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ABSTRACT

The relationship between course work and general learning at Stanford University (California), Mills College (California), and Ithaca College (New York) was studied. The study used the Differential Course Work Patterns (DCP) Project faculty survey and Cluster Analytic Model (CAM) to link course work to student assessment. The study examined what the faculty perceptions of general learned abilities are in relation to the courses they taught, what advice faculty give to students who want to improve their general learned abilities, the results from the quantitative findings of the CAM study with the DCP for levels of congruency; and faculty members' perceptions of the courses they teach. Findings for both instruments indicated that reading comprehension, quantitative comparisons, and analytic reasoning were the types of general learned abilities where large changes occurred. At all three institutions students at or above the mean were more likely to enroll in course work associated with improvement in student learning. At all three institutions, faculty overestimated student cognitive skills in sentence completion and regular mathematics. Included are 32 references, copies of a letter to prospective participants, a copy of the DCP survey instrument, and procedures for syllabi and test administration. (JB)

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Final Report

A report developed with support from the Exxon Education Foundation and the National Center for Postsecondary Teaching, Learning & Assessment

October 1991

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ACKNOWLEDGEMENTS

Field-based research is neither feasible nor terribly meaningful unless there are individuals at the institutions participating in the research who take an interest in its progress and conduct. They work with the research team to shape the questions asked and conclusions drawn, guiding the research to look at issues important to the institution itself. Also, they articulate the purpose, value, and procedures followed to their broader campus constituents--the administrative leaders, faculty, and students.

This project was no exception to the above observations. Larry Metzger, Amy Rubenstein, and Terry Condren at Ithaca College coordinated the testing of students and the interviewing of faculty. They reviewed prior reports associated with this project and every step of the way, provided sage, counsel, and helpful criticism. Similarly at Stanford University, Sally Mahoney, Dean Namboothri, and Michele Marincovich provided counsel, guidance, and assistance in the conduct of the research. At Mills College, our thanks go to Betsy van Patten, Marshall Northcutt, and Allison Wagley for coordinating the student testing and faculty interviews and providing the necessary transcript and catalog information.

Any project involving standardized test results also involved the assistance of the producers of such instruments. Here we owe thanks to Susan Vitella, Craig Mills, and Jose Santiago at Educational Testing Service.

Lastly, in the pilot-testing of the faculty survey, we owe our gratitude to Bob Strahan of Iowa State University and Mary Sula Linney of Iowa Central Community College. In the end result, however, the analyses, findings, and conclusions are our own.

INTRODUCTION

The capacity to determine which parts of the college curriculum contribute to gains in the general learning of undergraduates is of critical importance to higher education institutions. There is general agreement among researchers and practitioners that undergraduate study should foster certain essential skills, abilities and habits of mind among all students. Indeed, the requirement of the baccalaureate degree by many employers, most professional schools and almost all graduate study programs presumes a level or degree of development of general learned abilities that surpasses secondary education. The responsibility for developing these "general learned abilities" rests not only with general education programs, per se, but with the entire curriculum, including the academic major. In recent years many institutions, including 80 percent of four-year colleges, have initiated outcomes assessment programs at some level. Using a variety of instruments and criteria, these assessments measure such desired outcomes as the ability to interpret data, do basic computational mathematics, make comparisons using quantitative data, read a passage and interpret its themes, make deductive choices, analyze a piece of information and break it down into its component parts, recognize like and opposing concepts, and decipher the use of concepts and terms within a verbal context. The exact outcomes differ from test to test, those listed above being those measured by the General Test of the Graduate Record Examinations.

Assessments of this kind are useful in documenting that learning has occurred. They cannot tell us, however, which courses most consistently produce gains in learning for specific groups of students over time at particular institutions. Such information would be extremely useful. Knowing the degree to which different courses contribute to different learning outcomes would provide a college or university with an empirical basis for curriculum review.

Knowledge of such links between coursework and learning could serve as a powerful source of information which would complement faculty wisdom, student evaluation, and other means of appraising the extent to which particular sets and sequences of courses have the effect for which they were intended. Such information could also be used to improve the academic advising and guidance students receive in making course selections (Ratcliff, 1990a, 1990b, 1990c).

Over the past 6 years we have developed a model for linking assessments of the general learning of undergraduates with the coursework in which they enrolled (Ratcliff, 1987, 1988, 1990a, 1990b, 1990c; Jones & Ratcliff, 1990a; 1990b; Ratcliff & Jones, 1990; 1991). This research has proceeded under the rubric of the Differential Coursework Patterns (DCP) Project, and the model for linking coursework to student assessment has been referred to as the Cluster Analytic Model (CAM). Its development and testing was supported first by the Office of Educational Research and Improvement of the U.S. Department of Education. Subsequent qualitative validity studies of the GRE item-types, trend analyses of coursework patterns, and studies of the applicability of the model to curricular reform, assessment program development and academic advising has been supported by the Exxon Educational Foundation. The CAM has been tested at six institutions: Stanford and Georgia State Universities, and Clayton State, Evergreen State, Mills and Ithaca Colleges. In addition, CAM has been applied to student reports of enrollment patterns and ACT COMP scores at the University of Tennessee-Knoxville (Pike & Phillippi, 1989). In all instances where students made choices from a wide selection of coursework, the CAM consistently discriminated that coursework most associated with large gains in general learned abilities.

In the most common application of the CAM, assessment instruments were administered to graduating seniors, and the results of these post-tests were compared with the results of corresponding pre-tests of the same students. Such well-known standardized instruments were used: the SAT, GRE, ACT and ACT COMP examinations, as well as the Kolb Learning Styles Inventory and locally-constructed measures of student-perceived course difficulty. In fact, it is a great strength of the Model and an asset that seems to enhance its acceptability to faculty, that it is not solely dependent on instruments supplied by external vendors. It can use a locally-developed instrument, tailored to particular needs and extensively employing local judgment. A college, for instance, might administer its own essay examinations to freshmen and seniors, and its own faculty might grade them holistically; so long as the final evaluation, and/or its subparts, can be translated to a numeric scale, this instrument would be entirely adequate for inclusion and use with the Cluster Analytic Model.

Some faculty and academic leaders have been quick to reject the standardized measures of general learning, arguing that tests such as the SAT, GRE and ACT COMP are biased, are normed on a select group of students, measure a narrow band of lower-level learning, and the like. These arguments come despite the fact that most American colleges and universities use either the SAT or ACT tests in undergraduate admissions decisions, and the GRE, LSAT, MCAT and Miller's Analogies are widely used in graduate and professional school admissions. It is no small hypocrisy that the academy is comfortable using standardized testing as an indicator of prior student learning but rejects the notion that such testing is appropriate criteria in describing the effects of their college environment on their students. Proponents of qualitative measures of student learning often do not address the problems of assessing general learning in large research universities or community colleges, where thousands, not hundreds of students need to be assessed to determine the impact of the educational program.

A common stumbling block in the development of an assessment program is that of what form of test or assessment information to use. Curricular reviewers, reformers and researchers quickly acknowledge that there is no clear conception of what constitutes general learning. Such recognition emerges regardless of whether it is the college curriculum or the various tests and assessment devices that are being examined. A college that attempts to reach consensus among its constituents on either general education goals or on the "best" measure of general learned abilities will foster heated discussion. But the quest for consensus on what should be the common intellectual experience of undergraduates may end in irresolution or, worse, abandonment of the assessment initiative. Instead of searching for the ideal measure of general learning in college, those charged with assessment can better direct their energies toward the selection of a constellation of assessment means and measures that appear to be appropriate criteria for describing one or more dimensions of the general learning goals of the college.

The Cluster Analytic Model provides a basis for determining the relative extent to which each measure explains general student learning within a given college environment. When nine different assessment measures were used with the CAM, for example, we were able to determine what proportion of the variation in student scores was explained by each measure. This information can lead to a decision-point for the academic leader or faculty committee charged with the development and oversight of the assessment program. If a measure of general learning does not explain much of the variation in student scores, one option is to conclude that the measure is inappropriate to the students and the educational program of that particular college or university. In short, it can assist in the discard of that particular form of evaluation as superfluous and unnecessary. An alternative conclusion is that the institution is not devoting sufficient attention to the type of learning measured. Here, an examination of the assessment instrument itself relative to the curriculum is called for. Again, the Cluster Analytic Model can point to those courses and classes that were associated with gains in student learning on the measure in question.

While we have tried to give you a brief overview of the Cluster Analytic Model, it is not our intention to present or justify its constructs, assumptions and procedures in this paper. And despite our enthusiasm for the CAM, we should note that it should still be regarded as an exploratory research technique. In this paper, we present research funded by the Exxon Educational Foundation wherein we used CAM to determine the relationship between coursework and general learning at a particular college. This information told us what, among the nine measures of learning we used, explained most of the gains in student learning. Then we sought to verify and to elaborate on that learning by talking with the faculty who taught the courses associated with such gains. In the end, we have found some interesting relationships between certain types of questions in the General Tests of the Graduate Record Examinations and the faculty's intentions in teaching selected courses that are part of the undergraduate curriculum of that institution.

OBJECTIVES

The aim of the differential coursework patterns faculty survey is two-fold. First, in Part One, the major goal is to determine what the faculty perceptions of general learned abilities are in relation to the courses they teach. Specifically, do the faculty perceive that their courses help students gain in different areas of their general learned abilities and how do their courses enhance general learned abilities? In addition, this research explores what advice faculty give to students who want to improve their general learned abilities. In this research, general learned abilities denotes students cognitive development and is further defined by the criteria selected to measure general learning as described in the methodology section.

A secondary goal of Part One is to compare the results from the quantitative findings of the CAM study with the qualitative procedures used in recent faculty interviews to determine the level of congruency of these two analyses concerning the courses effects in the general learned abilities of students. In addition to the interviews, we collected examples from the course syllabi and final examinations to provide corroborating evidence for each interview.

The second aim of the DCP faculty survey, discussed in Part Two of this report, is to assess faculty members' perceptions of the courses they teach. More specifically, we examine issues such as how students are evaluated, the desired outcomes of class teaching, course planning, and class scheduling.

FRAMEWORK

A literature review indicated that no single curricular model and no single analytical process clearly identified the effect of coursework patterns on the general learned abilities of students. Ratcliff and associates (1987) developed the Cluster Analytic Model to determine the effect of coursework in colleges and universities on the general learned abilities of undergraduates. The CAM has demonstrated strong secondary validity and reliability within the context of a variety of higher education institutional types and student populations (Ratcliff, 1988, 1990c). The model uses a conceptual-empirical approach. Student decisions about courses and actual selections indicated on their transcripts guided the empirical search for coursework patterns associated with gains in general learned abilities.

This model guided the development of an interview protocol used to ascertain faculty perceptions concerning their courses relationship with the different areas of student general learned abilities.

OVERVIEW OF METHODOLOGY AND PROCEDURES

The procedures followed the Cluster Analytic Model. While incoming student ability of the sample was controlled by SAT scores, the exiting student achievement was measured by the Graduate Record Examination (GRE) scores. Specifically, the residual differences from the predicted and observed scores on the nine item-types within the General Test (of the GRE) served as the measures of exiting student achievement. In the Verbal section of the GRE, the four item-types are Analogies, Sentence Completion, Reading Comprehension, and Antonyms. Analogy items test students' ability "to recognize relationships among words and the concepts they represent and to recognize when these relationships are parallel. The process of eliminating four wrong answer choices requires one to formulate and then analyze the relationships linking six pairs of words" (ETS, 1988, p. 28). Antonym items provide a direct test of the student's vocabulary. However, the purpose of this item-type is not merely to measure the student's vocabulary, but also to gauge "the student's ability to reason from a given concept to its opposite" (ETS, 1988, p. 29). For the Reading Comprehension items, students must read narrative with "understanding, insight and discrimination." These passages challenge a student's ability to analyze using a variety of perspectives "including the ability to recognize both explicitly stated elements in the passage and assumptions underlying statements or arguments in the passage as well as the implications of those statements or arguments" (ETS, 1988, p. 31). Due to the length of the narratives around which the questions for this item-type are built, students are given ample opportunity to assess a variety of relationships, such as the function of a key word in a passage, the relationships among several ideas, or the relationship of the author to the topic or the audience. Sentence Completion items determine the student's ability to "recognize words or phrases that both logically and stylistically complete the meaning of a sentence" (ETS, 1988, p. 30). The student must decide which of five words, sets of words or phrases can best complete a sentence. In completing this type of task, the student must consider which answer gives the sentence a logically satisfying meaning and stylistically integrated whole to the discourse.

In the Quantitative section of the GRE the item-types are Quantitative Comparison, Regular Mathematics, and Data Interpretation. The Regular Mathematics item-type has also been labelled Discrete Quantitative questions and Arithmetic, Algebra and Geometry in various GRE and ETS publications. The Quantitative Comparisons items test the student's ability "to reason quickly and accurately about the relative sizes of two quantities or to perceive that not enough information is provided to make such a decision" (ETS, 1988, p. 34). Data Interpretation items present sets of data in graphs and tables and ask students to synthesize the information, choose the correct data to answer the question, or to determine that the information needed is not present in the data set.

In the Analytic section, the item-types are Analytical Reasoning and Logical Reasoning. Analytic Reasoning items measure a student's ability "to understand a given structure of arbitrary relationships among fictitious persons, places, things, or events, and to deduce new information from the relationships" (ETS, 1988, p. 38). Logical Reasoning items assess a student's ability to understand, analyze and evaluate positions and contentions. Specific questions may evaluate a student's ability to recognize a point of argument or the assumptions on which a position is based, to draw conclusions or form hypotheses, to assess the manner of arguments and the evidence supporting them.

While the GRE General Tests are designed to describe the student's broad verbal, mathematics and analytic abilities, the nine individual item-types of the Test provide discrete measures of general learned abilities. These nine GRE item-type residual scores represented the gains students experienced in general learned abilities from the time they entered college to the time of GRE testing during their senior year.

Next the coursework patterns for each sample were identified among the student transcripts. The unit of analysis was a single course. Each course examined had nine attributes represented by the nine residual item-type scores of students enrolling in the course. Courses with sufficient enrollment by the student sample were grouped according to the collective item-type scores of the students enrolling in the course. Therefore, each course had a mean residual score for each item-type. The effect of individual courses on test score residuals were determined by using cluster analysis. The cluster analysis techniques facilitated the construction of a classification scheme for unclassified data sets and it empirically examined the college curriculum using student decision-making behavior (represented on the student transcripts) as the primary source of information. Through the cluster analytic model, sets of courses were identified that were associated with gains in general learning on one or more of the nine (item-type) areas of general learning.

Using this course data from the samples, instructors whose individual courses yielded high positive means on the GRE item-types and enrolled three or more students were identified. Campus liaisons (at Stanford, Ithaca, and Mills) sent a letter describing the research project to these instructors (see Appendix A). Then the researchers phoned each professor to schedule a forty minute interview. At Stanford, the Registrar and Senior Associate Provost's office initially coordinated the interview schedule. However, due to the low response rate, subsequent site visits and interview schedules were coordinated by the researchers. Two site visits (usually a week long) were made to Ithaca College and Stanford University. Due to the changes in the administration and controversies relative to mission, faculty interviews were not scheduled for Mills College until April 1991. Results from Mills College have been incorporated into this report.

An interview protocol was utilized to assess faculty perceptions. This protocol was pilot tested at two Midwestern universities and two Midwestern colleges to insure the clarity of questions. Each professor was asked if the specific course he or she taught aided students in answering questions similar to each of the nine GRE item-types. Faculty were given examples of the GRE item-type questions (taken directly from a Graduate Record Examination) so that they could make direct comparisons. If a professor indicated that his or her course was helpful, then a follow-up question was asked concerning <u>how</u> the course aided students. Additional questions probed how faculty decide what advice to give students who want to develop their abilities in a specific area and what courses the faculty would recommend for students who wished to improve their abilities. Finally, course syllabi and final examinations were collected and analyzed as supplemental sources of information regarding the purposes of the courses and their means of evaluation.

Two random samples of graduating seniors were drawn from Stanford University. The first sample consisted of 105 students who constituted approximately 8 percent of the graduating seniors during the 1987-1988 academic year at Stanford University. The second sample of 161 students were graduating seniors from the 1988-1989 academic year.

Three random samples of graduating seniors were drawn from Ithaca College. The first sample consisted of 146 students who constituted approximately 14 percent of the graduating seniors during the 1987-1988 academic year at Ithaca College. The second sample of 191 students constituted 19 percent of the population of graduating seniors during 1988-1989 academic year. A third sample of 186 students constituted 16 percent of the graduating seniors during the 1989-1990 academic year.

Two random samples of graduating seniors were drawn from Mills College. The first sample consisted of 62 students who were graduating seniors from the 1987-1988 academic year. The second sample of 44 students were graduating seniors from the 1988-1989 academic year. The samples at these three institutions were proportional to the distribution of Scholastic Aptitude Test (SAT) scores, majors, and other socioeconomic characteristics of the population of graduating seniors at each institution (Ratcliff, 1990b; 1990c; 1990d).

