Using Bloom's Cognitive Taxonomy for Curriculum Planning and Evaluation in Nontraditional Educational Settings

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A tool based on Bloom and Krathwohl's Taxonomy of Educational Objectives, *the Examination Profile, is presented for use in nontraditional and in traditional educational settings to provide planning and evaluative information. Its general categories can be helpful in structuring the multitudinous and diverse interactions characteristic of nontraditional education, while helping address questions of educational objectives and accountability. Finally, data using the Examination Profile and evaluating the divisional examination system at Hampshire College is presented.*

The student participation movement of the late sixties and its causal antecedents have left a dual legacy. On the one hand, open, informal, and nontraditional educational approaches and institutions have been spawned throughout the country [6, 8, 12, 14, 17, 21, 25]. Diverse in their specifics, one common theme may be seen in open classrooms, schools without walls, free schools, contract learning, college residential learning centers, and university experimental colleges; central is the ac-

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tive involvement of the student in determining his/her academic objectives and program.

Although metagoals are likely to have been established by the designers of a nontraditional institution, the specific educational objectives chosen and behavioral outcomes enacted by a student cannot be known or specified in advance, for such choice is a critical part of the educational setting. In addition, nontraditional pedagogy (relative to the dominant modes in the recent past, cf. [2, 7, 9, 16]) tends to favor process and affective rather than exclusively content and cognitive objectives. By focusing on affective and high cognitive objectives as well as the supporting lower cognitive objectives, nontraditional institutions are actually planning a larger proportion of the total influence of the school on the student, although such structure is often less readily visible than major credit hours and distribution course requirements [19]. However, the goal statements of nontraditional planners are often not readily measured directly. Rather than bind the student to a fixed curriculum, nontraditional catalogs may discuss the value of responsibility, self-direction, self-esteem, self-control, and awareness, and successful graduation may depend on the faculty's judgment that a student's progress and work meet their implicit, subjective standards.

The second legacy of the student movements of the late sixties is increased pressure for accountability and thus for behavioral objectives [18, 22, 24, 29]. Although there are many benefits to the prior specification of intended educational outcomes, there is some conflict between this and the development of self-guiding students [20]; however, this tension does not mean that nontraditional education has no need for accountability, evaluation, and specification of measurable objectives. In fact, because of the lesser experience with nontraditional education and its need to justify and defend more than is usually the case for traditional institutions, more descriptive and evaluative information is needed.

Ebel [10] has suggested that although insistence on detailed statements of educational objectives may be of questionable value, it is more urgent for educators to reach agreement on their general purposes and goals. In his review of studies on the organization and administration of higher education, Peterson [23] notes the lack of research relating goal consensus to greater or lesser effectiveness; Bidwell [3] and Sarason [26] discuss the high value teachers place on autonomy. Finally, Gabarro [11] highlights the usefulness of integrating devices in organizations with subgroup autonomy and interdependence (cf. [15]).

This paper presents a tool, the examination profile, that may be used

in nontraditional and in traditional educational settings to provide planning and evaluative information. By operating at a middle level of specificity it is applicable to a wide range of individually tailored curricula, while providing a schoolwide integrating, planning, and evaluation device.

THE EXAMINATION PROFILE

For a study of academic progress at Hampshire College we needed a general, noncurriculum-limited research instrument consistent with the organizational climate and norms. At Hampshire, divisional examinations are the sole measure of academic progress; they are student-initiated learning contracts approved by a faculty member. The divisional framework, which replaces the conventional academic year sequence, was designed to accommodate individual patterns of learning and growth, while helping the student move steadily toward greater independence in study. A Division I exam demonstrates the student's independent ability to pursue advanced work—competence in a "mode of inquiry." At the Division II level the student, with the help of a faculty adviser, designs and completes studies in the chosen area of concentration, often multidisciplinary. For Division III the student completes an independent project and participates in an integrative activity.

There is no single typical divisional examination at any divisional level; they vary greatly depending on the interests and abilities of the students completing them. However, the two examinations described below may give an indication of the kind of work that can be involved. Each description is abstracted from the faculty report written after successful completion of the examination. The first is for a Division I social science examination:

> The student has written an excellent paper which includes the history, biology, anthropology and social aspects of controlling fertility naturally. Her paper begins with a thorough biological and anatomical study of the fertility process in both males and females. Following this, she engages in a fascinating historical review of the ways in which peoples throughout recorded history have attempted to deal with the question of controlling their own populations and managing their fertility. In the process of this historical review, she concentrates on the use of plants and herbs as naturally available substances for fertility control. Her work touches on many of the social political questions involved in such fertility control, and though it does not thoroughly go into such analysis, gives every indication of her ability and interest to engage in this kind of work at the Division II and III level. Her ability to work with historical and cultural data, to

analyze the relationship of social pressures and beliefs to concepts of fertility control clearly indicates her understanding of the modes of inquiry in social science. She has included more than 75 items in her bibliography which serve as an extremely strong resource base for any subsequent students interested in this topic. We are very pleased to award a pass for this excellent examination.

