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ABSTRACT

This study investigated predictors of Harvard University (Massachusetts) student ratings of courses. Data were drawn from 33,180 evaluations of 1,114 undergraduate courses in 47 departments. Predictors examined at the student level included satisfaction with the course, perceived course difficulty, whether the course was in the student's major, whether the course was required, and whether or not the student was a freshman. Course-level variables included mean student rating of difficulty, proportion of students who were majors, proportion of students taking the course as a requirement, proportion of students who were freshmen, course size, faculty rank, course format, and whether the course was introductory. Hierarchical linear modeling of the data found that factors positively influencing course satisfaction included: social sciences/humanities/core curriculum courses; higher level of difficulty; high proportion of majors; tutorial courses; course taught by an assistant or associate professor; and being in a freshman class with few freshmen. Factors found to have a negative influence on satisfaction included: math/science courses; high proportion of students taking the course as a requirement; and being in a math/science course and finding it more difficult than others. The rating form and statistical summaries are appended. (Contains 11 references.) (MSE)

Student and Course Factors Predicting Satisfaction in Undergraduate Courses at Harvard University

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INTRODUCTION

This study is concerned with undergraduate student ratings of courses at Harvard University.[1] Several student-level and course-level predictors are included in the model which is estimated using hierarchical linear modeling. Hierarchical linear modeling (Bryk & Raudenbush, 1992) is particularly well-suited to the analysis because it allows us to simultaneously estimate models at the student level, the course level and the department level, thus resolving the unit of analysis problem that has plagued this area of research for decades (Cranton & Smith, 1990). Student-level predictors include whether or not the student is in the first year of study, taking the course as a requirement, and taking the course in his or her concentration (major). Additionally, we calculate a measure for how difficult the student perceives the course to be. Course-level predictors include course size, faculty member's rank, course type (seminar, lecture, etc.), division, and whether or not the course is in the "Core" (i.e., the group of general education courses, of which several are required for graduation). Finally, models are estimated to control for the department in which the course is offered. The dependent variable is a measure of satisfaction constructed from several survey items.

BACKGROUND

A wealth of research exists in the area of student evaluation, ranging from analyses of validity and reliability to studies parceling effects related to student, teacher, and course characteristics. Several summaries and meta-analyses help to guide the researcher through the maze of often contradictory evidence (Feldman, 1978; Smith & Glass, 1980; Braskamp, Brandenburg, & Ory, 1984). We provide an overview of the findings related to the predictors available for the current study.

Studies examining class size arrive at various conclusions. While the Smith and Glass (1980) meta-analysis found an inverse relationship for the effect of class size on student ratings, Marsh, Overall, and Kesler (1979) found a curvilinear effect where small and large classes tended to get higher ratings. In his review of existing research, Feldman (1978) found both of these effects as well as no effect of class size. Very little analysis exists on the effect of course format

1 The authors wish to acknowledge the Derek Bok Center for Teaching and Learning at Harvard University for supporting this project.

(i.e., discussion versus lecture versus lecture/section), perhaps because it is not easily coded for multi-course studies and considered to be measured in large part by course size. Two studies (Bejar & Doyle, 1978; Bruton & Crull, 1982) found no effect of course format while Wigington, Tollefson and Rodriguez (1989) found a main and an interaction effect between course format and size. For the main effect, discussion courses were rated higher than both lecture and lecture/discussion courses; for lecture/discussion courses, the authors found a positive effect of size where larger courses tended to be rated higher than smaller ones.

Feldman (1978) found consistent results for several predictors of course ratings. He found positive associations between ratings and taking a course as an elective and also for taking a course outside the sciences. While Feldman also reports a positive association between course level and student ratings, he notes that the association is relatively weak in strength. We found no effect of course level in the present study; hence, it does not appear in our final estimated model.

Very little attention has been paid to the effect of course difficulty on student ratings. Marsh (1980) found a positive effect of course difficulty where more difficult courses are rated higher than less difficult courses. We replicate that finding.

Finally, the effects of faculty rank, age and years of teaching prove difficult to disentangle; this is the topic of an exhaustive piece by Feldman (1983). Research typically indicates a positive effect of rank on student ratings but a negative effect for age of the faculty member and years of teaching on ratings. Years of teaching will sometimes exhibit a curvilinear relationship where ratings will increase in the early years of teaching and then plateau and decrease in later years. Many studies show no effect of these predictors. Feldman notes that while higher faculty rank is typically associated with higher overall ratings, the relationship can disappear or reverse when particular dimensions of teaching are examined.