FINDINGS OF DCP FACULTY SURVEY: PART ONE

Stanford University Samples and Dominant Item-Types

A cluster analysis of coursework and assessment scores for the Stanford samples produced a list of 94 courses where students had demonstrated high positive gains on one or more of the GRE nine item-types. The faculty who taught these courses were identified. From this group, 79 faculty agreed to be interviewed individually to assess their perception of their courses in relation to the general learned abilities of college students. Some faculty interviewed taught more than one course associated with improvement in student learning and responses were obtained for both courses.

For Stanford Sample #1, five item-types were dominant and associated with student improvement. Forty percent of the variation in Sample #1 test scores was explained by the Analytic Reasoning item-type. Another twenty percent was explained largely by Reading Comprehension. However, only one course was associated with this item-type in the interviews and therefore no further analysis was conducted with this item-type. Thirteen percent of the variation in Sample #1 was explained by Quantitative Comparisons, nine percent was explained by Antonyms, and seven percent was explained by Regular Mathematics.

For Sample #2, thirty percent of the variation in their test scores was explained by Analytical Reasoning and this was comparable to the results in Sample #1. Another twenty-five percent was explained largely by the Antonyms and Quantitative Comparisons item-types. Another eleven percent was explained by Analogies and eight percent was explained by the Regular Mathematics item-types (Ratcliff, 1990a).

The following discussion represents an aggregation of the data across these two samples since improvements in student learning were associated with some similar item-types. Tables 1 through 5 indicate the Stanford University courses represented in the faculty interviews and their association with the item-types. These relationships were identified from the quantitative procedures utilized in the Cluster Analytic Model.

Table 1

Courses Represented in Faculty Interviews at Stanford University Associated With Improvement in Analytical Reasoning

Course	Number	Title	Course	Number	Title
AS LIT	110	Japanese-Western Literacy/Interaction	PSYCH	111	Developmental Psychology
CE	170	Environmental Science Technology	PSYCH	115	Social Development
CHEM	31	Chemical Principles	PSYCH	116	Psychology of Women
CHEM	33	Structure and Reactivity	PSYCH	136	Abnormal Psychology
CHEM	35	Organic Monofunctional Compounds	STAT	60	Introduction to Statistical Methods I
CHEM	36	Chemical Separation	STAT	110	Statistics Methods in Engineering and the Physical Sciences
CHEM	131	Organic Polyfunctional Compounds			
CHEM	135	Physical Chemical Principles	STAT	116	Theory Probability
CLAS LIT	11	Age of Heroes	VTSS	115	Technology and Aesthetics
ECON	1	Elementary Economics			
ECON	51	Economics Analysis I			
ECON	165	International Economics			
EEC	31	Decision Analysis			
GE	10	Applied Mechanics: Statistics			
GE	30	Engineering Thermodynamics			
GE	40	Basic Electronics			
GE	50	Introductory Science of Materials			
GE	60	Engineering Economics			
GEOL	1	Interpreting the Earth			
HIST	1	Europe: Antiquity, Middle Ages, and Renaissance			
HIST	2	Europe from the Wars of Religion to the Nation State			
HIST	3	Europe: 1815 to the Present			
HUM	62	Western Thought and Literature			
HUM BIO	2	Genetics, Evolution, and Ecology			
HUM BIO	4	The Human Organism			
IE	60	Analysis of Production and Operation Systems			
IE	100	Organizations: Theory and Management			
MATH	20	Calculus and Analytic Geometry			
MATH	41	Calculus/Economics			
MATH	130	Ordinary Differential Equations			
ME	103	Manfacturing Technology			
ME	111	Stress, Strain, and Strength			
ME	112	Mechanical Systems			
ME	113	Engineering Design			
ME	131	Fluid Mechanics			
ME	161	Mechanical Vibrations			
OPER RE	151	Introduction to Operations Research I			
OPER RE	152	Introduction to Operations Research I			
POL SCI	1	Major Issues in American Public Policy			
POL SCI	182	Introduction to American Law			
PHYS	21	Mechanics and Heat			
PHYS	61	Advanced Freshmen Physics			
PHYS	62	Advanced Freshmen Physics			
PHYS	63	Advanced Freshmen Physics			
PSYCH	106	Cognitive Psychology			

Table 2
Courses Represented in Faculty Interviews at Stanford University Associated With Improvement in Analogies

Course	Number	Title
ART H	10	Introduction to Art
CLAS LIT	8	Classics Politics
COMM	108	Mass Communication Theory
COMM	110	Media and Law
COMM	170	Communication and Law
COM SCI	108	Computer Science and Fundamentals
POL SC	35	International Politics
VTSS	115	Technology and Aesthetics

Table 3
Courses Represented in Faculty Interviews at Stanford University Associated With Improvement in Antonyms

Course	Number	Title
ANTH	3	Human Prehistory
ART H	10	Introduction to Art
BIO SCI	31	Molecular and Cellular Biology
BIO SCI	32	Development and Organism Biology
BIO SCI	33	Evolutionary Biology and Ecology
BIO SCI	166	Genetics
GE	30	Engineering Therodynamics
GE	60	Engineering Economics
HUM BIO	32	Not Available
MATH	130	Ordinary Differential Equations
ME	33	Introductory Fluids Engineering
ME	103	Manufacturing Technology
ME	111	Stress, Strain, and Strength
ME	112	Mechanical Systems
ME	113	Engineering Design
ME	131	Fluid Mechanics
PHYS	55	Light and Heat

Table 4
Courses Represented in Faculty Interviews at Stanford University Associated With Improvement in Quantitative Comparisons

Course	Number	Title
ART H	10	Introduction to Art
BI SC	42	Not Available
CLAS LIT	8	Classics Politics
COMM	108	Mass Communication Theory
COMM	110	Communication Media and the Law
COMM	170	Communication and Child
COM SCI	108	Computer Science and Fundamentals
HUM BIO	10	Human Sexuality
MATH	41	Calculus and Analytic Geometry
POL SC	35	International Politics
POL SC	116	European Policy and Society
SOC	121	Not Available
VTSS	110	Philosophical and Ethical Issues in Public Policy
VTSS	115	Technology and Aesthetics

Table 5
Courses Represented in Faculty Interviews at Stanford University Associated With Improvement in Regular Mathematics

Course	Number	Title
ENGR	35	Not Available
HUM BIO	4	The Human Organism
MATH	21	Calculus and Analytic Geometry
MATH	41	Calculus and Analytic Geometry
VTSS	110	Philosophical and Ethical Issues in Public Policy

Faculty Responses

Many faculty at Stanford believed their courses helped students gain in their general learned abilities. As Table 6 indicates, the majority of faculty (78.7%) perceived that their courses helped students to improve in Logical Reasoning, followed by 64.9% of faculty who believed their courses helped students in Analytical Reasoning, and 67.0% viewed their courses as beneficial in the area of Data Interpretation. Reading Comprehension was considered by 61.1% of the faculty as an area where their courses would aid students to improve.

Table 6
Faculty Perceptions of General Learned Abilities at Stanford University

	GRE ITEM-TYPES								
	Sentence Completion	Analogies	Reading Comprehension	Antonyms	Regular Mathematics	Quantitative Comparisons	Data Interpretation	Logical Reasoning	Analytic Reasoning
My course helps students improve	31.91% (n=30)	37.23% (n=35)	61.70% (n=58)	24.47% (n=23)	35.11% (n=33)	44.68% (n=42)	67.02% (n=63)	78.72% (n=74)	64.89% (n=61)
My course does not help students improve	64.89% (n=61)	59.57% (n=56)	36.17% (n=34)	73.40% (n=69)	57.45% (n=54)	53.19% (n=50)	30.85% (n=29)	19.15% (n=18)	34.04% (n=32)
Don't know	3.19% (n=3)	3.19% (n=3)	2.13% (n=2)	2.13% (n=2)	7.45% (n=7)	2.13% (n=2)	2.13% (n=2)	2.1[illegible] (n=2)	1.06% (n=1)

The faculty responses of whether they considered their own courses as enhancing a student's ability to respond to each of the nine item-type areas were compared with the results from the quantitative analysis. Recall that through the Cluster Analytic Model, courses were identified and their associations with the nine measures of general learning. Table 7 indicates that low levels of congruency existed between the faculty responses and the quantitative results primarily for the Analogies, Antonyms, and Quantitative Comparisons item-types. Three reasons account for some of these differing viewpoints. First, many faculty believed that the academic level of students attending Stanford University was very high. Therefore, they perceived that students would have already attained solid levels of abilities in these areas prior to college attendance. They believe their own courses would not enhance these abilities. However, the quantitative analysis indicated that there were many courses associated with student improvement in these areas. The second reason for the incongruence of results between the faculty perceptions and the quantitative analysis involve the actual interview instrument used. Faculty were given examples of the item-types taken directly from a Graduate Record Examination. They often based their remarks on the content of the specific question rather than the broader goal of what ability the item-type was measuring. For example, in the area of Quantitative Comparisons, faculty were given a test item with a geometric figure. They viewed this question as dealing with geometry and were unable to see connections with their own courses. However, Quantitative Comparisons items were intended to measure the student's ability to make decisions about the sizes of two different quantities or to determine if there was not enough information to make a decision (ETS, 1988, p. 34). A third reason for the lack of congruence may be that these item-types did not explain the majority of score variance among students in either sample.

There were higher levels of agreement for the Regular Mathematics and Analytical Reasoning item-types. More faculty believed their courses helped students to improve in these areas and the quantitative results supported their perceptions. Overall, faculty seemed to better understand what abilities these item-types were measuring. Also, Analytic Reasoning explained the largest proportion of score variance among students (Ratcliff, 1990a).

Table 7
Level of Agreement Between Responses from Faculty Interviews and Quantitative Analysis for Stanford University

	GRE ITEM-TYPES				
	Analogies	Antonyms	Regular Mathematics	Quantitative Comparisons	Analytic Reasoning
Percentage of agreement that course helps to improve learned ability	14.28%	31.25%	50.00%	20.00%	66.67%

Faculty at Stanford University who responded that their courses helped students improve their abilities in relation to the GRE item-types were asked how their individual courses helped. They were also asked what courses to recommend for students to take if they wanted to improve their abilities. Specific examples from the faculty examinations supplement the faculty interview responses in reference to the five major item-types of Analytical Reasoning, Quantitative Comparisons, Antonyms, Analogies, and Regular Mathematics.

Analytical Reasoning

Some faculty believed that their courses helped students to improve in Analytical Reasoning. A biological science professor stated that in his course students were regularly given data and had to visualize it and interpret it based upon some information that was given to them. In a computer science course, a professor said he gave students complicated programs which required skills in abstraction and managing complexities. Students in this course were required to determine what information was true before they could work on the programs and had to fit many complex pieces of information together. Overall, the professor believed his course required vigorous analysis.

A chemistry professor's test item exemplifies the parallels we found with Analytical Reasoning types of abilities.

> In 1955, a small asteroid landed in the middle of San Francisco bay, ending the drought in surrounding counties. By 1998, surviving scientists had analyzed the cooling mineral debris for traces of organic matter. They discovered an unusual protein that they named Dilsegin (for Diluvio Segundo).
>
> Dilsegin has the following properties:
>
> 1. molecular weight 72,500;
> 2. does not form a phenylthiohydantoin when treated with Edman regent;
> 3. does not react with diazomethane;
> 4. is not cleaved to smaller peptides by trypsin or chymotrypsin;
> 5. complete hydrolysis yields an equimolar mixture of Gly, Phe, Ala, Lys, and His.
>
> * What do clues 2 and 3 tell you about the structure of Dilsegin?

An engineering economy course also contained a test item illustrating the similarity to an Analytical Reasoning item-type:

> Given a lottery, we know the following regarding John, Jim, and Larry.
>
> 1. John has a certain equivalent of $90 for the lottery.
> 2. Jim is risk neutral and has a certain equivalent of $100 for the lottery.
> 3. Larry has a certain equivalent of $80 for the lottery.
>
> * Which of the following is true?
>
> a. John is risk seeking; Larry is more risk seeking than John.
>
> b. John, Jim, and Larry are risk neutral.
>
> c. John is risk-averse; Larry is more risk-average than John.
>
> d. John is risk seeking but Larry is risk-averse.

Faculty believed their own courses helped students to improve in Analytic Reasoning. Concrete examples from actual faculty examinations indicated links between coursework and the faculty's evaluation of a student's ability to understand a structure of relationships to deduce information (ETS, 1988).

Quantitative Comparisons

Some faculty believed that their courses helped students to improve in Quantitative Comparisons. An engineering professor had students do problem solving by looking at two alternatives in financial decisions and deciding which option was best. Students had to structure problems and reach solutions. A human biology professor stated in a more general manner that his course taught students how to systematically approach and disentangle complex problems. Overall, in this area faculty were unable to clearly see connections with their courses helping in Quantitative Comparisons. Part of the reason for this difficulty was that the actual item in the interview instrument was a geometric figure and faculty tended to concentrate on this visual image rather than focusing on the actual abilities associated with Quantitative Comparisons.

An introductory science materials course exam contained a good example of Quantitative Comparisons item that asked students to compare the relative sizes of two different quantities.

> Indicate whether the following statement is true or false.
>
> Consider two metals, one with a melting point about 1600 C and one with a melting point of 600 C. At 500 C it is likely that the latter would have the higher vacancy concentration.

An engineering economics course test item also provides a good example of Quantitative Comparisons where students must compare the results of two different gambles.

> You are given the option of two mutually exclusive gambles.
>
> For the first gamble, a coin will be flipped three times. If the

coin come up "heads" each of the three times, you will be given $1600 in five years. If "tails" comes up each of the three times, you will be given $800 in five years. For any other combination you will will be given nothing.

For the second gamble, a coin will be flipped once. If the coin comes up "heads", you will be given $400 right away. If the coin comes up "tails", you will be given nothing.

If you bet so as to maximize expected value, which of the gambles should you take? Show why?

Faculty viewed definite relationships between their own courses and the improvement of a student's ability to deal with Quantitative Comparisons. The faculty examinations provided concrete evidence that these abilities are assessed in coursework.

Regular Mathematics

Some faculty believed that their courses helped students to improve in Regular Mathematics. A human biology professor stated in a general manner that his course taught students how to use statistics to describe a population.

An automotive technology course exam provides an example of an item similar to Regular Mathematics.

> Assuming that the average energy requirements are 180 watt-hours per mile for a vehicle, calculate the weight of sodium-sulfur batteries required for it to achieve a 200 mile range. Assume that the efficiency of transferring energy from the battery to the wheels is 85%.

Faculty believed their own courses helped students to improve in Regular Mathematics. Faculty examinations indicated that they did assess a student's ability to handle mathematics.

Analogies

Some faculty believed that their courses helped students to improve in Analogies. A professor in his history course used the primary activity of analysis of arguments and how elements related with each other. He believed that through this analysis in his course, students increased their vocabulary. An engineering professor believed his course taught new terms and concepts in the field so that students could understand current articles.

A test item from a professor's course in psychology in a general way relates to Analogies and the notion of recognizing relationships among words and the concepts they represent.

> Which of the following observations best illustrates the idea that families need to be thought of as true social systems?
>
> a. A young boy establishes a secure attachment with his mother.
>
> b. Mothers are less inclined to play with their children when fathers are present.

c. Parents today are having fewer children.

d. In today's families, an ever-increasing percentage of mothers choose to work outside the home.

e. Abusive parents were often abused children themselves.

In general, though, faculty did not have a ready sense of how students develop the ability to draw analogies. It was difficult to find examples of Analogies in the faculty examinations.

Antonyms

Some faculty believed that their courses helped students to improve in Antonyms. A professor in his communication course encouraged students to read a lot and learn vocabulary in the course. In a similar fashion an engineering professor believed his course taught students the specific acquisition of new terms and an understanding of them.

A sociology professor's exam contains an item related with Antonyms where students had to reason with two opposing situations.

> Choose ONE of the following pairs of situations from the episodes recorded in your journals:
>
> A. Situations in which you were a high interactor and situations in which you were a low interactor.
>
> B. Situations in which there was a formal organization and formal roles and situations that were informal.
>
> C. Situations in which all of the participants were of the same gender and situations in which there were both males and females.

Faculty believed their courses helped students to improve in Antonyms. However, it was difficult to find examples of this area in the faculty examinations.

In general, faculty thought that the courses they taught enhanced students' abilities to answer certain GRE item-type examples. With the exception of Quantitative Comparisons, faculty selected those item examples which correspond with the types of student learning gains associated with their course. Analytic

Reasoning produced the most score variance of the item-types in both Sample groups and was frequently picked by faculty as associated with learning occurring in their courses.