A Division II natural science examination was described as follows:

In her Division II the student combined a strong interest in environmental health with a firm grounding in biology and the physical sciences. The main bulk of her work consisted of courses in chemistry, human biology, physics and genetics. In addition, she spent one semester doing research, largely independent library research, for the X Research Group in Washington, D.C. Her supervisor described the student's work at X as follows: "Her major assignment was to do research on the occupational health problems of women workers and to prepare drafts of "chapters" on health hazards for a pamphlet on this subject. She did an exhaustive scientific literature search on each topic assigned to her and compiled her information in a well-organized manner. Although she had conducted scientific research studies (both in and out of the laboratory) before, the advocacy approach necessary for a pamphlet of this sort (aimed at action to change women's working conditions) was new to her. Moreover, she readily grasped legal concepts of public health and job discrimination problems that were new to her, such as the relevance of occupational health and equal employment legislation. . . . Her secondary assignment was concerned with analyzing data on lead poisoning among workers at a storage battery plant. She compiled a report on the findings for use by the local labor union involved."

Her portfolio of evaluations and papers is excellent, representing very solid work. We were particularly impressed that she had set and maintained consistently high standards for herself over a long period of time. She works well both in structured courses and independently. Her Division II leads very nicely into her proposed Division III project, a study of how industrial health hazards can be more quickly detected. For this new work, she needs more knowledge of statistics, but knowing her, we are confident that she will proceed to add this background to her present skills.

During its initial five years, Hampshire has worked to define and explicate its expectations and standards for the three divisional examinations—the major criteria for graduation. However, although balancing individually tailored curricula with college-wide standards was not an easy process, it was necessary for the academic planning and evaluation of this new, experimenting college. Bloom and Krathwohl's *Taxonomy of Educational Objectives* [4] provided a useful conceptual framework, although it has been used for curriculum design and evaluation within

specific content areas in most prior research (personal communications with Masia, 1973, and Bloom and Krathwohl, 1974; cf. [27, 30, 31]).

The Examination Profile asks a research participant to rate on a five-point scale the extent to which the student displayed various skills (see Appendixes A and B). The five-point extent scale was chosen for its versatility and its fully reported methodological development [28]. Rated skills include the six major cognitive objectives (recall, comprehension, application, analysis, synthesis, and evaluation) and the three cognitive subcategories of knowledge recall. Knowledge recall was given more detailed assessment since these objectives are so dominant in much traditional education. The affective domain was assessed by four statements concerning the student's displayed motivational interest (see question 26 of Appendix A). These statements represented a mapping of the affective categories of responding, valuing, organization, and value complex along the dimension of internalization into statements more readily understood by students and faculty. Demonstrated physical abilities and personal style (a nontaxonomic skill added after discussion with performing arts faculty) were also rated. Appendix C presents examples of the cognitive taxonomy using possible tasks from Hampshire divisional examinations. In addition to these skills from Bloom's taxonomy, several questions were asked concerning the examination process, for example: difficulty of writing the exam proposal, student and examiner enjoyment of the exam, agreement on exam standards, and fulfillment of examiner responsibilities. Finally, an overall evaluation of the examination was requested.

An interview format with a rather structured questionnaire was developed for faculty. The potentially repetitious precoded format was mitigated by several factors: focus on concrete examinations by specific students, general open-ended questions following the three examination ratings, and a responsive interviewer. Although the current version of the Examination Profile has produced useful, discriminating data, the reliability of its data can be expected to be impaired if the raters do not have a collaborative orientation toward the research or evaluation project [1]. On the other hand, as faculty and other academic planners gain experience with the way such a framework can helpfully structure the multitudinous and diverse interactions characteristic of nontraditional education, their expertise in rating and the validity of the resultant data should be improved.

There were several rather straightforward questions to be asked of the divisional examination system. Do faculty agree on the criteria for a good exam? Do student evaluations agree with those of their examiners?

