistics in psychology research.	6. Use APA style of research report writing to report their results.	7. Explain the role of ethics in the conduct of psychology research.
Department Objectives							
1. Relate major historic and current theories of human and animal behavior and their major confirmatory research studies which are basic to the systematic body of knowledge accepted as the science of psychology.	✓	✓	✓	✓			
2. Use experimental and observational techniques established by psychologists to develop and confirm theories that describe and explain behavior.	✓	✓	✓	✓	✓		
3. Appraise benefits and limitations of systematic methods evolved for the study of behavior.	✓	✓	✓	✓	✓		
4. Apply pertinent techniques to assess research literature in psychology.	✓		✓	✓		✓	
5. Demonstrate competencies basic to success in graduate study or in some applied field that requires no further academic preparation.						✓	
6. Demonstrate understanding of the APA writing style required by professional psychology journals.	✓	✓	✓	✓	✓	✓	✓
7. Demonstrate growth related to the incorporation of the ethical standards adopted by APA in academic and personal life.	✓			✓			✓
8. Exhibit understanding of the value of statistics in the science of psychology.	✓		✓	✓	✓		

Figure 2. (Above, and on next two pages.) The three steps of curriculum matrices from the level of department objectives to individual learning objectives.

a synthesis and map of clearly specified objectives at every discrete level. Once formulated, assessment procedures can be designed to determine the extent to which those objectives are met. Only by means of such a process can clear, measurable objectives lead directly to the correspondingly clear instructional strategies that produce desired outcomes. If, as this model requires, results of program assessment are available for each program objective, then, by using the program matrices, each objective can be traced through the course objectives and the unit objectives to the individual learning activities to de-

termine which educational experiences are having the desired long-term effect and which are not. Appropriate measures can then be taken and the effectiveness of those changes subsequently evaluated via instructional feedback during the teaching/learning cycle, and then again in the next round of program assessment.

Most faculty members quickly comprehend the benefits of this curriculum model; however, they are often overwhelmed by the labor-intensive process of developing objectives on three levels for their courses. In fact, most of those who have used this model for course de-

CURRICULUM MATRIX: COURSE OBJECTIVES BY UNIT OR CHAPTER OBJECTIVES		Unit or Chapter Behavioral Objectives								
PSY208 Unit 1										
PSY208: Course Objectives		1. Describe the scientific method.	2. Evaluate common systematic methods used by psychologists (other than the experimental method) in terms of the contributions of each to the development of knowledge.	3. Use descriptions to explain a simple experiment; including all variables, necessary controls and how outcomes allow conclusions.	4. Explain how the scientific method differs from other methods of gaining information.	5. Distinguish between the experimental and alternative approaches.	6. Explain hypothesis testing.	7. Distinguish between inductive and deductive reasoning.	8. Identify sources of ideas for research among psychologists.	9. Describe the experience of performing one of Hull's learning experiments using the computer simulation.
1. Analyse how psychologists formulate and test theories of behavior.		✓	✓	✓	✓	✓	✓	✓	✓	✓
2. Assess the effects of individual perception or experimenter bias on research findings.		✓	✓	✓	✓	✓	✓	✓	✓	✓
3. Explain the basic components of an experiment (eg. hypotheses, variables, control).		✓	✓	✓		✓	✓			
4. Conduct three studies according to good scientific practice.										
5. Describe the role of statistics in psychology research.				✓						✓
6. Use APA style of research report writing to report their results.										
7. Explain the role of ethics in the conduct of psychology research.										

velopment are amazed that the process does not take much more time or effort than did the more haphazard process that they had used previously. This process simply forces the instructor to formulate and record objectives that in the past were only vaguely conceptualized. To overcome this misconception, we are developing a computer system to automate the process. The program is sufficiently general to support all sorts of program and course design, as well as evaluation. The entire program has been designed; we have completed the programming and testing of the tutorial segment. It is used in training our assessment facilitators in the departmental assessment program funded by the Bush Foundation.

COMPUTER HARDWARE AND SOFTWARE

The program is written using ToolBook 1.53 by Asym-matrix. This program requires Windows (either 3.0 or 3.1). ToolBook is a programming language that allows the development of "books," which consist of text and graphics. The pages can be linked together not only in

the standard linear format but also in any fashion that the programmer desires. Navigation and/or execution of routines can be initiated by the reader by pointing and clicking with a mouse. The program also permits the reader to enter text as appropriate.