Implications for Academic Advising at Stanford University

Faculty were asked what courses to recommend for students to take if they wanted to improve their abilities as defined by the item-type areas of the GRE. In general, faculty did not have a consistent knowledge base for making such decisions. They drew upon their own undergraduate experience (usually at another college or university), The Stanford Bulletin, word of mouth recommendations of courses by other faculty or students. Faculty thought that courses in logic, computer science, engineering, philosophy, and biology helped students improve their abilities in Analytical Reasoning. Some faculty recommended these general areas while other faculty recommended specific courses offered at Stanford University which were usually courses in their own disciplines. Faculty were less knowledgeable about recommending courses outside of their disciplines. Since the majority of faculty were associated with technical and science related disciplines, these types of courses were frequently recommended. However, the cluster analysis indicated that other specific courses at Stanford in disciplines such as economics, history, psychology, political science, and statistics were associated with student improvement in Analytical Reasoning as well.

Faculty thought that courses in mathematics, geometry, logic, and computer science helped students improve their abilities in Quantitative Comparisons. Again, faculty recommended specific courses offered at Stanford within their own disciplines or general traditional subject areas. However, the cluster analysis indicated that other specific courses in political science and humanities were associated with student improvement in Quantitative Comparisons.

Faculty thought that courses in mathematics, geometry, logic, statistics, and engineering helped students improve their abilities in Regular Mathematics and these were the predominant courses in the CAM. Faculty thought that coursework in English, philosophy, history, fine arts, and liberal arts courses would help students improve their abilities in Analogies. Faculty often recommended these general areas. However, the cluster analysis indicated that other specific courses in computer science and communications were associated with student improvement.

Faculty thought that courses in English, public speaking, literature, history, and foreign language would help students improve their abilities in Antonyms. Most faculty recommended these general areas. However, the cluster analysis indicated that other specific courses in biological science, engineering, and physics were associated with student improvement. This research demonstrated that there were many different types of courses and disciplines associated with improvement in student learning. Faculty were tentative in recommending general traditional subject areas. When faculty viewed direct linkages of their own discipline with a certain item-type, they were comfortable in suggesting specific courses in their own discipline.

Ithaca College Samples and Dominant Item-Types

A cluster analysis of coursework and assessment scores for these samples produced a list of 107 courses where students had improved on one or more of the GRE nine item-types. The faculty who taught these courses were identified. From this group, 93 faculty agreed to be interviewed individually to assess their perception of their courses in relation to the general learned abilities of college students. Some faculty interviewed taught more than one course associated with improvement in student learning and responses were obtained for all their courses that had been identified in the research.

For Ithaca Sample #1, five item-types were dominant and associated with student improvement. Forty six percent of the variation in Sample #1 test scores was explained by Analytic Reasoning and Regular Mathematics item-types. Another twenty percent was explained largely by Quantitative Comparisons. Fourteen percent of the variation in Sample #1 was explained by Quantitative Comparisons, and eight percent was explained by Antonyms (Ratcliff, 1990b).

For Sample #2, forty-eight percent of the variation in their test scores was explained by Analytical Reasoning and this was comparable to the results in Sample #1. Another seventeen percent was explained largely by the Reading Comprehension item-type. Another sixteen percent was explained by Quantitative Comparisons (Ratcliff, 1990b).

For Sample #3, twenty-eight percent of the variation in their test scores was explained by Analytic Reasoning. Another seventeen percent was explained by the Antonyms item-type. Another seven percent was explained largely by Reading Comprehension and Regular Mathematics (Ratcliff, 1990c).

The data and discussion represent an aggregation of the data across these three samples since improvements in student learning were associated with some similar item-types. Tables 8 through 12 indicate the Ithaca College courses represented in the faculty interviews and their association with the item-types. These relationships were identified through the quantitative procedures in the Cluster Analytic Model. The predominant item-types associated with student improvement were Analytical Reasoning, Reading Comprehension, Regular Mathematics, Quantitative Comparisons, and Antonyms.

Table 8
Ithaca Courses Targeted in Faculty Interviews and the CAM Linkage
to Gains in Analytical Reasoning

Course	Number	Course Title
AC	105	Principles of Acct I
AC	105	Principles of Acct I
AHS	205	Critical Health Issues
AHS	401	Public Health and Epidemiology
ANTHRO	104	Cultural Anthropology
BIO	101	Fundamentals of Bio
BIO	104	Environmental Biology
BIO	112	Food and Fed Control
BIO	201	Anatomy and Physiology
BIO	202	Anatomy and Physiology
CHEM	102	Contemporary Chemical Issues
CHEM	111	Fundamentals of Chem
CHEM	112	Organic & Biochemistry
CHEM	113	Chemistry Lab
COM	102	Career Development
CSCI	110	Introduction to Data Processing
CSCI	157	Ex Machina: Computers
ECON	122	Prin of Micro Econ
ECON	121	Prin of Macro Econ
ECON	321	Money and Banking
ECON	341	Microanalysis
EDUC	219	Elements of Tutoring
EDUC	340	Foundations of Education
ENGL	112	Introduction to Short Story
FIN	203	Principles of Finance
FIN	311	Business Finance
FREN	201	Intermediate French
FREN	202	Intermediate French
GBUS	303	Business Law I
GIPPE	63	Golf I
HEAL	450	Psychoactive Drugs
HEAL	350	Psychoactive Drugs
HIST	105	News of the Day
HRM	306	Organizational Behavior
HRM	340	Personnel Administration
LING	233	Intro to Linguistics
MA	111	Introduction to Business
MA	310	Quantitative Methods in Management
MA	421	Business Policy
MATH	105	Math for Decision Making
MATH	108	Calculus for Decision Making
MATH	243	Statistics
MKTNG	323	Consumer Behavior
MRA	102	Medical Terminology
MU ED	110	Women's Chorale
PHIL	151	Reasoning I
PHYSED	81	Men's Football
PHYSED	125	Human Anatomy
PHYSED	126	Human Anatomy Lab
PHYSED	237	Biomechanics of Humans
PHYSED	246	Not Available
PHYSED	334	Physiology
PHYSED	335	Physiology
PHYST	103	Introduction to Health Professions
PHYST	203	Intro to Physical Therapy
PHYST	311	Physical Therapy Procedures
PHYST	331	Histology & Pathology
PHYST	342	Neuroanatomy & Neuroph
PHYS	101	Intro to Physics I
PHYS	102	Intro to Physics II
PHYS	111	Principles of Physics
PHYS	160	Physics of Sound
PHYS	170	Descriptive Astronomy
POL	102	Media and Politics
POL	103	U.S. & the World
PM	343	Production Management
PSY	210	Educational Psychology
PSY	311	Physiological Psych
PSY	321	Abnormal Psychology
SOC	207	Race & Ethnicity
SPATH	203	Intro to Speech Correc
SPATH	284	Manual Communications
SP COM	115	Business and Professional Communication
THEA	160	Intro to Theatre
TV-R	121	Intro to Mass Media
TV-R	131	Media Writing
TV-R	202	Television Directing
TV-R	232	Public Relations
TV-R	241	Advertising
TV-R	296	Audience Research
TV-R	322	New Telecomm Tech
W&R	108	Foundations of Writing
W&R	315	Technical Writing

Table 9

Ithaca Courses Targeted in Faculty Interviews and the CAM Linkage to Gains in Regular Mathematics

Course	Number	Course Title	Course	Number	Course Title
AHS	205	Critical Health Issues	THEA	160	Intro to Theatre
AHS	401	Public Health and Epidemiology	TV-R	121	Intro to Mass Media
ANTHRO	104	Cultural Anthropology	TV-R	296	Audience Research
ANTHRO	104	Cultural Anthropology	PHYST	103	Introduction to Health Professions
BIO	101	Fundamentals of Biology	PHYST	203	Intro to Physical Ther
BIO	201	Anatomy and Physiology	PHYST	311	Physical Therapy Proc
BIO	202	Anatomy and Physiology	PHYST	342	Neuroanatomy & Neuroph
BIO	112	Food and Fed Control	SPATH	284	Manual Communications
CHEM	102	Contemporary Chemical Issues	PHYS	101	Intro to Physics I
CHEM	111	Fundamentals of Chemistry	PHYS	102	Intro to Physics II
CHEM	112	Organic & Biochemistry	PHYS	111	Principles of Physics
CHEM	113	Chemistry Lab	PHYSED	125	Human Anatomy
COM	102	Career Development	PHYSED	126	Human Anatomy Lab
CSCI	110	Introduction to Data Processing	PHYSED	246	Not Available
ECON	121	Prin of Macro Econ	PHYSED	237	Biomechanics of Humans
ECON	122	Prin of Micro Econ	PHYSED	334	Physiology
ECON	321	Money and Banking	PHYSED	335	Physiology
ECON	341	Microanalysis	PHYST	331	Histology & Pathology
EDUC	219	Elements of Tutoring	SPATH	203	Intro to Speech Correc
EDUC	340	Foundations of Educ	TV-R	232	Public Relations
ENGL	110	Introduction to Fiction	W&R	315	Technical Writing
ENGL	112	Introduction to Short Story	W&R	108	Foundations of Writing
FIN	311	Business Finance			
GBUS	303	Business Law I			
HEAL	350	Psychoactive Drugs			
HEAL	450	Psychoactive Drugs			
HRM	250	Labor Relations			
HRM	306	Organizational Beh			
LING	233	Intro to Linguistics			
MA	310	Quant Meths in Mngmt			
MA	310	Quant Meths in Mngmt			
MA	421	Business Policy			
MATH	108	Calculus for Decision Making			
MATH	243	Statistics			
MKTNG	323	Consumer Behavior			
MRA	102	Medical Terminology			
PHYSED	81	Men's Football			
PHYS	170	Descriptive Astronomy			
POL	102	Media and Politics			
POL	103	U.S. & the World			
PM	343	Production Management			
SP COM	115	Business and Professional Communication			
SOC	207	Race & Ethnicity			

Table 10
Ithaca Courses Targeted in Faculty Interviews and the CAM Linkage to Gains in Reading Comprehension

Course	Number	Course Title
AC	105	Principles of Acct I
AC	105	Principles of Acct I
BIO	104	Environmental Biology
ECON	121	Prin of Macro Econ
ECON	122	Prin of Micro Econ
FIN	203	Principles of Fin
GIPPE	63	Golf I
GBUS	303	Business Law I
HRM	306	Organizational Beh
HRM	340	Personnel Administra
MA	111	Introduction to Bus
MA	310	Quant Meths in Mngmt
MA	421	Business Policy
MATH	105	Math for Decision Making
MATH	105	Math for Decision Making
MKTNG	323	Consumer Behavior
PHYS	160	Physics of Sound
PHYSED	125	Human Anatomy
PHYSED	126	Human Anatomy Lab
PHYSED	237	Biomechanics of Humans
PHYSED	334	Physiology
PHYSED	335	Physiology
TV-R	232	Public Relations
TV-R	241	Advertising

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Table 11
Itheca Courses Targeted in Faculty Interviews and the CAM Linkage
to Gains in Quantitative Comparisons

Course	Number	Course Title
BIO	101	Fundamentals of Bio
BIO	201	Anatomy and Physiology
BIO	202	Anatomy and Physiology
CHEM	102	Contemporary Chemical Issues
CHEM	111	Fundamentals of Chem
CHEM	112	Organic & Biochemistry
CHEM	113	Chemistry Lab
CSCI	157	Ex Machina: Computers
ECON	321	Money and Banking
ECON	341	Microanalysis
EDUC	219	Elements of Tutoring
EDUC	340	Foundations of Educ
ENGL	112	Introduction to Short Story
FIN	311	Business Finance
FREN	201	Intermediate French
GBUS	303	Business Law I
HEAL	350	Psychoactive Drugs
HEAL	450	Psychoactive Drugs
HRM	250	Labor Relations
HRM	306	Organizational Behavior
HIST	105	News of the Day
LING	233	Intro to Linguistics
MA	310	Quant Meths in Mngmt
MA	421	Business Policy
MATH	108	Calculus for Decision Making
MATH	243	Statistics
MRA	102	Medical Terminology
MU ED	105	Wind Ensemble
PHIL	151	Reasoning I
PHYST	203	Intro to Physical Ther
PHYST	311	Physical Therapy Proc
PHYST	331	Histology & Pathology
PHYST	342	Neuroanatomy & Neuroph
PHYS	101	Intro to Physics I
PHYS	102	Intro to Physics II
PHYS	111	Principles of Physics
PHYS	170	Descriptive Astronomy
PHYSED	125	Human Anatomy
PHYSED	126	Human Anatomy Lab
PHYSED	237	Biomechanics of Humans
PHYSED	334	Physiology
PHYSED	335	Physiology
PHYSED	246	Not Available
PSY	210	Educational Psychology
PSY	311	Physiological Psychology
PSY	321	Abnormal Psychology
SPATH	203	Intro to Speech Correc
SPATH	284	Manual Communications
SP COM	115	Business and Professional Communication
TV-R	131	Media Writing
TV-R	202	Television Directing
TV-R	322	New Telecomm Tech
W&R	108	Foundations of Writing
W&R	315	Technical Writing

Table 12
Ithaca Courses Targeted in Faculty Interviews and the CAM Linkage to Gains in Antonyms

Course	Number	Course Title
ENGL	110	Introduction to Fiction
FIN	203	Principles of Finance
GIPPE	63	Golf I
PHYS	160	Physics of Sound

Faculty Responses

Through the quantitative procedures and analysis, individual courses were identified that were associated with gains in the general learned abilities of students and subsequently faculty were identified who had taught these particular courses and were currently employed at Ithaca College.

As Table 13 indicates, the majority of faculty (77.6%) perceived that their courses helped students to improve in Logical Reasoning, followed by 63.5% of faculty who believed their courses helped students in Analytical Reasoning and Reading Comprehension, and 60.7% viewed their courses as beneficial in the area of Sentence Completion.

Table 13
Faculty Perceptions of General Learned Abilities at Ithaca College

	GRE ITEM-TYPES								
	Sentence Completion	Analogies	Reading Comprehension	Antonyms	Regular Mathematics	Quantitative Comparisons	Data Interpretation	Logical Reasoning	Analyti Reasoni
My course helps students improve	60.75% (n=65)	57.94% (n=62)	63.55% (n=68)	55.14% (n=59)	46.73% (n=50)	24.30% (n=26)	59.81% (n=64)	77.57% (n=83)	63.55 (n=68
My course does not help students improve	38.32% (n=41)	41.12% (n=44)	34.58% (n=37)	47.94% (n=48)	51.40% (n=55)	75.07% (n=81)	40.19% (n=43)	22.43% (n=24)	36.45 (n=39
Don't know	.93% (n=1)	.93% (n=1)	1.87% (n=2)	0	1.87% (n=2)	0	0	0	0

The faculty responses of whether they considered their own courses as enhancing a student's ability to respond to each of the nine item-type areas were compared with the results from the quantitative analysis. Recall that through the Cluster Analytic Model, courses were identified and their associations with the nine measures of general learning. Table 14 indicates that there were high levels of agreement for the Reading Comprehension, Analytical Reasoning, and Regular Mathematics item-types. Faculty believed their courses helped students to improve in these areas and the quantitative results supported their perceptions. Overall, faculty seemed to understand what abilities these item-types were measuring. However, low levels of congruency existed between the faculty responses and the quantitative results primarily for the Antonyms and Quantitative Comparisons item-types. However, the quantitative analysis indicated that there were courses associated with student improvement in these areas. The main reason for the incongruence of results between the faculty perceptions and the quantitative analysis involve the actual interview instrument used. Faculty were given examples of the item-types taken directly from a Graduate Record Examination. They often focused on the content of the specific question rather than the broader goal of what ability the item-type was measuring. Also, these item-types explained 20 percent or less of score variance.

Table 14
Level of Agreement Between Responses from Faculty Interviews and Quantitative Analysis for Ithaca College

	GRE ITEM-TYPES				
	Reading Comprehension	Antonyms	Regular Mathematics	Quantitative Comparisons	Analytic Reasoning
Percentage of agreement that course helps to improve learned ability	70.73%	20.00%	48.53%	25.45%	66.13%

Faculty who responded that their courses helped students improve their abilities in relation to the GRE item-types were asked how their individual courses helped. They were also asked what courses to recommend for students to take if they wanted to improve their abilities. Specific examples from the faculty examinations supplement the faculty interview responses in reference to the four major item-types of Analytical Reasoning, Reading Comprehension, Quantitative Comparisons, and Regular Mathematics.

Analytical Reasoning

Some faculty believed that their courses helped students to improve in Analytical Reasoning. A political science professor stated that through a major written paper in his course, students must analyze a situation such as the Vietnam war and make a written case of whether it was winnable. A business professor stated that her consumer behavior course helped students since it dealt with the changing environmental conditions and students drew conclusions of how these conditions affected certain problems. A science professor thought that his biology course helped students improve Analytical Reasoning through the extensive number of clinical decisions that the students made.