Do non-Hampshire faculty describe Hampshire examinations differently than do Hampshire faculty? How do examinations differ at the various divisional levels? Which cognitive taxonomic levels contribute to good exams? Are practiced exam criteria consistent with official policy? Some of these questions are still being studied, others are reported below.

Attempts were made to interview all faculty while remaining responsive to their workload and personal assessment of priorities; fifty-one faculty were interviewed (45 percent response rate of all faculty, 50 percent of fte). Each was asked to select a recent Division I exam, a recent different Division I exam, and a recent Division II exam. Because of the newness of the college there were few completed Division III exams; therefore they were omitted from this study. The faculty at this college, as most, are responsible for and quite interested in the quality of academic performance; thus the principal focus of this study was on faculty assessments of student performance. Because of a belief in student involvement in their education, a strong secondary focus was on student assessments of their own work. For each of the 127 examinations rated (some faculty had not had examinations at both divisional levels) the involved student was sent a parallel questionnaire and requested to describe his/her examination; forty-two students responded. This 33 percent student response rate is not unusual for mailed questionnaires without followup (cf. [13]). In addition, some selected examinations had occurred in prior terms and the students were no longer on campus.

RESULTS

Matching student and faculty ratings showed that more faculty than students felt that (a) the examiners agreed on the standards for the exams, (b) the examiners fulfilled their responsibilities, and (c) the exam was a direct outgrowth of course work (paired t-tests using SPSS, $p < 0.05$). More students than faculty felt that their exams displayed the ability to (d) recall principles, generalizations, and theories, (e) evaluate utilizing knowledge, and (f) project personal style. There were no other significant differences between faculty and student ratings, including certainty of ratings and overall evaluation of how well the student did on the exam.

Twenty-one faculty did not have any of their nominated students

respond; thirty faculty did. These sets of faculty ratings significantly differed only on three items (t-tests, $p < 0.05$): faculty with responding students felt the students enjoyed the exam more, felt the examiners enjoyed the exam more, and felt the discussions with the committee at the exam were more helpful than did faculty with nonresponding students. Since there were no significant differences between the matched faculty and students on any of these items it seems reasonable to infer that the more enjoyable the exam experience the more likely the student was to respond to this study.

Regression analyses were done for the faculty ratings to assess the relation between overall exam quality and the cognitive taxonomy levels (see Tables 1 and 2). For Division I exams 72 percent of the total variance was explained by the cognitive levels: synthesis was the dominant skill, accounting for 54 percent of the variance; recall of conventions, trends, categories, and methodologies accounted for 9 percent; and application accounted for 5 percent. In contrast, evaluation accounted for 63 percent of the variance for Division II exams; recall of conventions for 11 percent, and comprehension and recall of principles each for 4 percent; altogether 85 percent of the total variance for Division II exam quality was explained by the cognitive taxonomy levels.

These relationships between the cognitive taxonomy and divisional examinations should be considered descriptive, not normative. Although the college has in its student and faculty handbooks and in its planning documents several descriptions of the purpose and process of academic progress by divisional examination, these written statements are not phrased in terms of Bloom's taxonomy. Nor are these statements as clear and consistent as would sometimes be helpful for faculty and students. One familiar with Bloom's taxonomy can rephrase Hampshire divisional policy into taxonomic categories, but this has not yet been officially done. One of the hopes of this research project was to help the faculty make explicit their academic expectations and to help them rewrite clearer descriptions of the objectives of examinations at each divisional level.

Finally, dichotomous contingency table analyses were performed for a few critical variables against all the variables of the profile. In general, most of the questions on the profile were positively associated with divisional level, with motivational interest, and with overall quality of the examination (Kendall's tau, $p < 0.05$). Part of this may be explained by a halo effect, by the relative difficulty and newness of the rating task, and by an implicit unidimensional assumption that a good (or poor)

TABLE 1
DIVISION I REGRESSION ANALYSIS ON OVERALL EXAM EVALUATION

VARIABLE		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
V 034	Synthesize knowledge	0.738	0.545	0.545	0.738	0.314	0.259
V 029	Recall conventions, trends, categories, methods	0.796	0.634	0.089	0.617	0.223	0.167
V 032	Apply knowledge	0.827	0.682	0.048	0.700	0.205	0.175
V 027	Recall knowledge	0.838	0.702	0.020	0.574	0.266	0.206
V 031	Comprehend knowledge	0.844	0.712	0.010	0.690	0.169	0.122
V 028	Recall terminology and facts	0.845	0.715	0.003	0.443	-0.128	-0.094
V 033	Analyze knowledge	0.847	0.718	0.003	0.700	0.117	0.097
V 030	Recall principles, generalizations, theories	0.849	0.721	0.003	0.645	0.091	0.068
V 035	Evaluate utilizing knowledge	0.850	0.722	0.002	0.568	0.074	0.057
(Constant)						-1.234	