SAMPLE

The data for this investigation come from student course evaluations at Harvard College and are drawn from three consecutive semesters beginning in the spring of 1992. We eliminated from the sample all evaluations completed by individuals who are not Harvard undergraduates (i.e., students from Harvard University's graduate schools). We also eliminated evaluations on which students failed to respond to questions that are key variables in the model. The final analytic sample includes 33,180 evaluations for 1,114 courses which are offered in 47 departments.

MEASURES

Course evaluations at Harvard are developed and administered by the Committee on Undergraduate Education and are commonly called the CUE. Among other purposes, the data are used to publish a book of course descriptions for students. The survey instrument consists of several background questions and 28 items assessing various aspect of the course (see Appendix A). These anonymous surveys are completed by students at one of the last class meetings and are returned directly to the Committee. Faculty are not required to have their courses evaluated.

For this investigation we create two composite measures: one for overall course satisfaction, the other for course difficulty. All items used in the composite are measured on a 5-point Likert scale and are standardized before being entered into the composite. The satisfaction composite includes the following items:

- Overall course rating
- Stimulated interested in the subject matter
- Overall instructor rating
- Instructor gave clear, well-structured presentations

The items are averaged to create the composite. The standardized scale has a reliability (Cronbach's alpha) of .87. The composite requires a logit transformation due to its bounded nature and is then cubed to improve its distribution. Finally, the satisfaction composite is standardized to a mean of 50 and a standard deviation of 10 to aid in interpretation. The course difficulty measure is created by averaging the following standardized items:

- Difficulty overall
- Course workload overall
- Pace of course overall

This variable is distributed symmetrically and does not require transformation. The reliability of the difficulty measure (Cronbach's alpha) is .79. The next section describes the measures included in each of the three levels of the hierarchical model.

Student-level database (n=33,180)

The level-one database is concerned only with student predictors which include:

- Student's satisfaction with the course (the satisfaction composite variable)
- Student's rating of course difficulty (the difficulty composite variable)
- whether or not the student is taking the course within his/her concentration
- whether or not the student is taking the course as a requirement
- an interaction term for concentration by requirement
- whether or not the student is a freshman

Additionally, identification variables are retained which indicate the student's course and the course's department (these are the linking fields for the three databases). All student-level variables are drawn directly from the CUE instrument.

Course-level database (n=1,114)

The level-two database includes all the variables that pertain to the descriptions of each course. These variables are drawn from several sources. Several variables represent the mean values of the predictors in the student-level database. Others are merged from a descriptive database created for this study; these data are culled from course catalogs. Finally, a created variable describes the course size. The course-level variables are:

from the student-level database:

- mean student rating of course difficulty
- proportion of students taking the course in their concentration
- proportion of students taking the course as a requirement

- proportion of students who are taking the course BOTH as a requirement AND in their concentration
- proportion of students in the course who are freshmen
- size (as measured by the number of students who returned evaluations[2])

from the course description database:

- faculty rank -- represented by three binary variables: full professor, assistant or associate, lecturer/instructor
- course format -- represented by four binary variables (described in greater detail below): tutorial course, course taught "in section," discussion course, and lecture course with sections
- introductory course -- whether the course is at an introductory level versus an advanced level (this predictor dropped out of the analysis for lack of predictive power)
- Interaction terms between course format and size

The course identification and the department name are retained in this database as linking fields with the other two. Four types of course formats are represented in the database (see Table 1). Tutorials are small seminars that typically range in size from 7 to 17 students with an average size of 12.

Table 1
Class size by format (n=1,114)

	n	mean	std dev	min	max
Tutorials	32	12	5	6	31
Discussion	464	23	17	3	95
Courses taught in section	330	17	10	1	68
Lectures with sections	288	93	104	6	624

[2] This variable was created before any cases were dropped to create the analytic sample.

Discussion courses constitute the bulk of courses. These are courses that tend to be of small to medium size, ranging from 6 to 40 students and averaging about 23 students. Neither tutorials nor discussion courses offer sections due to their small size. Courses taught "in section" are of two varieties: 1) language courses, and 2) several heavily subscribed non-language courses (e.g., expository writing, mathematics courses). While several hundred students may be enrolled in a course such as expository writing, they never meet together in a lecture hall; rather they always meet in smaller sections. While a few of these courses taught in section can be quite large (up to 68 in this sample), typically they range in size from 7 to 27 with an average size of 17. Finally, about a quarter of the courses in the sample (enrolling almost two-thirds of the students in the sample) are taught in large lectures that offer sections. While the mean enrollment for these courses is 93, this figure is heavily influenced by some very large courses in the database (most notably Social Analysis 10, a popular economics course). The median enrollment for courses with sections is 56 students; a quarter of these courses have 26 or fewer students, the second quartile captures enrollments of 26 to 56, the third quartile ranges from 56 to 124, and the fourth quartile spans enrollments from 124 to 624.