A test item from a philosophy professor's examination is an example of how Analytical Reasoning is assessed in the course.

> The following problem takes place in the Forest of Forgetfulness. The Lion lies on Mondays, Tuesdays, and Wednesdays and tells the truth on the other days of the week. The Unicorn lies on Thursdays Fridays, and Saturdays and tells the truth the other days. One day Alice met the two in the forest.
>
> The Lion said "I lied yesterday."
> The Unicorn said "I lied the day before yesterday or I will tell the truth tomorrow."
>
> Can it be determined what day of the week it is? ____________
> If so, what day? ____________

A biology professor's examination also provides a test item that involves Analytical Reasoning.

> From plant A the coleoptile was removed and placed on an agar block. The agar block was then placed on top of portion 2 of the same plant. Exposed to light, it bent toward the light source.
>
> From plant B section 1 was removed, then replaced in its original position. Exposed to light, it bent toward the light surface.
>
> In plant C, the coleoptile (1) was removed and discarded, being replaced by and untreated agar block. Exposed to light, nothing happened.
>
> What do these three plants demonstrate relative to the cause of the bending of the plant. Explain the purpose of plants A, B, and C in this experiment.

Faculty perceived that their own courses helped students to gain in Analytic Reasoning and their examinations provided illustrations of how this type of learning was evaluated.

Reading Comprehension

Some faculty believed that their courses improved students' Reading Comprehension abilities. An economics professor stated students gained an understanding of arguments and the cause/effect relationships through the readings involved in the textbook and the course content. A marketing professor used sets of mini-cases to apply the material learned in class through assigned readings. An advertising professor assigned a great deal of reading material and required students to read the New York Times. He emphasized words and the use of language in his course primarily through the extensive reading assignments. Another advertising professor stated that his course involved the practice of using reading comprehension skills for creating persuasive strategies. A math professor used word problems in his course.

A business professor's examination in Consumer Behavior illustrates a test item involving Reading Comprehension.

> Tandy Corporation is attempting to reposition its consumer business by changing its current "low budget", "frumpy", image to one as America's technology company". Which element of their marketing mix is being changed most dramatically in order to accomplish this desired change in image?
>
> a. Product
> b. Price
> c. Promotion
> d. Place

Another business professor's exam in an Introduction to Business course demonstrates a Reading Comprehension item.

> Twenty nonunion employees of the American Telephone and Telegraph Company (AT&T) and the Chesapeake & Potomac Telephone Company (C&P) filed suit against the Communication Workers of America (CWA) in 1986. AT&T and C&P maintained labor agreements containing agency shop provisions with the union. In their lawsuit the nonunion employees in the bargaining unit objected to CWA's use of their agency fees for the purposes unrelated to collective bargaining, contract administration, or grievance adjustments. The judge found CWA guilty of misusing agency shop dues. In her findings the judge should have indicated that CWA action violated the

a. Taft-Hartley Act
b. Norris-LaGuardia Act
c. Wanger Act
d. Ladrum-Griffin Act
e. Fair Labor Standards Act

Faculty viewed their own courses as aiding students in Reading Comprehension. The test items reveal that faculty did evaluate the student's ability to comprehend narrative and understand the implications.

Quantitative Comparisons

An advertising professor stated that in his audience research course students were given sets of information and made comparisons for decisions. An anatomy professor's course dealt with work in math and examined relationships in data. A business professor stated that correlation, regression, and advanced math techniques were used in her course. A chemistry professor to a limited extent covered basic algebra.

A biology professor's examination demonstrates a test item similar to the GRE item-type of Quantitative Comparisons.

If all else is equal, which subject will have the highest rate of blood flow?

Subject A	Subject B
B.P. = 130/80	120/80
X AP = 102	90
Central Venous Pressure	2

A. subject A
B. subject B
C. both subjects will be equal

A physics professor's test item also illustrates a similarity to the Quantitative Comparison item-type.

You have two tones: 90 dB at 123 Hz and 90 dB at 1500 Hz. Is one louder than the other and if so by how many times? Show your work!

Both of these test items require students to make comparisons of two quantities. These examples illustrate how faculty evaluate this type of learning.

Regular Mathematics

Some faculty believed their courses improved students' abilities in Regular Mathematics. An economics professor stated that his course used math formulas to address theories and applied work problems. A professor of business policy stated that his course used spreadsheets and balance sheets in order to solve business operation problems. A biology professor required a major course project involving diet analysis.

A physical therapy professor's examination in neuroanatomy/neurophysiology provides an illustration of an item similar to the Regular Mathematics item-types.

> A neuron has a resting membrane potential of -80 millivolts, and an excitatory threshold of -60 millivolts. The dendritic spines of this neuron receive input from the pre-synaptic terminals of about 50 other neurons. Each pre-synaptic terminal is capable of producing an EPSP of 3 millivolts. What is the minimum number of pre-synaptic terminals which must fire in order to cause an action potential in the neuron?
>
> a. 3
> b. 5
> c. 7
> d. 21
> e. all of them

A business professor's final examination for a Quantitative Methods in Management course demonstrates another example of similarity with Regular Mathematics.

> Total yearly sales achieved by the members of your sales force are normally distributed. The mean is $1,000,000 and the standard deviation is $2,000,000. Joe's yearly sales are $1,400,000. The most accurate statement about his position is:
>
> a. in the top half, but not in the top quarter
> b. in the top quarter, but not in the top ten percent
> c. in the top ten percent, but not in the top five percent
> d. in the top five percent

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These examples involve arithmetic and ask students to perform mathematical calculations.

Implications for Academic Advising at Ithaca College

Faculty were asked to recommend courses that would help students answer sample questions taken from the GRE examination used in this study. Faculty thought that courses in mathematics, science, logic, economics, and philosophy helped students improve their abilities in Analytical Reasoning. Some faculty recommended these general areas while other faculty recommended specific courses offered at Ithaca College such as Math for Decision Making. However, the cluster analysis indicated that other specific courses in health care, history, political science, and advertising were associated with student improvement in Analytical Reasoning.

Most faculty thought that English, literature and writing courses helped students improve Reading Comprehension. However, other specific courses in music, mathematics, accounting, finance, and marketing were associated with student improvement in Reading Comprehension.

Faculty thought that math, computer science, science courses such as biology, chemistry, statistics, social science research and economics helped students to improve their abilities in Quantitative Comparisons. Most faculty recommended these general courses while some faculty recommended specific courses such as Math for Decision Making or Microeconomics.

Faculty thought that math, physics, chemistry, economics, and statistics helped students to improve their abilities in Regular Mathematics. However, other specific courses in Physical Therapy, Speech Pathology, Psychology, and Accounting were also associated with Regular Mathematics as determined by the quantitative analysis.

Faculty clearly had difficulty making specific course recommendations beyond their immediate discipline or field of expertise. Instead, they would most frequently identify a discipline, field of study or department that they believed would be able to help the student. Faculty drew upon their undergraduate and graduate experience, the Ithaca College catalog (Undergraduate Announcements), and word of mouth information from other faculty and former students to make specific course recommendations. When faculty did not know how to advise the student, their course recommendations were understandably vague and general. When faculty saw a similarity between the abilities tested in a GRE questionnaire and that which they tried to develop in their class, they were able to quite articulately explain how they tried to encourage student development.

Mills College Samples and Dominant Item-Types

A cluster analysis of coursework and assessment scores for the Mills samples produced a list of courses where students had improved on one or more of the GRE nine item-types. The faculty who taught these courses were identified. From this group, 34 faculty agreed to be interviewed individually to assess their perception of their courses in relation to the general learned abilities of college students. Some faculty interviewed taught more than one course associated with improvement in student learning and responses were obtained for both courses.

For Mills Sample #1, four item-types were dominant and associated with student improvement. Seventeen percent of the variation in Sample #1 test scores was explained by the Quantitative Comparison item-type. Another ten percent was explained by Antonyms. Six percent of the variation in Sample #1 was explained by Analytic Reasoning and Data Interpretation (Ratcliff, 1990d).

For Sample #2, forty percent of the variation in their test scores was explained by Analytical Reasoning and another twenty-five percent was explained by the Reading Comprehension item-type. Eighteen percent was explained by Quantitative Comparisons and Regular Mathematics. Eight percent was explained by the Antonyms and Logical Reasoning item-types (Ratcliff, 1990d).

The following discussion represents an aggregation of the data across these two samples since improvements in student learning were associated with some similar item-types. Tables 15 through 19 indicate the Mills College courses represented in the faculty interviews and their association with the item-types. These relationships were identified from the quantitative procedures utilized in the Cluster Analytic Model.

Table 15
Courses Represented in Faculty Interviews at Mills College Associated with Improvement in Quantitative Comparisons

Course	Number	Title
ANTH	58	Cultural Anthropology
ARTH	186	Japanese Painting & Prints
BIO	42	Human Physiology
DANCE	5	Elementary Modern Dance Techniques
DANCE	5	Elementary Modern Dance Techniques
DRA	63	Make-Up
EDUC	101	Social Foundations of Education
ENG	88	Communication Aesthetics & Criticism
ENG	56	Writing of Fiction & Verse
FRENCH	10	Composition & Text Analysis
GOVT	102	Administrative Behavior
HIST	139	Diplomatic History of U.S.
MUS	27	Chamber Music

Table 16
Courses Represented in Faculty Interviews at Mills College Associated with Improvement in Analytical Reasoning

Course	Number	Title
ATRH	18	Introduction to Western Art
CHEM	4	Introduction to College Chemistry
DANCE	15	Jazz Dance
ECON	135	Microeconomic Theory
ECON	81	Introduction to Statistics
ENG	61	Genre Courses
FRENCH	40	French Pheonetics
GOVT	90	American Foreign Policy
MUS	27	Chamber Music
SOC	99	Criminology
SOC	142	Medical Sociology
SOC	61	Women in Contemporary Society
SOC	103	Women & Work

Table 17
Courses Represented in Faculty Interviews at Mills College Associated with Improvement in Data Interpretation

Course	Number	Title
ANTH	58	Cultural Anthropology
DRA	63	Make-Up
EDUC	101	Social Foundations of Education
ENG	10	Introductory Seminar in Writing about Literature
ENG	88	Communication Aesthetics & Criticisms
ENG	10	Introductory Seminar in Writing about Literature
FRENCH	57	Composition & Text Analysis
GOVT	17	International Relations
HIST	139	Diplomatic History of U.S.
MUS	107	Individual Instrument Instruction--Piano

Table 18
Courses Represented in Faculty Interviews at Mills College Associated with Improvement in Reading Comprehension

Course	Number	Title
ATRH	18	Introduction to Western Art
ECON	81	Introduction to Statistics
ENG	61	Genre Courses
FRENCH	40	French Pheonetics
FRENCH	2	Elementary French
FRENCH	3	Intermediate French
FRENCH	4	Intermediate French
HIST	120	Ireland: Culture & Conflict
HIST	11	History of Western Thought
PSCH	49	Fundamentals of Psychology

Table 19
Courses Represented in Faculty Interviews at Mills College Associated with Improvement in Antonyms

Course	Number	Title
ANTH	161	Cross-Cultural Perspective: Women
ARTH	186	Japanese Painting & Prints
GOVT	148	Model United Nations
M&CS	4	Discrete Mathematics
M&CS	151	Modern Algebra
M&CS	8	Linear Algebra
SOC	55	Introduction to Sociology
SOC	94	Sociology of Mass Communication

Faculty Responses

Many faculty at Mills believed their courses helped students gain in their general learned abilities. As Table 20 indicates, the majority of faculty (85.7%) perceived that their courses helped students to improve in Reading Comprehension, followed by 78.6% of faculty who believed their courses helped students in Logical Reasoning, and 64.2% viewed their courses as beneficial in the areas of Analogies and Analytic Reasoning.

Table 20
Faculty Perceptions of General Learned Abilities at Mills College

	GRE ITEM-TYPES								
	Sentence Completion	Analogies	Reading Comprehension	Antonyms	Regular Mathematics	Quantitative Comparisons	Data Interpretation	Logical Reasoning	Analytical Reasoning
My course helps students improve	57.14% (n=24)	64.29% (n=27)	85.71% (n=36)	54.76% (n=23)	26.19% (n=11)	21.43% (n=9)	40.48% (n=17)	78.57% (n=33)	64.29% (n=27)
My course does not help students improve	42.86% (n=18)	35.71% (n=15)	14.29% (n=6)	45.24% (n=19)	71.43% (n=30)	78.57% (n=33)	59.52% (n=25)	21.43% (n=9)	30.95% (n=13)
Don't know	.00% (n=0)	.00% (n=0)	.00% (n=0)	.00% (n=0)	2.38% (n=1)	.00% (n=0)	.00% (n=0)	.00% (n=0)	4.76% (n=2)

The faculty responses of whether they considered their own courses as enhancing a student's ability to respond to each of the nine item-type areas were compared with the results from the quantitative analysis. Recall that through the Cluster Analytic Model, courses were identified and their associations with the nine measures of general learning. Table 21 indicates that low levels of congruency existed between the faculty responses and the quantitative results primarily for the Data Interpretation, Antonyms, and Quantitative Comparisons item-types. Two reasons account for some of these differing viewpoints. The first reason for the incongruence of results between the faculty perceptions and the quantitative analysis involve the actual interview instrument used. Faculty were given examples of the item-types taken directly from a Graduate Record Examination. They often based their remarks on the content of the specific question rather than the broader goal of what ability the item-type was measuring. For example, in the area of Data Interpretation, faculty were given a test item with a graph of data pertaining to a sample. They viewed this question as dealing mostly with similar graphs and were unable to see connections with their own courses. However, Data Interpretation items were intended to measure the student's ability to make decisions about "data presented in tables or graphs and test one's ability to synthesize information, to select appropriate data for answering a question or to determine that sufficient information for answering a question is not provided (ETS, 1989, p. 39). A second reason for the lack of congruence is that these item-types did not explain the majority of score variance among students in either sample.

There were higher levels of agreement for the Reading Comprehension and Analytical Reasoning item-types. More faculty believed their courses helped students to improve in these areas and the quantitative results supported their perceptions. Overall, faculty seemed to better understand what abilities these item-types were measuring.

Table 21
Level of Agreement Between Responses from Faculty Interviews and Quantitative Analysis for Mills College

	GRE ITEM-TYPES				
	Data Interpretation	Reading Comprehension	Antonyms	Quantitative Comparisons	Analytic Reasoning
Percentage of agreement that course helps to improve learned ability	30.00%	90.00%	37.50%	23.08%	69.23%

Faculty at Mills College who responded that their courses helped students improve their abilities in relation to the GRE item-types were asked how their individual courses helped. They were also asked what courses to recommend for students to take if they wanted to improve their abilities. Specific examples from the faculty examinations supplement the faculty interview responses in reference to the five major item-types of Analytical Reasoning, Quantitative Comparisons, Antonyms, Reading Comprehenion, and Data Interpretation.

Analytical Reasoning

Some faculty believed their courses helped students to improve in Analytical Reasoning. An art history professor gives students a tray of slides to study over the duration of the course and then they are given new slides to identify and analyze based upon the concepts they have learned. This professor's examination in Western Art provides a test item illustrating the necessity of analytical skills.

> This is a portal on the south side of a medieval European church. Analyze this example and classify it according to the characteristic of Romanesque or Gothic art.

A sociology professor requires her students to do analysis in class. For example, students analyze gender roles as outsiders observing the inner structures of a family. Her exam contains an essay question which deals with role stereotypes.

> Explain de Beauvoir's self-other dichotomy. Include in your discussion the concept of "identification with the oppressor" (aggressor). How do these conceptual tools explain the persistence of gender role stereotypes?

Faculty examinations indicated that a student's ability to analyze were assessed.