TABLE 2

DIVISION II REGRESSION ANALYSIS ON OVERALL EXAM EVALUATION

VARIABLE		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
V 035	Evaluate utilizing knowledge	0.795	0.632	0.632	0.795	0.465	0.498
V 029	Recall conventions, trends, categories, methods	0.861	0.742	0.110	0.520	0.316	0.288
V 031	Comprehend knowledge	0.882	0.778	0.036	0.696	0.332	0.313
V 030	Recall principles, generalizations, theories	0.905	0.819	0.041	0.268	-0.400	-0.367
V 034	Synthesize knowledge	0.912	0.832	0.014	0.547	0.121	0.140
V 027	Recall knowledge	0.919	0.844	0.012	0.417	0.136	0.123
V 028	Recall terminology and facts	0.920	0.847	0.003	0.270	0.108	0.095
V 032	Apply knowledge	0.921	0.848	0.001	0.626	0.046	0.048
(Constant)						-0.681	

exam will evidence all the taxonomic skills to a large (or little) extent. In spite of these fuzzying factors significant relations did appear, as discussed in the above *t*-test and regression analyses.

Reversals to this general trend of positive associations were instructive for the evaluation of the examination system. Division II exams as compared with those of Division I seemed to be a problem area. Faculty ratings indicated that students and faculty enjoyed Division II exams less, that the examiners learned less through the exam process, and that each of the examiners fulfilled fewer responsibilities.

DISCUSSION

A traditional academic year educational sequence might parallel the cognitive taxonomic levels, with a heavy emphasis at the lower levels of knowledge recall and comprehension. Nontraditional institutions are likely to have different temporal orderings and different priorities for their educational objectives. Until or unless nontraditional education becomes dominant and traditional, its faculty and students can be expected to have been previously educated and socialized primarily under traditional educational systems.

To assess curricular planning, to help explain faculty standards to students, to compare actual practice with official policy, to provide data for external accountability, and to do so while retaining the saliency of individually tailored educational programs, a generalized curriculum-free version of the cognitive taxonomy of educational objectives can be a useful tool. As with any tool, it is not magic; it does not provide a reality of "hard data" any more meaningful than the subjective judgments it requests. And as with many data tools, its beneficial impact can by synergistically increased if it is appropriately fed back to the participants in the study [5]. However, the Examination Profile does provide a framework upon which the judgments that are being made in nontraditional and in traditional settings may be surfaced, examined, and evaluated.

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APPENDIX A

EXAMINATION PROFILE

1. Divisional level_____. 2. School_____. 3. Were you chairperson?_____

This Examination Profile is designed to describe an examination and to measure how much a student has achieved (learned) certain universal educational objectives or skills as shown by his/her divisional examination. Please rate the student's examination you are about to observe or review according to how you feel the exam went. Leave blank inapplicable questions. Comment as desired. Use this *extent* scale: (1) to a very little extent; (2) to a little extent; (3) to some extent; (4) to a great extent; (5) to a very great extent.

To What Extent:
4. was a written paper(s) an important part of the contract
5. was a performance or demonstration an important part of the contract
6. was a discussion an important part of the contract
7. was it difficult to write the exam proposal/contract
8. was it difficult to find a chairperson for the exam committee
9. was it difficult to find other members for the exam committee
10. was it difficult for the exam committee to get together
11. did the student seem to enjoy the exam
12. did the examiners seem to enjoy the exam

EXAMINATION PROFILE (*continued*)

13. did the student seem to learn through the exam process itself
14. did the examiners seem to learn through the exam process itself
15. did the student's standards for the exam agree with those of the committee
16. did the examiners seem to agree on the standards for the exam
17. did the examiners seem to know the subject matter
18. were the discussions with the committee at the exam helpful
19. was the written evaluation helpful to the student/not written?/
20. did all members of the committee participate in all evaluation activities (read papers, observe performances, attend orals, etc)
21. did each of the examiners fulfill his/her responsibilities
22. was the exam a direct outgrowth of course work
23. did the contract and exam directly evidence the student's academic progress
24. did the contract and exam directly evidence the student's general growth
25. How long was the oral exam, if any: __ minutes.

Now please rate how much you feel the student displayed skills as described in Appendix B. Mark spaces only for those skills that make sense to you and seem appropriate to the work at hand. Any other observations or comments you can add will be appreciated.