In order to run ToolBook, a program very similar to HyperCard for the Mac, the user must have at least a 286 PC/AT with a minimum of 2.0 MB of memory and a hard disk. ToolBook comes with a run-time version that can be distributed freely along with the book program. The run-time version allows the book to be used, but no changes can be made in the programming.

DEVELOPMENT OF THE COURSE PROGRAM

First, we constructed a paper-and-pencil algorithm of the process of course design and development. Course objectives are the explication of the learning outcomes that students are expected to achieve. They describe the evidence of the transformations that are to come about as a result of the course—namely, answers to the question,

CURRICULUM MATRIX: Unit or Chapter Objectives and Individual Learning Activities PSY208: Methods I Unit 1 Assignment: Hull Simulation		Learning Activity Behavioral Objectives									
Unit or Chapter Behavioral Objectives		1. Define the specific learning issues that led Hull to design and conduct the study that you chose to perform	2. Define the variables in the experiment that you ran	3. Describe the levels of the independent variable	4. Appraise the extent to which extraneous variables are controlled by experimental procedures	5. Describe how and in what units the dependent variable is measured	6. Evaluate the role of the double blind procedure in control of experimenter bias	7. Distinguish between control and experimental groups	8. Significance of the major research outcomes of this study	9. Identify what statistics were used to analyze the results of this study	10. Judge the contribution of this study to Hull's theory of learning
1. Describe the scientific method.			✓	✓	✓		✓	✓			
2. Evaluate common systematic methods used by psychologists (other than the experimental method) in terms of the contributions of each to the development of knowledge.											
3. Use descriptions to explain a simple experiment, including all variables, necessary controls and how outcomes allow conclusions.			✓	✓	✓	✓	✓	✓	✓	✓	
4. Explain how the scientific method differs from other methods of gaining information.	✓	✓	✓	✓	✓		✓	✓	✓		✓
5. Distinguish between the experimental and alternative approaches.	✓	✓	✓	✓	✓		✓	✓	✓		✓
6. Explain hypothesis testing.	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
7. Distinguish between inductive and deductive reasoning.	✓	✓	✓	✓					✓	✓	✓
8. Identify sources of ideas for research among psychologists.	✓										✓
9. Describe the experience of performing one of Hull's learning experiments using the computer simulation.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

"How will I know when students have successfully learned the subject matter and mastered skills required to apply knowledge in this area?" Outcome-oriented course objectives are stated in terms of behavioral, observable, measurable responses on the part of the student that reflect the desired educational transformations. In this way, course assessment techniques flow directly from the objectives of the course. They provide a means for assessing whether or not the student has met these goals. Course objectives provide the rationale for the assessment techniques. In this sense, they answer the question, "why?" The assessment statements are made up of four components. They explicate "who" will do "what," "when," and "where." The program will lead the instructor through the construction of course objectives and concomitant assessment statements for each of these objectives.

The completed part of the package provides an overview of the "whys" and "wherefores" of realistic objectives. It is a tutorial using graphics and textual material. Toolbook allows either the construction of graphics in the program itself or permits importation from a graphics package or clip art. Any object within Toolbook may be provided with a script written in the programming lan-

guage of Openscript. Messages are sent when either mouse clicks or events occur. These messages are sent along a hierarchy of objects. When the message finds a handler, the script is executed. For example, a button may have a script attached to it with the handler, to handle mouseEnter. This use of messages and handlers allows the programmer to give control of the flow of the program to the user. The user can control the information that is provided next, the question next asked, the page next shown, and so forth.

In the tutorial, not only is information provided along with many figures and images, but the users are given the opportunity to test their knowledge and understanding. A concerted effort was made to make the user an active participant and not simply a passive reader.

The final part of this program will automate the construction of objectives and matrices. The user will be asked to determine the domain that the objective will describe and then will be asked a series of questions to determine who, what, where, and so forth. At each step along the way, the program offers comprehensive lists of possibilities, one of which is selected by the developer. When the selection is made, it is transferred to the docu-

ment that is being constructed. At the end of the program, the user will have a document that contains course objectives and assessment measures for each objective. Each objective will ultimately be linked to departmental objectives using the dynamic data exchange capabilities of Windows to connect to a database in which all the data entered will be stored across users.