Quantitative Comparisons

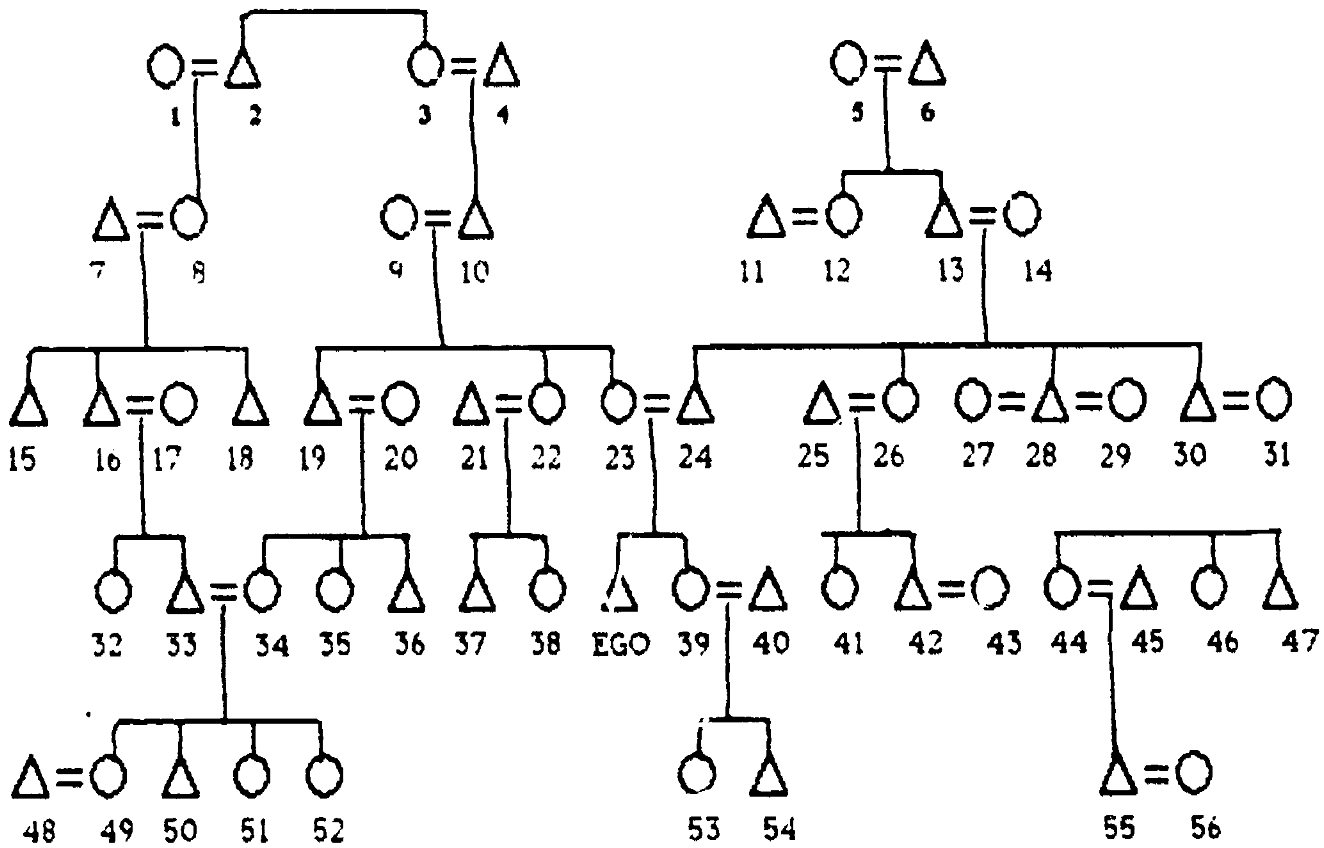
Some faculty believed their courses helped students to improve in Quantitative Comparisons. An economics professor stated that students in her course completed maximization problems to determine which quantity is larger. A statistics professor has students comparing their results to other quantitative entities to determine whether one result is greater or less than another. Similar with the findings at Stanford University and Ithaca College, faculty at Mills were unable to see clear linkages with their courses helping in Quantitative Comparisons. One reason for this difficulty was the actual item in the interview instrument was a geometric figure and faculty tended to focus on this visual image rather than the broader abilities associated with Quantitative Comparisons.

Second, the majority of courses associated with gains in Quantitative Comparisons were humanities and creative arts courses rather than quantitative or mathematical courses. None of the exams collected for courses associated with improvement in Quantitative Comparisons contained test items similar to this item-type.

Data Interpretation

Some faculty believed their courses helped students to improve in Data Interpretation. An anthropology professor stated that her students obtain a great deal of practice in interpreting tabular data. A chemistry professor emphasized that data interpretation is the foundation of his course. Students used observational data which was frequently experimental and interpreted the results.

A cultural anthropology exam contains a test item which involves the interpretation of data relevant to the discipline.



Assume this is a chart for a matrilineal, matrilocal society. Answer the following, using numbers where appropriate.

A. Shade in all the members of EGO's clan.

B. Who is the head of EGO's clan?

C. If this society prefers matrilateral cross-cousin marriage, who should EGO marry?

D. Who will EGO live with after he is married?

E. If EGO has a son, who will have authority over him (the son)?

In general, though, the majority of faculty believed their courses did not help students to develop data interpretation skills. It was difficult to find examples of Data Interpretation in the faculty examinations especially since many humanities and creative arts courses were associated with improvement in Data Interpretation.

Antonyms

Some faculty believed their courses helped students to improve in Antonyms. A professor who teaches criminology stated that students in his course define and discuss opposing concepts such as criminal versus non-criminal activities or morality versus no morality. In a similar manner, a history professor stated that his course aids students in Antonyms since he teaches the precision of language through an examination of historical documents.

A sociology of mass communications course test item provides an example of Antonyms where students note the differences between two types of programming.

> What are the major differences between day time soap operas and prime time programming? Focus on three major areas of contrast, and describe the differences between "soaps" and "prime time." Finally, for each "difference" that you have identified, give a brief (one or two sentence) explanation of "why" this difference is significant.

Approximately one-half of the faculty at Mills thought their courses helped students to improve in Antonyms. However, it was difficult to find examples of this area in the faculty examinations.

Reading Comprehension

Some faculty believed their courses helped students to improve in Reading Comprehension. An English professor teaches her students to read the text carefully in her course. They learn to identify the main ideas and supporting statements by searching for clues in the text. Students also learn to differentiate between statements and to discover their implications. An art history professor emphasized reading for her students so that they understand both the content and context of art.

A professor's exam in the fundamentals of psychology illustrates a test item involving Reading Comprehension.

Mary takes a course in which she is tested every two weeks. Her studying falls off right after a test, followed by a gradual increase to a rapid rate of studying as the next test approaches. Her studying conforms to the typical pattern of responding maintained on _________ schedules.

A. fixed-ratio
B. variable-ratio
C. fixed-interval
D. variable-interval

Humanities courses were frequently associated with improvement in Reading Comprehension. A review of the syllabi in these particular courses revealed an emphasis on required readings often supplemented with a series of discussion questions. However, many of the examinations in these courses did not test Reading Comprehension directly. Instead, the examinations often focused on testing the analytical abilities of students.

Implications for Academic Advising at Mills College

Faculty were asked what courses to recommend for students to take if they wanted to improve their abilities as defined by the item-type areas of the GRE. In general, faculty did not have a consistent knowledge base for making such decisions. They drew upon their own undergraduate experience (usually at another college or university), The Mills College Bulletin, word of mouth recommendations of courses by other faculty or students. Faculty thought that courses in logic, statistics, research methods, philosophy, and theory-related courses helped students improve their abilities in Analytical Reasoning. Some faculty recommended these general areas while other faculty recommended specific courses offered at Mills College which were usually courses in their own disciplines. Faculty were less knowledgeable about recommending courses outside of their disciplines. Since the majority of faculty were associated with liberal arts-related areas, these types of courses were frequently recommended. However, the cluster analysis indicated that other specific courses at Mills in chemistry, economics, and music were associated with student improvement in Analytical Reasoning as well.

Faculty thought that courses in mathematics, geometry, and logic helped students improve their abilities in Quantitative Comparisons. Again, faculty recommended specific courses offered at Mills within their own disciplines or general traditional subject areas. However, the cluster analysis indicated that other specific courses in biology, dance, art history, and music were associated with student improvement in Quantitative Comparisons.

Faculty thought that courses in mathematics, economics, social science methods, and math helped students improve their abilities in Data Interpretation. However, the cluster analysis indicated that other specific courses in French, English, anthropology, and music were associated with student improvement.

Faculty thought that courses in English, public speaking, literature, history, and foreign language would help students improve their abilities in Antonyms. Most faculty recommended these general areas. However, the cluster analysis indicated that other specific courses in mathematics (algebra-related courses), anthropology, and sociology courses were associated with student improvement. This research demonstrated that there were many different types of courses and disciplines associated with improvement in student learning. Faculty were tentative in recommending general traditional subject areas. When faculty viewed direct linkages of their own discipline with a certain item-type, they were comfortable in suggesting specific courses in their own discipline.

FINDINGS OF DCP FACULTY SURVEY: PART TWO

Introduction

As noted earlier, Part Two of this report examines faculty perceptions of the courses they teach. More specifically, faculty members from Stanford, Ithaca, and Mills were asked about the nature, purpose, and form of student evaluation, the desired outcomes of class instruction, course planning strategies, and class scheduling. What follows, then, are current faculty perspectives regarding college students' educational experiences.

The work of several curriculum and learning theorists provided the basis for the development of many of the questions in the survey concerning faculty instructional goals, assessments, and teaching methods. For example, the survey's first four questions, which focused on the evaluation of student learning, were constructed using Bloom's (1956) cognitive domain taxonomy, Krathwohl's (1964) affective domain taxonomy, and Simpson's (1972) psychomotor domain taxonomy. In this context, a domain simply refers to a specific category or arena of educational development. Similarly, a taxonomy, as it is used here, denotes a classification of various goals of the educational process that is intended to assist educators with the design and evaluation of course curricula.

A brief description of each of the domains above may be instructive. The cognitive domain describes educational outcomes that require "the recall or recognition of knowledge and the development of intellectual abilities and skills (Bloom, 1956, p. 7). An example of an educational outcome within the cognitive domain is a student's ability to remember dates, events, persons, or similar bits of information.

The affective domain consists of educational objectives that are linked with a student's "interests, attitudes, appreciations, values, and emotional sets or biases" (Krathwohl, 1964, p. 7). An individual's active participation in class discussions is an example of an educational outcome within the affective domain.

Finally, the psychomotor domain is comprised of educational goals that focus on "some muscular or motor skill, some manipulation of material and objects, or some act which requires a neuromuscular coordination" (Krathwohl, 1964, p. 7). For instance, an educational outcome that characterizes the psychomotor domain is a student's ability to conduct a physical procedure with consistency.

The Nature of Student Evaluation

Faculty members were asked to indicate the degree to which the final evaluation of their students is based on each of the three primary areas discussed above: cognitive, affective, or psychomotor performances. The majority of faculty respondents (68%) across the three institutions in the study based 80 percent or more of students' final evaluation on the students' cognitive development (see Table 22). Among the institutions, Stanford has the largest percentage of faculty (76%) who based 80 percent or more of students' final evaluation on their cognitive development, followed by Ithaca (65%) and Mills (56%). Although marked differences exist among the institutions (owed, at least in part, to differences in institutional priorities), a majority of those interviewed at each institution consider knowledge acquisition and the ability to use it vital to the educational process. Most faculty members perceive students' cognitive development to be the legitimate basis for test construction and course evaluation.

The proportion of faculty members' evaluation of students' affective development is small (see Table 23). Only 14 percent of the respondents stated that they include students' affective performance as more than 30 percent of the final grade. Most of these individuals teach in either traditional liberal arts disciplines (e.g., English, Economics, History, Chemistry, Sociology, Literature) or applied fields (Business, Government, Engineering). Approximately one-quarter (28%) of the faculty use students' affective performance as 10 to 20 percent of the final grade. This corresponds with a finding from the syllabi analysis, in which 26 percent of the syllabi sample that we examined included class attendance/participation as 10 to 20 percent of students' final evaluation. The largest percentage (45%) of the faculty, representing a wide array of courses, remarked that students' affective development constitutes less than ten percent of the final evaluation.

Even more pronounced is the percentage of students' final evaluation that is based on psychomotor competencies (see Table 24). A large majority (82%) of the faculty observed that students' psychomotor development is not a criterion for final evaluation. This finding is not unusual given that the development of psychomotor abilities would not be expected in the traditional courses that comprise a large portion of the sample. Only 42 faculty members (18%) included psychomotor performance as a basis for final evaluation, and most of these individuals (28) considered student's psychomotor development as 20 percent or less of a student's final grade. Faculty members who placed greater emphasis (i.e., 50% or higher) on psychomotor competencies in determining students' final grades were members of performance disciplines such as music, drama, or dance.

Table 22
Students' Final Evaluation Based on Cognitive Development

Percentage	Stanford	Ithaca	Mills	Total
100	45	33	13	91
95	3	9	0	12
90	7	12	5	24
86	0	0	1	1
85	1	2	0	3
80	13	13	4	30
75	5	3	3	11
70	4	7	2	13
66	1	0	0	1
65	0	1	0	1
60	3	5	0	8
50	7	11	5	23
40	2	4	2	8
33	0	1	0	1
30	0	1	1	2
25	0	0	2	2
20	0	4	1	5
10	0	0	2	2
TOTAL				238

Table 23
Students' Final Evaluation Based on Affective Development

Percentage	Stanford	Ithaca	Mills	Total
100	0	0	0	0
90	0	0	1	1
80	0	2	0	2
60	0	0	1	1
50	5	7	5	17
40	2	5	1	8
35	1	1	0	2
33	1	1	0	2
30	6	9	2	17
25	5	6	5	16
20	14	10	5	29
15	0	6	1	7
14	0	0	1	1
10	9	14	6	29
5	3	9	0	12
2	0	2	0	2
0	45	34	13	92
TOTAL				238

Table 24
Students' Final Evaluation Based on Psychomotor Development

Percentage	Stanford	Ithaca	Mills	Total
100	0	0	0	0
75	0	0	1	1
60	0	1	2	3
50	1	1	2	4
40	0	3	0	3
33	0	1	0	1
25	0	2	0	2
20	2	5	1	8
15	1	4	0	5
10	1	4	0	5
5	3	5	0	8
3	0	2	0	2
0	83	78	35	196
TOTAL				238

Faculty members also were asked to provide a more specific description of their evaluation of students' cognitive, affective, and psychomotor development by rating the importance that they attach in their overall evaluation of selected student abilities (using a Likert-type scale). A majority of interviewed faculty members (64% and 71%, respectively) consider the evaluation of students to be very important in two particular cognitive development areas: (1) gaining basic knowledge, language, or terms, and (2) understanding concepts, theories, and trends of the field of study (see Table 25). The area of cognitive competence ranked least important in faculty members' evaluation of students is students' ability to judge the worth or value of something based on specific criteria; students' ability to distinguish between facts and inferences; and students' ability to perform, act out, and demonstrate skills involved in the field of study. These findings suggest that students' final evaluations are based on the development of lower order cognitive abilities (e.g., knowledge, comprehension), rather than the development of higher order cognitive abilities (e.g., application, analysis, synthesis, and evaluation) (Bloom, 1972).

The analysis of sample syllabi and tests, at first glance, seem to contradict these findings. That is, a majority (54%) of the sample syllabi portray higher order cognitive skills (analysis, synthesis, evaluation) as expected course outcomes. Further, an even larger majority (74%) of sample examinations test students' higher order cognitive development (analysis, synthesis, evaluation). On closer inspection, however, the findings from the sample syllabi and tests are inflated. Each rater included higher order skill categories as present (usually implicitly) if a simple phrase was included in a syllabus or a test contained even one question that required higher order cognitive skill. As a result, the analysis of sample syllabi and tests is skewed upward, giving the impression that the development of higher order skills typically is expected from students (based on sample syllabi) and that higher order skills typically are necessary to complete course examinations (based on sample tests).

As noted earlier, most faculty members do not base a large portion of their final evaluation of students on students' affective development. This finding is reflected in faculty members' responses regarding their evaluation of specific affective abilities in students (see Table 26). Each component of students' affective development, particularly the two that focused on students' class participation, was thought to be "very important" or "important" by a considerable percentage of faculty members (ranging between 34% and 48%). Mills faculty ranked each affective component considerably higher than did Stanford or Ithaca faculty. An equally significant percentage of faculty members (ranging between 43% and 55%), largely from Stanford and Ithaca, rated the selected areas of affective development to be "unimportant," "very unimportant," or "neutral" in their overall evaluation of students. Faculty members who consider the development of students' affective abilities as an important component of their evaluation are scattered across many disciplines and fields.

Students' psychomotor development played even less of a role in students' overall evaluation according to faculty members (see Table 27). As a result, a majority of interviewees (ranging between 71% and 73%) explained that each of the seven psychomotor development areas listed in the survey question is "very unimportant" in their final evaluation of students. Only those faculty members who teach in fields such as physical education, music education, drama, dance, engineering, and chemistry--subjects that typically require some type of physical proficiency--considered the development of psychomotor skills important to students' learning processes.