Department-level database (n=47)

The level-three database allows us to observe any variations that may occur between departments. Only two predictor variables are included at this level:

- division -- represented by three binary variables: humanities, science/math, and social sciences
- "Core" -- whether or not the department falls under the rubric of the general education program

DESCRIPTIVE STATISTICS

Next we provide some overall descriptions of the sample as well as some data on how satisfaction and difficulty vary in simple (uncontrolled) relationships. It is meaningless to interpret the difficulty and satisfaction composites for the overall sample of students as these variables have been standardized. Table 2 presents satisfaction and difficulty ratings for four variables in the student-level model.

Table 2
Description of student-level variables
(n=33,180 students)

	n	%	mean satisfaction	std dev satisfaction	mean difficulty	std dev difficulty
Concentrators	13,999	42%	50.033	9.973	0.171	0.815
Non-concentrators	19,181	58%	49.976	10.020	-0.174	0.834
Taking course for a requirement	22,030	66%	49.172	9.617	0.026	0.844
Not taking as a requirement	11,150	34%	51.636	10.528	-0.136	0.832
Both concentrator and course required	9,007	27%	49.162	9.464	0.253	0.822
Either concentrator or course required or neither	24,173	73%	50.312	10.175	-0.134	0.828
Freshman	10,035	30%	49.709	10.29	0.091	0.838
Sophomore, Jr. or Sr.	23,145	70%	50.126	9.869	-0.080	0.841

Very small differences are in evidence at the student level. Concentrators and non-concentrators are virtually indistinguishable in their satisfaction with courses, as is the case with freshmen versus their older classmates. Students taking the course for a requirement are slightly more likely to be satisfied with their courses than are students not taking the course as a requirement. Differences in perceived course difficulty are similarly quite small, with some tendency for concentrators, those taking a course for a requirement, and freshmen to find their courses somewhat easier.

Turning to the course-level dataset, we describe these data according to their division: humanities, social sciences, math/science (see Table 3):

Table 3
Description of course-level predictors by division
(n=1,114 courses)

	Total (n=1,114)	Human-ities (n=537)	Social Sciences (n=310)	Math & Science (n=267)
Mean and standard deviation of satisfaction	51.208 (6.169)	52.454 (6.575)	51.185 (5.150)	48.729 (5.656)
Mean and standard deviation of course difficulty	0.069 (0.519)	0.020 (0.524)	0.014 (0.475)	0.229 (0.526)
Mean proportion of concentrators	49%	31%	64%	69%
Mean proportion of students taking the course as a requirement	52%	48%	46%	64%
Mean proportion of concentrators taking the course as a requirement	27%	15%	32%	43%
Mean proportion of students who are freshmen	30%	38%	14%	34%
Mean course size and std deviation: TUTORIALS	12 (5)	12 (5)	13 (6)	12 (7)
Mean course size and std deviation: DISCUSSION	23 (17)	20 (16)	27 (18)	23 (16)
Mean course size and std deviation: TAUGHT IN SECTION	17 (10)	16 (8)	none	20 (13)
Mean course size and std deviation: LECTURES W SECTIONS/LABS	93 (104)	107 (105)	95 (106)	79 (100)
Proportion of courses in each format:				
Tutorial	3%	3%	4%	1%
Discussion	42%	34%	61%	36%
Taught in section	30%	49%	0%	25%
Lectures with sections/labs	26%	14%	35%	38%
Proportion courses taught in each faculty rank category:				
FULL PROFESSOR	35%	25%	40%	50%
ASSOCIATE	8%	5%	14%	8%
ASSISTANT	16%	11%	24%	19%
LECTURER/INSTRUCTOR	40%	58%	22%	24%
Proportion of courses in Core Pgm	12%	9%	18%	10%
Number of departments	47	23	13	11

Comp. ring across divisions we find some interesting relationships. Students in humanities courses appear to be the most satisfied, followed by social sciences students and then math/science students. Mean difficulty is highest in math/science, lower for humanities courses, and lowest for social sciences courses. The mean proportion of concentrators in a course is highest in mathematics and science where students seem to choose few of their electives. Mean proportions of freshmen are low in the social sciences (14%) as compared to humanities (38%) and math/science (34%). Average course sizes do not vary dramatically between divisions, except that math/science courses taught in lecture with sections or labs tend to be smaller (79) than lecture/section courses taught in social sciences (95) and humanities (107). It appears that a strikingly high percentage of courses in the humanities are taught by instructors (58%). This is consistent with the fact that almost half of humanities courses are taught in section, most notably expository writing sections and language courses.