THE EVALUATION

The project is currently at the end of the first stage, which is the construction and testing of the tutorial/introduction of the program. Field testing with the current year's assessment facilitators has been completed. These faculty members have been given a one-course load reduction in order to use this model to develop an assessment program to measure student learning outcomes in their departments. They are to become experts for their departments and offer workshops for their colleagues. They are also to develop objectives for their respective departments. This computer program has been used as part of their training.

Prior to the facilitators' use of the program, they were given a short four-item quiz based on information covered in the program. As soon as they had completed the program, they were given a follow-up questionnaire with the same four-item quiz, along with some other questions soliciting their opinion about the content and presentation of the material.

Ten of the facilitators completed the program and the pre- and posttest. On average, they took 55 min ($SD = 12$) to complete the program. Only 1 person indicated that he or she could not finish in one session. Three people indicated that they felt that the program was too long to hold their attention. On average, they indicated that they were relatively computer-experienced ($M = 4.9$, $SD = 1.4$, with 1 = very inexperienced and 7 = very experienced). There was a significant change from pretest scores ($M = 6.9$, $SD = 1.9$) to posttest scores [$M = 9.1$, $SD = 1.8$; $t(9) = -2.64$, $p < .03$]. This is neither a floor nor a ceiling effect, since possible scores range from 0 to 17.

The facilitators reported that they felt that they could go where they wanted to in the program ($M = 5.7$, $SD = .8$, with 1 = never and 7 = always), that they rarely had trouble understanding what they were supposed to do next ($M = 2.6$, $SD = 1.7$ with 1 = never and 7 = always). They reported the content of the program to be interesting ($M = 5.0$, $SD = 1.4$, with 1 = never and 7 = always),

that the program was useful ($M = 5.6$, $SD = 1.2$, with 1 = never and 7 = always), and that they would recommend it to colleagues who want to learn about course objectives ($M = 5.2$, $SD = 1.8$, with 1 = never and 7 = always). They reported a slight difficulty with reading the screens ($M = 4.5$, $SD = 1.9$, with 1 = never and 7 = always) and that there was a possibility that the vocabulary might be a little difficult ($M = 3.4$, $SD = 2.2$, with 1 = never and 7 = always). Their responses were neutral to the question regarding whether it would be easier to learn the material with a standard paper/text presentation ($M = 3.1$, $SD = 2$, with 1 = never and 7 = always). Their overall rating of the program was positive ($M = 5.6$, $SD = .9$, with 1 = very negative and 7 = very positive).

The evaluation shows that the tutorial is successful in imparting information about our model of course objectives. Instructors who used the program gave it a positive evaluation and showed an increase in knowledge after using it. The amount of time required to use the program is minimal; therefore, it is a useful tool for teaching course-objective construction.

REFERENCES

- ADELMAN, C. (1986). To imagine an adverb: Concluding notes to adversaries and enthusiasts. In C. Adelman (Ed.), *Assessment in higher education: Issues and contexts* (pp. 73-82). Washington, DC: U.S. Department of Education.
- ASTIN, A. W. (1985). *Achieving institutional excellence*. San Francisco: Jossey-Bass.
- BLOOM, B. S. (Ed.) (1956). *Taxonomy of educational objectives: Handbook I. Cognitive domain*. New York: Longmans, Green.
- BOYER, E. L. (1987). *College: The undergraduate experience in America*. New York: Harper & Row.
- COLEMAN, E. (1991). Curricular coherence: Thinking about intentions and outcomes. *Liberal Education*, 77, 15-19.
- NICHOLS, J. O. (1991). *A practitioner's handbook for institutional effectiveness and student outcomes assessment implementation*. Bronx, NY: Agathon Press.
- PETTY, L. C. (1992, June). *The sequential curriculum matrix approach to program development and assessment*. Paper presented at the meeting of the American Association of Higher Education Assessment, Miami Beach.
- SOUTHERN ASSOCIATION OF COLLEGES AND SCHOOLS. (1984). *Criteria for accreditation*. Decatur, GA: Commission on Colleges.
- STARK, J. S., & LOWTHER, M. A. (1986). *Designing the learning plan: A review of research and theory related to college curricula*. Ann Arbor: National Center for Research to Improve Postsecondary Teaching and Learning.
- STARK, J. S., LOWTHER, M. A., SASSEN, P. L., & SHAW, K. M. (1990). *Course planning exploration for program self-study*. Ann Arbor: National Center for Research to Improve Postsecondary Teaching and Learning.