Table 25
Students' Cognitive Development: Evaluation of Students' Ability to:

Institution	Very Important	Important	Neutral	Unimportant	Very Unimportant
• Gain basic knowledge, language, or terms					
Stanford	40	37	13	1	1
Ithaca	79	19	8	0	0
Mills	33	6	2	0	0
TOTAL	152	62	23	1	1
• Understand concepts, theories, and trends of field					
Stanford	75	14	2	0	1
Ithaca	68	30	8	0	0
Mills	26	12	2	0	1
TOTAL	169	56	12	0	2
• Perform, act out, demonstrate skills involved in field					
Stanford	32	30	11	11	8
Ithaca	38	23	22	10	13
Mills	18	13	6	1	0
TOTAL	88	66	39	22	21
• Distinguish between facts and inferences; etc.					
Stanford	32	21	22	12	5
Ithaca	38	23	22	10	13
Mills	24	7	1	6	3
TOTAL	94	51	45	28	21
• Integrate learning from different areas into original idea					
Stanford	33	28	21	5	5
Ithaca	43	31	23	5	4
Mills	19	9	8	5	0
TOTAL	95	68	52	15	9
• Judge worth, value of something based on specific criteria					
Stanford	22	32	22	10	6
Ithaca	31	31	26	9	8
Mills	11	16	8	4	2
TOTAL	64	79	56	23	16

n 239

Table 26
Students' Affective Development: Evaluation of Students' Ability to:

Institution	Very Important	Important	Neutral	Unimportant	Very Unimportant
• Willingness to participate in class					
Stanford	6	21	12	12	29
Ithaca	24	34	18	10	16
Mills	16	13	4	2	0
TOTAL	46	68	34	24	45
• Interest shown through class participation					
Stanford	10	14	17	10	28
Ithaca	22	29	26	12	13
Mills	14	17	2	2	0
TOTAL	46	60	45	24	41
• Attitude toward or appreciation of class learning					
Stanford	8	19	16	11	25
Ithaca	23	26	27	11	15
Mills	9	14	9	2	1
TOTAL	40	59	52	24	41
• Development of consistent value system					
Stanford	8	13	19	12	27
Ithaca	18	25	31	8	20
Mills	8	10	7	1	6
TOTAL	34	48	57	21	53

n = 239

65

Table 27
Students' Psychomotor Development: Evaluation of Students' Ability to:

Institution	Very Important	Important	Neutral	Unimportant	Very Unimportant
• Isolate components of physical action in performing skill					
Stanford	0	1	5	4	54
Ithaca	5	10	12	8	66
Mills	2	4	0	0	22
TOTAL	7	15	17	12	142
• Express proper sequence for actions in physical procedures					
Stanford	1	4	1	5	54
Ithaca	7	9	16	5	64
Mills	2	4	0	0	22
TOTAL	10	17	17	10	140
• Imitate a physical process					
Stanford	2	4	2	3	54
Ithaca	8	8	17	3	65
Mills	3	2	2	0	21
TOTAL	13	14	21	6	140
• Perform physical process with consistency					
Stanford	1	2	7	1	54
Ithaca	13	4	14	4	66
Mills	3	2	1	1	21
TOTAL	17	8	22	6	141
• Execute physical procedures					
Stanford	1	2	4	4	54
Ithaca	8	7	17	3	66
Mills	2	3	1	1	21
TOTAL	11	12	22	8	141
• Modify physical process in order to adapt to circumstances					
Stanford	1	4	1	5	54
Ithaca	6	13	15	5	62
Mills	4	1	0	2	21
TOTAL	11	18	16	12	137
• Create new or original physical procedures to fit situations					
Stanford	2	3	3	2	55
Ithaca	2	8	18	9	64
Mills	4	2	0	2	20
TOTAL	8	13	21	13	139

n = 239

Teaching Modes and Purposes

Two questions in the survey were designed with reference to Axelrod's (1973) model of didactic and evocative modes of teaching. The didactic mode of teaching, characterized by the "transmitting 'knowledge'" side of the continuum in the survey question, has as its goal a mastery of a definite body of knowledge. The emphasis in this model is on the acquisition of knowledge or skills that are obtained primarily through memorization; a teacher's goal is "to develop in the student an automatic or semi-automatic response" (Axelrod, 1973, p. 11).

In contrast, the evocative mode of teaching, symbolized by the "teaching 'thinking processes'" end of the continuum in the survey question (#5), is concerned with inquiry and discovery strategies. From this perspective, the teacher may be thought of as an artist who creates an atmosphere for learning by promoting students' encounters with each component of the teaching-learning process: teacher, learner, and subject matter.

Most of the faculty who were interviewed believed that "teaching 'thinking processes'" best represented their teaching approach; that is, more than half (57%) of the respondents ranked their teaching approach as a "7" or above (see Table 28). The second single largest number (24%) of faculty stated that their teaching style was a balance between "transmitting 'knowledge'" and "teaching 'thinking processes'" ("5" on the scale). Many of the faculty in this group objected to a distinction between these two "poles," calling the distinction arbitrary and stating that learning involved both content acquisition and development thinking processes.

Faculty members also commented on their primary purposes in teaching (see Table 29). As the results indicate, the most primary objective of faculty members by far (37%) is to "have students learn course content." This finding corresponds closely with faculty members' strong emphasis in their final evaluations on students' cognitive development. It also should be noted that a majority of Mills faculty (61%) ranked as first or second the "having students learn a particular perspective on course content" objective. This finding is not unusual given Mills' stated mission as a single-gender institution. That is, as a women's college, the focus of all Mills' programs, policies, and practices is the development of women.

In addition, faculty informants (53%) also explained that "teaching students how to learn" is an important goal of teaching (i.e., ranked this objective either first or second). This finding relates to the previous question in which a majority of faculty members see themselves as "teaching 'thinking processes.'" The purpose of teaching that faculty members (35%) considered to be furthest from primary is "assisting students to incorporate certain skills and/or knowledge into their daily, personal lives." Reflected in this finding is the idea, mentioned earlier, that faculty members are more concerned with the development of lower order cognitive skills rather than higher order skills such as integration, application, and evaluation.

The findings on faculty members' evaluation of students' cognitive development and the findings on the nature of faculty members' purposes in teaching, when compared, present a confused picture. On the one hand, we saw that faculty members rated students' ability to "gain basic knowledge, language or terms" and to "understand concepts, theories, and trends of the field of study" as very important components of their final evaluation (Question #2). Further, we observed that the largest number of those interviewed believe that a primary purpose of teaching is "having students learn course content" (Question #6). Finally, a large number of informants (47%) commented that "teaching students how to learn" is not one of their primary teaching purposes. Each of these findings is most characteristic of a didactic teaching-learning process.

On the other hand, however, a majority of faculty members (57%) stated that their teaching approach may be identified as "teaching 'thinking processes'" (Question #5). This finding corresponds with an evocative teaching-learning mode. Thus, it appears that many faculty members see themselves as evocative "artists" although their course objectives and evaluation procedures are clearly didactic. Thus, for many, content and pedagogy may not intersect in the classroom. Simply stated, many faculty members may be unable "to transform the content knowledge he or she possesses into forms that are pedagogically powerful" (Shulman, 1987, p. 15).

Table 28
Purpose of Teaching/Learning

Score	Stanford	Ithaca	Mills	Total
0	2	1	0	3
1	0	0	0	0
2	0	2	0	2
3	6	4	3	13
4	4	6	1	11
5	19	24	12	55
6	6	7	4	17
7	14	12	4	30
8	22	30	4	56
9	7	10	6	23
10	10	7	6	23

n = 233

Table 29
Faculty Ranking of Their Primary Purposes in Teaching

Institution	Closest to Purpose (Rank 1)	Three (Rank 2)	Two (Rank 3)	Furthest from Purpose (Rank 4)
• Have students learn course content				
Stanford	38	22	16	12
Ithaca	43	31	20	12
Mills	5	8	15	13
TOTAL	86	61	51	37
• Have students learn particular perspective on course content				
Stanford	27	15	27	19
Ithaca	13	26	27	40
Mills	18	7	12	4
TOTAL	58	48	66	63
• Teach students how to learn				
Stanford	18	36	23	11
Ithaca	26	24	30	26
Mills	6	14	5	16
TOTAL	50	74	58	53
• Assist students to incorporate certain skills/knowledge in personal lives				
Stanford	5	15	21	46
Ithaca	26	24	29	27
Mills	12	12	9	8
TOTAL	43	51	59	81

n = 234

Course Characteristics

Most of the remaining questions in the first section of the survey were developed following Bergquist's (1981) suggestions for curricular implementation and evaluation. Accordingly, various curriculum-related issues that may have an impact on undergraduate learning were explored, such as when courses are offered, characteristics of teachers, instructional techniques, and assessment strategies.

Course Scheduling

According to the participants in the survey, course scheduling follows what Bergquist (1981) refers to as traditional patterns (see Table 30). That is, standard semester (Ithaca and Mills) and quarter (Stanford) systems are used in which the vast majority of courses are taught on a yearly basis, in daylight, during the week, for 3-5 hours. Very few courses are offered in the summer, on weekends, or in the evening.

Faculty Characteristics

Table 31 provides a picture of faculty characteristics. As the chart indicates, faculty rank is fairly evenly distributed among full, associate, and assistant designations. In addition, a large majority of those interviewed are full-time faculty members (94%) whose primary responsibilities are as faculty (98%), rather than as administrators or departmental chairs, or mentors. As a result, the faculty participating in the survey are more likely to contribute to the overall institutional and educational environment (National Institute of Education, 1984).

Who Teaches

We asked respondents to state who typically is involved in teaching the course (see Table 32). As might be expected, in most cases, instruction is performed by an individual faculty member (86%). However, we also found that teaching assistants (TA's) and team teaching are utilized in some courses (19% and 11%, respectively), particularly at Stanford, and most often in the biological and physical sciences. The presence of a significant number of TAs at Stanford is characteristic of larger, research-oriented universities. Here TA's read student papers and projects, grade student exams according to criteria established by faculty, and provide primary feedback to students on their performance in the course. Our study indicates that there is a lower occurrence of team-teaching in our study than would be anticipated by Levine (1978). In contrast to his finding that 47 percent of undergraduates have taken at least one team-taught course, only 11 percent of the courses in our study are team-taught. We do not know if this finding holds true within each institution since our interviews were with a select group of faculty at each campus.

Our findings do support Bergquist's (1981) contention that professional staff members are often "overlooked" instructional resources. Professional staff personnel (including administrators) are rarely called upon to develop and teach courses (3%) despite their rich experiences, expertise, and insight on particular subjects. Student peer teaching (7%) and student self-instruction (6%) are uncommon practices in these college and university courses as well.

Table 30
Course Scheduling

Time Offered	Stanford	Ithaca	Mills	Total
Fall	52	99	31	182
Winter	45	4	0	49
Spring	31	88	17	136
Summer	5	33	0	38
Every year	85	103	36	224
Two-year rotation	3	0	4	7
Other	1	1	1	3
Weekdays	86	104	40	230
Weekends	2	0	0	2
Evenings	4	14	0	18
Other	0	1	0	1

Contact Hours/Week	Stanford	Ithaca	Mills	Total
14.0	1	0	0	1
12.0	0	3	0	3
10.0	0	1	0	1
7.5	1	0	0	1
7.0	3	1	0	4
6.0	7	2	0	9
5.5	3	0	0	3
5.0	20	4	3	27
4.5	1	1	0	2
4.0	19	11	0	30
3.5	0	2	0	2
3.0	31	66	25	122
2.5	1	6	4	11
2.4	0	1	0	1
2.0	1	5	3	9
1.5	0	1	0	1
1.0	1	2	3	6

Number of Weeks	Stanford	Ithaca	Mills	Total
Regular	0	21	0	21
15	0	6	2	8
14	0	6	35	41
13-17	0	1	0	1
12	2	1	0	3
10	55	0	1	56
8	0	1	0	1
2 Semesters	0	2	0	2
No Answer	36	70	3	109

Table 31
Rank and Status of Faculty Interviewed

Description	Stanford	Ithaca	Mills	Total
Full professor	58	21	11	90
Associate professor	18	44	9	71
Assistant professor	15	31	16	62
Instructor	0	7	2	9
Other	2	2	2	6
Full-time	87	102	34	223
Part-time	3	4	6	13
Faculty response	92	102	39	233
Other response	2	6	1	9

Table 32
Who Teaches the Course

Who	Stanford	Ithaca	Mills	Total
Individual faculty member	68	103	39	210
Team teaching	22	4	0	26
Alternate days	1	1	0	2
Teaching assistants	38	7	2	47
Professional staff	0	4	3	7
Peer assistants	2	9	6	17
Student Self-Instruction	2	10	3	15

Course Frequency

Many faculty (51%) stated that they teach the course once a year (see Table 33). However, nearly one-third (30%) of the faculty said that they teach the course each term. Stanford and Mills faculty members accounted for the majority of those who teach their course once a year. Ithaca faculty members accounted for the large majority of those who teach their course each semester. This finding reflects institutional differences and concomitant distinctive faculty priorities. Nevertheless, these differences had no apparent bearing on other responses in the survey. Finally, a large majority (78%) of the faculty have taught their respective courses recently, either in 1991, 1990 or in 1989 (see Table 34).

Where Course is Taught

An overwhelming majority (97%) of the courses taught by interviewed faculty are taught on campus (see Table 35). Similar to the observations made regarding course scheduling, the responses to this question are characteristic of a traditional educational approach.

Table 33
Course Frequency

Description	Stanford	Ithaca	Mills	Total
Each term/semester	4	64	4	72
Once a year	67	30	27	124
Other				
Irregularly	2	7	0	9
Rarely	1	0	0	1
Alternate years	8	2	3	13
Twice a year	2	0	0	2
Department needs	0	1	0	1
When principles needed	0	1	0	1
Not offered now	3	3	2	3
Once in 5 years	2	0	0	2
Once only	2	0	1	3

Table 34
Course Last Taught by Interviewee

When	Stanford	Ithaca	Mills	Total
Fall	37	43	27	107
Spring	24	62	13	99
Summer	0	0	0	0
Winter	23	0	0	23
1983	1	0	0	1
1985	2	0	2	4
1986	6	1	1	8
1987	5	8	1	14
1988	15	7	6	28
1989	34	23	8	65
1990	35	67	16	118
1991	0	0	7	7
Fa86	2	1	1	4
Fa87	3	3	0	6
Fa88	5	5	3	13
Fa89	9	19	7	35
Fa90	20	15	14	49
Sp86	3	0	0	3
Sp87	2	5	0	7
Sp88	2	2	2	6
Sp89	8	4	1	13
Sp90	10	67	2	79
Sp91	0	0	7	7
Wi86	1	0	0	1
Wi87	0	0	0	0
Wi88	6	0	0	6
Wi89	16	0	0	16
Wi90	8	0	0	8
Other	7	0	0	7

Table 35
Where Course is Taught

Where	Stanford	Ithaca	Mills	Total
On campus	88	106	41	235
Off campus	3	0	0	3

Instructional Methods

Our findings support the notion that books, journals, newspapers, and the like constitute "the primary instructional materials" (Bergquist, 1981, p. 96) used by faculty members (90%) at most colleges and universities (see Table 36). Based on our research, various forms of video technology is also being used by faculty members (53%). For example, in the syllabi analysis, we found that audiovisual cassettes are common instructional methods. Although an instructor's lack of knowledge or skill at one time may have prevented him or her from using this equipment, more faculty are currently using this media effectively in their classrooms. In the same way, computer technology seems to be growing in popularity, even though a relatively small number of respondents (20%) included it. However, the use of the word "extensively" in the survey question may have prevented more participants from citing the use of computer technology. Simply stated, a faculty member who uses one film in her course may not be inclined to say she uses this computer technology "extensively" for classroom-related purposes.

In addition, significant numbers of faculty interviewees explained that they use laboratories/studios (21%), simulated environments (17%), and experiential learning (20%) as instructional devices. From examining a sample of course syllabi, for example, we learned that one instructor required students to spend several days at a physical therapy clinic; other faculty members required the completion of weekly laboratory homework assignments. Many of the instructors who include these instructional methods are in the physical, biological, or behavioral sciences, engineering, and the performing arts.

At this point, it may be instructive to reiterate an earlier point. Most of the faculty who were interviewed considered the purpose of teaching to be "teaching 'thinking processes'." A certain confusion existed regarding faculty members' stated teaching purposes and their evaluation of students' cognitive development. A similar observation can be made now. According to Bergquist (1981), content-based teaching, or, what Axelrod (1973) refers to as the didactic mode, includes the following instructional methods: lecturing (individual faculty member teaches class--Question #9), reading (print medium--Question #13), question and answer exercises (tests--see Question #15), and audiovisual instruction (video technology--Question #13).

In contrast, interaction-based teaching, or what Axelrod terms the evocative mode, includes these instructional methods: team teaching (Question #9), laboratory/studio (Question #13), simulations (Question #13), seminar/discussion, case study, role playing, and in-class discussions (class participation--see Question #15). The last few teaching methods cited here rarely, if at all, appeared in the comments of those interviewed or in the analysis of sample syllabi from the courses.