26. Which of these four statements best describes the motivational interest displayed by the student. For that *single statement,* mark whether it was displayed to a *great extent* or to *some extent:*
    Primarily interested in getting a pass;
    Some interest, but unlikely to continue in area;
    Extended interest, likely to continue in area for a few years:
    Central interest, likely to remain for years.
27. Ability to recall knowledge
28. Ability to recall terminology and facts
29. Ability to recall conventions, trends, categories, criteria, and methodology
30. Ability to recall principles, generalizations, and theories
31. Ability to comprehend knowledge
32. Ability to apply knowledge
33. Ability to analyze knowledge
34. Ability to synthesize knowledge
35. Ability to evaluate utilizing knowledge
36. Physical abilities
37. Abilities to project personal style
38. To what extent are you certain of your above ratings
39. Overall, how well do you feel the student did on the exam (write number): (1) poor; (2) fair; (3) good; (4) very good; (5) excellent

APPENDIX B

GENERAL EDUCATIONAL SKILLS

Ability to recall knowledge. The student recognizes and/or remembers facts, terminology, and general information.

GENERAL EDUCATION SKILLS (*continued*)

Ability to recall terminology and facts. The student recalls specific bits of information or symbols with concrete referents.

Ability to recall conventions, trends, categories, criteria, and methodology. The student recalls characteristic ways of treating and presenting ideas and data.

Ability to recall principles, generalizations, and theories. The student recalls the major schemes and patterns by which ideas and data are organized.

Ability to comprehend knowledge. The student is able to communicate by translating, interpreting, or changing thoughts and ideas into parallel forms. Parallel forms include, but are not limited to, speaking and/or writing "in your own words," discovering relationships such as cause and effect or similar and different, drawing pictures, and acting out.

Ability to apply knowledge. The student is able to solve problems by transferring prior knowledge and/or learned behavior to new situations similar to those in which the student encounters in everyday life as related to the specific subject.

Ability to analyze knowledge. The student is able to solve problems through an organized process of investigation where features of the problem are identified, internal and/or external relationships are established, and logical conclusions are justified. Special attention is given to the investigative methods and the reasoning processes employed.

Ability to synthesize knowledge. The student is able to discover new knowledge and/or knowledge that is new to him through creative original thinking.

Ability to evaluate utilizing knowledge. The student is able to make judgments based upon available evidence and/or established standards, or set standards and thereby make judgments.

Physical abilities demonstrated. For example, dance, theater, laboratory skills.

Ability to project personal style. For example, poetry, painting, written reports, oratory.

APPENDIX C

EXAMPLES OF THE COGNITIVE TAXONOMY USING POSSIBLE HAMPSHIRE EXAMINATION TASKS

SKILL	HUMANITIES AND ARTS	LANGUAGE AND COMMUNICATION	NATURAL SCIENCE	SOCIAL SCIENCE
Recall terminology	Identify iambic pentameter	Describe CDC Cyberg bit, byte, baud	Draw periodic chart from memory	Estimate r from scatter diagram
Recall conventions	Identify three sonnet forms	Diagram deep structure of a sentence	Draw force diagram for child on a swing	Graph a function given tabular data
Recall principles	Discuss Dada	Discuss Whorfian hypothesis	Discuss Maxwell's equations	Discuss Hull's learning equations
Comprehend	Compare Kant and Tillich	List probable effects of TV on children	Discuss disagreement Ptolemic and Copernican systems	Discuss financial articles and data in one issue of New York *Times*
Apply	Write exam contract in blank verse	Flow chart, code, and run computer program	Grow and eat polyploit potatoes	Successfully organize support for academic council passage of personally significant motion
Analyze	Analyze Picasso's Chicago sculpture	Logically diagram samples of Rodino impeachment hearings	Quantitatively analyze sample of Connecticut River	Construct and interpret sociometric analysis of seminar discussion
Synthesize	Outline a personal philosophical statement	Design reinforcement schedule to facilitate more active discussion, base data from conversation analysis	Describe new compound which might help energy crisis, if compound created	Hypothesize causes and effects of student housing choices
Evaluate	Judge personal statement from perspective of Socrates, Spinoza, Sartre	Critique movie "Z" as art and as propaganda	Evaluate cost/benefit of popular "energy-saving" programs	Critique a school meeting
Physical abilities	Paint a portrait	Build a Babbage calculator	Construct a phone bug	Build a biofeedback device
Personal style	Play Gershwin	Mime	Design a diet	Be participant-observer