Once again, a certain incongruence exists in many faculty members' perceptions. Stated another way, many of those interviewed see themselves as "interaction-based," or "evocative" teachers whose expressed primary purpose in the learning process is to teach students "thinking processes." In reality, however, these faculty members fulfill their roles as "content-based," or didactic" teachers whose day-to-day actions are to "transmit knowledge" to students. The point is not to evaluate the "goodness" or "badness" of the evocative or didactic modes of teaching. Rather, the important issue is to affirm that teaching involves much more than simply "talking about what one knows" or "managing the classroom effectively." As Shulman (1987) explains, exemplary teachers continually weave together threads of what they know, how they know, and how they articulate what and how they know to students. From this perspective, dynamic teaching "begins with an act of reason, continues with a process of reasoning, culminates in performances of imparting, eliciting, involving, or enticing, and is then thought about some more until the process can begin again" (Shulman, 1987, p. 13).

Table 36
Instructional Methods Used

Resource	Stanford	Ithaca	Mills	Total
Print medium	82	97	38	217
Audio technology	11	28	7	46
Video technology	42	65	22	129
Computer technology	23	22	4	49
Labs/studios	17	24	10	51
Simulated environment	10	26	5	41
Experiential learning	15	28	5	48
Field trips	6	4	6	16

Course Planning

A large majority of faculty members (90%) explained that they are solely responsible for setting the goals and content of their courses (see Table 37). This finding is consistent with the course planning practices of most colleges and universities. According to Bergquist, "faculty-planned curriculums are pervasive and respond to the legitimate need of students for clear and detailed information about the courses they will take and the courses of study they will follow for particular careers" (1981, p. 144). Faculty members' responses to this question also coincide with the instructional purposes and methodologies that they utilize in the classroom.

How Learning is Assessed

Most faculty members use multiple measures of evaluation to assess student learning (see Table 38). The sample syllabi analysis confirms survey data that some combination of tests, papers, projects, and class participation/attendance typically serves as the criteria for student evaluation. Tests are the most common assessment tool, being cited by a large majority of the faculty who were interviewed (87%). From the sample test analysis, we found that course tests most often are objective in nature, in that they consist of multiple choice, true/false, matching, and short answer questions. Essay questions and problems or computations also were present in the tests sample, but not as frequently and with less comparative weight. Other common evaluation tools used by faculty members in the study are papers (43%) and projects (26%), which may be expanded to include exercises such as homework, lab assignments, and workbooks.

Who Assesses Learning

An overwhelming majority of the respondents (97%) stated that faculty members are the evaluators of student learning (see Table 39). Clearly, this is a common practice at most colleges and universities. In addition, we found that TAs also do a considerable amount of student assessment (19%), including reading students' examinations and assigning grades. This corresponds with an earlier finding that TAs are involved in the teaching process, particularly at research institutions such as Stanford.

A potential problem exists, however, when students are not involved in the assessment process. Bergquist notes: "... the authoritative role of the teacher is potentially exaggerated. Pleasing the powerful 'other' (the instructor, or the TA) may replace learning as the student's motivation" (1981, p. 242). According to Bergquist, this issue is resolved when students are partial or full participants in the evaluation process. The picture suggested by our data, however, reveals only slight student involvement in the assessment of learning.

Table 37
Course Planning

Who Plans	Stanford	Ithaca	Mills	Total
Faculty	88	93	36	217
Faculty & students	2	13	4	19
Students	1	0	1	2

Table 38
How is Learning Assessed

Medium	Stanford	Ithaca	Mills	Total
Tests	84	98	30	212
Papers	33	48	23	104
Projects	15	38	9	62
Presentation/Performance	8	37	19	64
Other				
Homework	15	3	3	21
Lab assignments	5	6	0	11
Participation/attendance	1	11	4	16
Workshops	0	1	0	1
Workbooks	0	2	1	3
National teaching exam	0	1	0	1
Rehearsal	0	1	0	1
Skill competency checks	0	1	2	3
Group presentation	0	1	0	1
Honors work	1	0	0	1

Table 39
Who Assesses Learning

Who Assesses	Stanford	Ithaca	Mills	Total
Faculty	87	106	41	234
Student peers	6	7	5	18
Student self-appraisal	3	11	10	24
External criteria	0	3	0	3
Other				
TAs/GAs	42	3	0	45
Homework	4	0	0	4
National teaching exam	0	2	0	2
External sponsor	2	0	0	2
Other faculty	0	1	0	1

CONCLUSION

Coursework from the transcripts of two samples of graduating seniors at Stanford University, three samples at Ithaca College, and two samples at Mills College were associated with gains in nine types of learning measured by the Graduate Record Examination. Most of the 9 item-types proved to be reliable, discrete and valid measures of general learned abilities. College officials can now examine these types of learning to determine if they should receive greater or less attention in the respective curricula of the three institutions. The Analogies and Antonyms questions test abilities frequently valued in the social sciences. Graduates are often asked to demonstrate these abilities on the Millers Analogies Tests, as well as other standardized graduate and professional examinations used for admissions and fellowship awards. Similarly, the ability to interpret data is fundamental to the physical and social sciences, as well as to applied fields, such as Engineering.

In most samples Reading Comprehension, Quantitative Comparisons and Analytic Reasoning proved to be types of general learned abilities where large changes occurred. The CAM research indicated clearly that this is where the majority of general student learning occurs in the coursework in which students commonly enrolled. Faculty who teach these courses encourage the development of Analytic Reasoning and Reading Comprehension through the syllabus, assignments and examinations they require of students. Less clear is the development of Quantitative Comparisons abilities. Faculty were unable to identify what the types of skills and abilities were required of students to successfully answer these types of questions.

The faculty interviews tended to corroborate the CAM findings, with the previously noted exception of Quantitative Comparisons. CAM identified courses that were linked to gains in one or more abilities represented on the GRE examination. Faculty were presented with examples of all 9 types of questions, so they had greater opportunity to pick item-type examples not linked to their course by the CAM procedure. Nevertheless, in most cases faculty did pick the GRE item-type with which their course had been identified and were only too happy to articulate how they strived to develop abilities. Few, if any of these faculty planned their course to develop any of the abilities examined. Still, there were underlying themes, skills or habits which faculty sought to develop in the way that students viewed and analyzed knowledge. Both the CAM findings and the faculty interviews do not leave us with a clear association between specific disciplines and general learned abilities. The conventional wisdom that only math classes develop math skills and only English classes develop reading comprehension abilities was not affirmed. The groups of courses, no matter whether they are derived from the Cluster Analytic Model or the faculty interviews, suggested that time-honored curricular notions of the role of broad disciplines to the structure of knowledge is fractured and incomplete. General learned abilities cut across fields. Many majors, programs and subject areas have their own philosophy course, their own history course, their own quantitative and qualitative methodology courses and the like. The curriculum is more like a fabric of interwoven threads than a system of sequences and linear relationships between subjects. Admittedly, these are emerging impressions, and far more examination of the relationship between what students specifically studied and what they precisely learned is very much needed. Only through such efforts will curricular reform go beyond the spasmodic review and cathartic emoting of academic leaders and faculty committees.

Curriculum at a liberal arts college, a comprehensive college, or a research university is necessarily complex, consisting of hundreds or thousands of course choices for students. These course choices represent the variation in the incoming ability of the students, the expanding knowledge base in the disciplines and fields of study and the dynamics of faculty experimentation and reform of the curriculum. All these forces make identifying and selecting appropriate coursework problematic. Faculty did not have a current working knowledge beyond their immediate field of study upon which to base specific, relevant advice to students regarding coursework to improve cognitive abilities. Given hundreds or thousands of courses in the undergraduate curriculum and given that each is designed to produce a distinct contribution to student learning, it is perhaps impossible for any single individual to provide such timely, appropriate advisement to students. Yet, beyond the complexities of the curriculum, faculty have yet to develop a professionally responsible basis for offering such advice. When students must choose between several math or science courses to fulfill their general education requirements, a faculty member's recollection of their own undergraduate education, then stereotypic notions of broad subject areas, thumbing through the college catalog, or making recommendations based on the rumors and off-hand comments passed by other faculty or other students is <u>not</u> a sound basis for constructing an educational program. Given the promise of the Cluster Analytic Model to isolate coursework associated with gains in learning for a particular group or student, a more exact, well-informed system of student guidance can be constructed.

While there is a critical need to improve the quality of information and the faculty skill in advising students, there is a commensurate need to better align what faculty intend to teach with their instructional and classroom examination practices. Critical to this improvement at research universities is the recognition of teaching assistants as legitimate custodians of much of the lower division undergraduate curriculum. TAs read students' papers and projects, assist students with their immediate learning problems, and grade and provide feedback to students about their performance on examinations.

At all three institutions examined, students at or above the mean were more likely to enroll in coursework associated with improvement in student learning (Ratcliff, 1990a, 1990b, 1990c, 1990d). At all three institutions, faculty overestimated student cognitive skills in such areas as Sentence Completion and Regular Mathematics. At both institutions faculty had clear visions of themselves as evocative teaching promoting analytic reasoning and developing the thinking process. While the CAM did show that the greatest proportion of student improvement in general learning did occur in Analytic Reasoning, course syllabi, course requirements, and classroom examinations continued to stress knowledge transmission, didactic instruction, and lower levels of cognitive learning.

Given that we interviewed faculty who taught coursework clearly associated with student improvement in general learned abilities, we conclude that most of the best teachers and classes of these institutions are still trying to develop students' basic knowledge of terms, concepts and theories rather than engaging students in critical analyses and problem-solving activities. Only by increasing faculty expectations for higher order analytic abilities will bring about such changes in the curriculum.

To improve general education, we must close the gap between intentions and practice. We can do so through systematic assessment and analysis of coursework patterns. This information, in turn, can be used to launch new, better-informed bases for student advisement, teaching, and learning.

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APPENDIX A

Letter Requesting Faculty Participation

LETTER REQUESTING FACULTY PARTICIPATION

March 28, 1990

Dear Colleague:

I am writing to enlist your support and cooperation in an ongoing research project. For the past three years, the University has been cooperating in a major research effort being carried out by Dr. James Ratcliff, formerly of Iowa State University and currently the Director of the Center for the Study of Higher Education at The Pennsylvania State University. Dr. Ratcliff and his associates have been investigating the relationship between course-taking patterns and gains in student scores on nine item-types measured by the GRE.

Funded initially by the U.S. Department and subsequently by the Exxon Foundation, this exploratory research uses transcript analysis to identify these relationships. During 1987 and 1988, two Stanford student groups participated by taking the GREs at the project's expenses. It is their transcripts that have been analyzed.

The initial analysis has identified 108 Stanford courses that are of interest to the project's researchers. These courses are associated with particularly high increases in student scores on one or more of the nine item-types measured. In order to understand better the nature of these courses, the researchers have requested the opportunity to interview the faculty members teaching these courses.

The purpose of this letter is to alert you that during the next few days, you can expect a call on behalf of the project researchers requesting the opportunity to meet with you. The interviews have been pilot tested and will take approximately twenty minutes, to be scheduled at your convenience sometime between April 4 and 10. Your participation is completely voluntary.

The interview is structured in two parts. First, you will be asked two or three questions regarding the nature and design of your course and your teaching methods. Second, you will be asked to discuss a series of advising questions related to sample GRE questions representing each of the nine item-types, e.g., what courses would you recommend to a student needing to develop that skill or knowledge, and is your course designed to develop that learned ability?

It is important here to emphasize that this is not an evaluation of the Stanford curriculum, but rather an exploratory investigation into associations that have been preliminarily identified between course taking patterns and student improvement on the GRE item types. The objective is better understanding of the effects of general education course work and curricular choices on student learning as measured by the GRE. This group of researchers has completed similar work at Evergreen State, in

Washington, and Georgia State and is continuing their investigation at Ithaca College in New York, and Mills College, in addition to Stanford. It is hoped that this research will provide some insights that may help students better plan their programs in order to enhance strengths and overcome deficiencies in these areas of learned abilities.

If you have any questions, please don't hesitate to raise them with the researchers when they call, or you can contact Virginia E. Ramos directly at 3-1550. If you do not receive a call, it will be because their quota of forty interviews has been filled by prior calls. Again, remember that your participation, if requested, is complete voluntary. Thanks much for your cooperation.

Sincerely,

Sally Mahoney
Registrar & Senior Associate Provost

APPENDIX B

Differential Coursework Patterns Project Faculty Survey

DIFFERENTIAL COURSEWORK PATTERNS PROJECT

FACULTY SURVEY

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Professor and Director

and

Elizabeth A. Jones
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INFORMATION FOR COURSE ______________________________

1. What percentage of your final evaluation of students is based on each of the following areas?

Percent	Evaluation of students in the area of:
______	a. Cognitive development
______	b. Affective development
______	c. Psychomotor development
100%	TOTAL EVALUATION

2. Rate the importance of the following <u>cognitive development</u> areas in your overall evaluation of students.

Very important 5
Important 4
Neutral 3
Unimportant 2
Very Unimportant .. 1

	Evaluation of students' ability to:
1 2 3 4 5	a. Gain basic knowledge, language or terms.
1 2 3 4 5	b. Understand concepts, theories, and trends of the field of study.
1 2 3 4 5	c. Perform, act out, demonstrate skills, involved in the field of study.
1 2 3 4 5	d. Distinguish between facts and inferences, recognize the components of an argument, theory, etc.
1 2 3 4 5	e. Integrate learning from different areas into an original idea or problem solution.
1 2 3 4 5	f. Judge the worth, value, or merits of something based on specified criteria.

6. Please rank order your primary purpose in teaching this course (1 is closest to your primary purpose, 4 is further from your primary purpose):

In my course, I try to ...

Rank

_____ a. Have students learn course content.

_____ b. Have students learn a particular perspective regarding course content.

_____ c. Teach students how to learn.

_____ d. Assist students to incorporate certain skills and/or knowledge into their daily, personal lives.

7. Primarily, this course is offered ... (Mark all that apply)

a. Fall term
b. Winter term
c. Spring term
d. Summer term

e. Every year
f. On a two year rotation
g. Other (specify) ______________________________

h. On weekdays
i. On weekends
j. Evenings
k. Other

l. Number of contact hours per week: _____
m. Number of weeks (if not equal to the regular course calendar): _____

8. Please provide the following information about yourself. Your rank is ...

a. Full professor
b. Associate professor
c. Assistant professor
d. Instructor
e. Other (specify) ________________________

You are contracted as ...

f. Full-time
g. Part-time

Your primary responsibility is ...

h. As faculty
i. Other (specify) ____________________________

GRE SAMPLE QUESTIONS

READING COMPREHENSION -- Reading to understand a written passage from several perspectives.

Directions: Each passage in this group is followed by questions based on its content. After reading a passage, choose the best answer to each question. Answer all questions following a passage on the basis of what is stated or implied in that passage.

Initially the Vinaver theory that Malory's eight romances, once thought to be fundamentally unified, were in fact eight independent works produced both a sense of relief and an unpleasant shock. Vinaver's theory comfortably explained away the apparent contradictions of chronology and made each romance independently satisfying. It was, however, disagreeable to find that what had been thought of as one book was now eight books. Part of this response was the natural reaction to the disturbance of set ideas. Nevertheless, even now, after lengthy consideration of the theory's refined but legitimate observations, one cannot avoid the conclusion that the eight romances are only one work. It is not quite a matter of disagreeing with the theory of independence, but of rejecting its implications: that the romances may be taken in any or no particular order, that they have no cumulative effect, and that they are as separate as the works of a modern novelist.

3.1 The primary purpose of the passage is to:

- (A)* Discuss the validity of a hypothesis.
- (B) Summarize a system of general principles.
- (C) Propose guidelines for future argument.
- (D) Stipulate conditions for acceptance of an interpretation.
- (E) Deny accusations about an apparent contradiction.

3.2 It can be inferred from the passage that the author believes which of the following about Malory's works?

- I. There are meaningful links between and among the romances.
- II. The subtleties of the romances are obscured when they are taken as one work.
- III. Any contradictions in chronology among the romances are less important than their over-all unity.

(A) I only (B) III only (C)* I and III only (D) II and III only (E) I, II, and III

Questions referring to GRE sample questions on Reading Comprehension

17a. Does the course you teach aid students in answering questions similar to the ones above?

Yes _____ No _____ If yes, how?

17b. If a student (not in your class) came to you to ask for advice on how to develop the ability to answer this question how would you decide what advice to give him or her?

How would you decide what classes to recommend for the student?

17c. If a student wished to improve his/her abilities relative to the above sample question, what course(s) would you recommend? (OBTAIN SPECIFIC COURSE TITLES)

GRE SAMPLE QUESTIONS

SENTENCE COMPLETION -- Identifying words or phrases which both logically and stylistically complete the meaning of a sentence.

Directions: Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five lettered words or sets of words. Choose the word or set of words for each blank that best fits the meaning of the sentence as a whole.

1.1 The sheer bulk of data from the mass media seems to overpower us and drive us to __________ accounts for an easily and readily digestible portion of news.

(A) Insular (B) Investigative (C)* Synoptic

(D) Subjective (E) Sensational

1.2 The sale of Alaska was not so much an American coup as a matter of __________ for an imperial Russia that was short of cash and unable to __________ its own continental coastline.

(A) Negligence..fortify (B) Custom..maintain

(C) Convenience..stabilise (D)* Expediency..defend

(E) Exigency..reinforce

Questions referring to GRE sample questions on Sentence Completion

19a. Does the course you teach aid students in answering questions similar to the ones above?

Yes _____ No _____ If yes, how?

19b. If a student (not in your class) came to you to ask for advice on how to develop the ability to answer this question, how would you decide what advice to give him or her?

How would you decide what classes to recommend for the student?

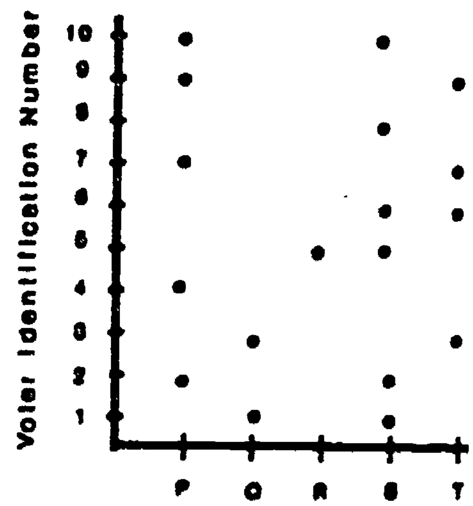
19c. If a student wished to improve his/her abilities relative to the above sample question, what course(s) would you recommend? (OBTAIN SPECIFIC COURSE TITLES)

GRE SAMPLE QUESTIONS

DATA INTERPRETATION -- Selection of data for answering questions

Directions: The following question refers to the following graph.

RESULTS OF A SAMPLE OF VOTERS
IN DISTRICT X



The graph above shows how a sample of 10 different voters (vertical axis) voted for 5 different candidates (horizontal axis). Each voter voted for either one or two of the five candidates. (No voter voted twice for the same candidate.) The two candidates receiving the most votes were the winners. The sample constituted 5 percent of those in the district who voted, and the number of votes in the district for each candidate was in the same proportion as the number of votes in the sample for each candidate.

7.1 What fraction of the total number of votes cast did the two winners receive?

(A)* $\frac{11}{18}$ (B) $\frac{11}{20}$ (C) $\frac{1}{2}$ (D) $\frac{1}{3}$ (E) $\frac{3}{10}$

Questions referring to GRE sample questions on Data Interpretation

21a. Does the course you teach aid students in answering questions similar to the ones above?

Yes ______ No ______ If yes, how?

21b. If a student (not in your class) came to you to ask for advice on how to develop the ability to answer this question, how would you decide what advice to give him or her?

How would you decide what classes to recommend for the student?

21c. If a student wished to improve his/her abilities relative to the above sample question, what course(s) would you recommend? (OBTAIN SPECIFIC COURSE TITLES)

GRE SAMPLE QUESTIONS

LOGICAL REASONING -- Recognizing relationships among arguments or parts of arguments.

Directions: Each question or group of questions is based on a passage or set of conditions. In answering some of the questions, it may be useful to draw a rough diagram. For each question, select the best answer choice given.

Dormitories range from two to six stories in height. If a dormitory room is above the second floor, it has a fire escape.

8.1 If the statements above are true, which of the following must also be true?

(A) Second-floor dormitory rooms do not have fire escapes.
(B) Third-floor dormitory rooms do not have fire escapes.
(C) Only dormitory rooms above the second floor have fire escapes.
(D)* Fourth-floor dormitory rooms have fire escapes.
(E) Some two-story dormitories do not have fire escapes.

Unlike other forms of narrative art, a play, to be successful, must give pleasure to its immediate audience by reflecting the concerns and values of that audience. A novel can achieve success over months or even years, but a play must be a hit or perish. Successful drama of the Restoration period, therefore is a good index to the typical tastes and attitudes of its time.

8.2 The author of the passage above assumes that

(A) Plays written for Restoration audiences do not appeal to modern audiences.
(B) Plays are superior to novels as a form of narrative art.
(C)* Restoration audiences were representative of the whole population of their time.
(D) Playgoers and novel readers are typically distinct and exclusive groups.
(E) Restoration drama achieved popular success at the expense of critical success.

Questions referring to GRE sample questions on Logical Reasoning.

23a. Does the course you teach aid students in answering questions similar to the ones above?

Yes _____ No _____ If yes, how?

23b. If a student (not in your class) came to you to ask for advice on how to develop the ability to answer this question, how would you decide what advice to give him or her?

How would you decide what classes to recommend for the student?

23c. If a student wished to improve his/her abilities relative to the above sample question, what course(s) would you recommend? (OBTAIN SPECIFIC COURSE TITLES)

GRE SAMPLE QUESTIONS

ANTONYMS -- Vocabulary; knowledge of opposites

Directions: Each question below consists of a word printed in capital letters, followed by five lettered words or phrases. Choose the lettered word or phrase that is most nearly opposite in meaning to the word in capital letters.

Since some of the questions require you to distinguish fine shades of meaning, be sure to consider all the choices before deciding which one is best.

4.1 SERRATED:

(A) Without joints (B) Without folds (C)* Without notches (D) Variegated (E) Mutilated

4.2 FLEDGLING:

(A)* Experienced practitioner (B) Successful competitor (C) Reluctant volunteer (D) Recent convert (E) Attentive listener

Questions referring to GRE sample questions on Antonyms

25a. Does the course you teach aid students in answering questions similar to the ones above?

Yes _____ No _____ If yes, how?

25b. If a student (not in your class) came to you to ask for advice on how to develop the ability to answer this question, <u>how</u> would you decide what advice to give him or her?

<u>How</u> would you decide what classes to recommend for the student?

25c. If a student wished to improve his/her abilities relative to the above sample question, what course(s) would you recommend? (OBTAIN SPECIFIC COURSE TITLES)

APPENDIX C

Procedures for Syllabi & Tests Examination

PROCEDURES FOR SYLLABI & TESTS EXAMINATION

We requested a syllabus and a test from each interviewee as part of our data collection in an effort to underestand, as fully as possible, what occurs in the course. The examination of the syllabi and tests followed several steps. First, we determined what we actually were able to collect on site (see Table 1).

Second, we selected a random sample of 25 from the "Both Syllabus and Test With Purpose" category--20 from Ithaca and five from Stanford--that represented a wide array of courses. We later determined that two of the samples were unusable, giving us a working sample of 23 sets of syllabi and tests. The sample was drawn from this category because we wanted to be able to compare the stated purposes of a course (including the expected levels and types of learning) with how students are assessed).

Third, We devised two protocols: one to collect information from syllabi, and the other to gather information from the tests to examine the levels of learning expected of students taking the course (using Bloom's taxonomy), and the types of learning expected of students taking the course (utilizing the nine item-types from the GRE General Test). In addition, both protocols solicited other kinds of useful information such as instructional methods used, how students of useful information such as instructional methods used, how students are evaluated, and the nature of the tests (i.e., multiple choice, essay, etc.).

Fourth, we developed a strategy to analyze the syllabi and tests using the respective protocols. Previous research on course planning (NCRIPTAL, 1988) was extremely valuable in this process. The plan was as follows:

1. Choose 3 raters.
2. Develop a Protocol Explanation Sheet (see Figure 3).

3. Each rater will review a syllabus and a test, and the syllabus and test protocols to become familiarized with the task.

4. Each rater will evaluate seven sets of syllabi and tests using the appropriate protocol.

5. The raters will meet to discuss issues/problems that emerged in the rating of the first seven sets of syllabi and tests.

6. The raters will evaluate the remaining 16 sets of syllabi and tests.

7. The raters will reevaluate the first seven sets of syllabi and tests.

8. The findings from each raters' evaluations will be tabulated and compared.

9. The raters will meet to discuss the similarity and dissimilarity of reporting.

10. The final findings will be tabulated, analyzed, and incorporated into the final report.

Fifth, we examined the sample of 23 syllabi and tests following the above plan. Two particular issues deserve mention. The first issue relates to the importance of "regrouping" after the raters had evaluated seven sets of syllabi and tests. This provided vital feedback regarding working definitions, raters' perceptions, and how to deal with various expressions contained in the syllabi and tests. As a result of this debriefing, the raters generated a list of "tips" to be used while completing the remaining sets of syllabi and tests (see Figure 4).

The second issue involves synthesizing the completed protocols. Each rater's evaluations of each of the 23 sets of syllabi and tests were tabulated. Then, focusing on the use of Bloom's taxonomy and the nine item-types of the GRE General Test, we determined the points at which disagreement between raters existed (defined as those instances in which at least one rater said that the level or type of learning was neither implicit nor explicit, and at least one rater said that the level or type of learning was either implicit or explicit). Accordingly, we found that, for each protocol set (syllabus and test of one course), disagreement existed in an average of approximately 13 (X = 12.7) of a possible 30 rating. Within these 13 areas of disagreement, wide discrepancy (at least one rater said that the level or type of learning was neither implicit or explicit and at least one rater said that the level or type of learning was explicit) occurred an average of approximately 5 times (X = 4.7).

The raters met to discuss each of these inconsistencies and examine syllabi and tests together. We found that, in almost every case, evaluative disagreement between raters was a result of one of two issues: (1) overlooking a statement in a syllabus or a question in a test, or (2) being unusually liberal in evaluating the level or type of learning. It should be noted that perception or bias was seldom the primary factor in explaining discrepancies. In fact, after the raters' discussions, only 4 of the original 292 total disagreements remained, all of which were due to differences in rater perception.

Finally, the 23 sets of syllabi and test were analyzed to produce frequency distributions and simple comparisons. Several conclusions based upon this analysis were incorporated into the differential coursework patterns faculty survey final report.

PLAN TO ANALYZE SYLLABI AND TESTS

1. Esta ish 2 or 3 raters.
2. Each rater will read through the syllabus and test protocols, the protocol explanation sheet, and a sample syllabus and test to become familiarized with the task at hand.
3. Each rater will evaluate seven (7) sets of syllabi and tests using the appropriate protocols.
4. The raters will meet to discuss problems and determine the similarity or dissimilarity or reporting.
5. The raters will evaluate the remaining eighteen (18) sets of syllabi and tests.

6. The raters will reevaluate the first seven (7) sets of syllabi and tests.

7. The results will be tabulated, analyzed, and incorporated into the final report.

8. The evaluation procedures used here will be included as part of the report.

Appendix C--Table 1
Information Collected at Sample Institutions

	Stanford	Ithaca	Total
Syllabus Only			
With purpose	2	6	8
Without purpose	5	2	7
Test Only	11	4	15
Both Syllabus & Test			
With purpose	12	50	62
Without purpose	29	20	49
Neither Syllabus Nor Test	26	12	38

Figure 1
Protocol for Syllabi Analysis

Institution ______________________

Instructor ______________________

Course ______________________

1. Does the syllabus explain the purposes/objectives of the course?

   ____ Yes ____ No

2. According to the syllabus, indicate the degree to which the following levels of learning are expected from students as follows:

   "0" -- the level of learning is neither stated or implied in the syllabus

   "1" -- the level of learning is implied but not stated explicitly in the syllabus

   "2" -- the level of learning is stated explicitly in syllabus

   Gaining basic knowledge, understanding concepts, as follows:

   ____ Knowledge ____ Application

   ____ Comprehension ____ Analysis

   ____ Synthesis ____ Evaluation

   ____ Interest, appreciation, attitude of learning in class (e.g., class participation)

   ____ Development of certain skills, abilities, competencies

3. According to the syllabus, indicate the degree to which the following types of learning are expected in this course as follows:

   "0" -- this type of learning is neither stated nor implied in the syllabus

   "1" -- this type of learning is implied but not stated explicitly in the syllabus

   "2" -- this type of learning is stated explicitly in the syllabus

____ Analogies ____ Antonyms

____ Sentence Completions ____ Reading Comprehension

____ Quantitative Comparisons ____ Data Interpretation

____ Analytical Reasoning ____ Logical Reasoning

____ Discrete Quantitative (Mathematics)

4. Does the syllabus describe course requirements or areas of evaluation?

____ Yes ____ No (Please weight below.)

____ Tests ____ Papers

____ Discussion/Debate ____ Labs

____ Attendance ____ Presentation/Performance

____ Homework/Exercises ____ Projects/Other

5. Are the texts for the course mentioned in the syllabus?

____ Yes ____ No

6. Does the syllabus include a weekly schedule of activities?

____ Topics ____ Readings

____ Assignments ____ Other

7. Does the syllabus describe the inclusion of various instructional methods?

____ Yes ____ No

____ Print media ____ Audio technology

____ Video technology ____ Computer technology

____ Labs or studios ____ Simulated environments

____ Field trips ____ Experiential learning

____ Case studies ____ Other

Figure 2
Protocol for Test Analysis

Institution ______________________

Instructor ______________________

Course ______________________

1. What types of questions does the exam include (weighted)?

___ Multiple choice ___ True/False

___ Essay ___ Short Answer

___ Sentence completion ___ Computations/Problems

___ Other

2. Indicate the extent to which this test measures the following GRE item-types as follows:

"0" -- this item-type is neither explicitly or implicitly tested in this test

"1" -- this item-type is implicitly but not explicitly tested in this test

"2" -- this item-type is explicitly tested in this test

___ Analogies ___ Antonyms

___ Sentence Completions ___ Reading Comprehension

___ Quantitative Comparisons ___ Data Interpretation

___ Analytical Reasoning ___ Logical Reasoning

___ Discrete Quantitative (Mathematics)

3. Indicate the extent to which this test measures the components of Bloom's taxonomy as follows:

"0" -- this component of Bloom's taxonomy is not explicitly or implicitly tested in this test

"1" -- this component of Bloom's taxonomy is implicitly but not explicitly tested in this test

"2" -- this component of Bloom's taxonomy is explicitly tested in this test

____ Knowledge ____ Comprehension

____ Application ____ Analysis

____ Synthesis ____ Evaluation

==

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Figure 3
Explanation of Protocols for Raters

To ensure that we are using similar starting points as we rate syllabi and tests from Ithaca and Stanford, a brief explanation of the components of Bloom's taxonomy and the nine item-types included in the GRE General Test are necessary. Please adhere to these explanations as you complete the protocols.

Components of Bloom's Taxonomy

Knowledge. The recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting.

Comprehension. Ability to know what is being communicated and the ability to use the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

Application. The use of abstractions--general ideas; rules or procedures; generalized methods; technical principles, ideas, and theories--in particular and concrete applications.

Analysis. The ability to breakdown communication into its constituent elements or parts such that the relative heirarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit.

Synthesis. The putting together of elements and parts so as to form a whole. Arranging and combining things in such a way as to constitute a pattern or structure not clearly there before.

Evaluation. Quantitative and qualitative judgments about the extent to which material and methods satisfy criteria. Use of a standard of appraisal.

Nine GRE Item-Types

Analogies. Ability to recognize relationships among words and the concepts they represent and to recognize when these relationships are parallel.

Antonyms. The ability to reason from a given concept to its opposite.

Sentence Completion. The ability to recognize words or phrases that both logically and stylistically complete the meaning of a sentence.

Reading Comprehension. The ability to read with understanding, insight, and discrimination; ability to examine a written passage from several perspectives.

Quantitative Comparisons. The ability to reason quickly and accurately about the relative sizes of two quantities or to perceive that not enough information is provided to make such a decision.

Discrete Quantitative. The ability to use basic mathematical knowledge in answering questions in which all the information required for answering a question is provided.

Data Interpretation. The ability to synthesize information, to select appropriate data for answering a question, or to determine that sufficient information for answering a question is not provided (similar to reading comprehension in the verbal section).

Analytical Reasoning. The ability to understand a given structure of arbitrary relationships among fictitious persons, places, things, or events, and to deduce new information from the relationship given.

Logical Reasoning. The ability to understand, analyze, and evaluate arguments, which includes recognizing the point of an argument and the assumptions on which an argument is based; drawing conclusions and forming hypotheses; identifying methods of rgument; evaluating arguments and counter-arguments; and, analyzing evidence.

Figure 4
Tips to Follow with Protocols

1. Bloom's taxonomy is a heirarchy. Therefore, if you enter a "2" for one category, everything above it has to be a "2" also. You cannot have larger numbers after smaller ones.

2. Almost always, knowledge and comprehension go together so a "2" for one means a "2" for the other.

3. In test protocol, be conservative; especially for antonyms, sentence completions, and reading comprehension.

4. In test protocol, if matching is in test, put a "2" for the item-type Analogies.

5. Data Interpretation on test protocol requires some kind of chart in the test.

6. In test protocol, Analytical Reasoning involves How and Why questions mostly, and builds on what has been provided in terms of deducing more from what is already there.

7. In test protocol, Logical Reasoning involves developing a way of thinking and/or providing your own argument, opinion, or evaluation based on question.

8. We are eliminating "X" selection from protocols. Please make some decision for each blank.