ANALYTIC STRATEGY

We used hierarchical linear modeling to estimate models because it offers considerable flexibility in describing variation both within and between classes. The outcome specified is associated with a student -- course satisfaction -- and can be predicted as a function of one or more characteristics of the student. Additionally, the outcome can be predicted as a function of one or more characteristics of the class (e.g., format of the course, rank of the teacher, proportion of students taking the course to fulfill a requirement, average difficulty) as well as characteristics of the department (e.g., division). The linked equations allow us to understand the relationships that simultaneously exist within and between courses. We used HLM software developed by Bryk, Raudenbush and Congdon (Scientific Software, 1996) to analyze these data.

RESULTS

Appendix B contains the final three-level trimmed model for the CUE data. The model simultaneously estimates effects at the three levels of data: student, course, and department. Like any regression model, the other terms in the model provide statistical control as we interpret any single parameter. We will highlight findings for student-, course-, and department-level predictors of satisfaction.

Student-level findings

Student-level effects are concerned with the experience of a single student in a particular classroom, thus allowing us to compare between students in a single class. We find that freshmen tend to be more satisfied with their courses and that the magnitude of this effect varies by division. The size of the effect also varies depending on the proportion of freshmen in the class: an increase in this proportion causes a precipitous drop in relative satisfaction. One example of the combined effect is that first-year students taking courses in math and science with a high proportion of freshmen are much less satisfied than sophomores, juniors and seniors in the same classroom.

There is no within-class main effect of being a concentrator on satisfaction with a course; concentrators and non-concentrators report similar levels of satisfaction. Taking the course as a requirement is another story, however, one that is well documented in the literature as having a negative effect on satisfaction. We find a main effect -- a negative one -- for taking a course as a requirement in the humanities (compared to courses in the social sciences). That is, students in humanities courses like the course less if taking it as a requirement than if they are taking it as an elective. Across all divisions, the dissatisfaction of a student taking a course as a requirement will increase as the proportion of students in the class taking it as a requirement increases. Said differently, the more students in a course who are taking it as a requirement, the more dissatisfied the student who is taking it as a requirement compared to the student who is not.

Among the most interesting effects at the student level are those associated with the difficulty measure. The effect of course difficulty on satisfaction varies by division. In the social sciences, we find on the average a small positive main effect of difficulty: as a student perceives a course to be harder relative to another student who finds it easier, the more s/he likes it. The reverse effect is present for math/science: on the average, finding a course harder is associated with dissatisfaction. On the average, there is no effect of course difficulty in the humanities. In all divisions, however, the magnitude and direction of the within-class effect of difficulty is predicted by the average rating of difficulty for the entire class. For example, in an "easy" course in the humanities, a student likes it better if s/he finds it harder, and in a "hard" course in the humanities, a student likes it less if s/he finds it harder. For all divisions, an increase in the proportion of concentrators translates to an improvement in satisfaction related to course difficulty. So, in a course of average difficulty heavily populated by students majoring in the field, a student who finds a course more difficult is predicted to like it better than a student who finds it easier. Finally, an increase in the proportion of students taking a course as a requirement translates to a positive effect of difficulty on satisfaction. So, in Core courses that have a high proportion of students taking it as a requirement, finding a course more difficult increases a student's satisfaction relative to someone who finds it easier.

Course-level findings

At the student level, we examine differences in satisfaction between individual students in a class. At this level, individual student ratings of satisfaction and difficulty have been averaged for comparisons between courses. Similarly, at the course level we think about average proportions of the other student characteristics we have been examining: the average proportion of concentrators in a course, the average proportion of those taking it as a requirement, and the average proportion of students in the course who are freshmen. In addition, we have several new predictors for our examination of satisfaction. These are the course level predictors of faculty rank, course format, and class size.

Faculty rank. A small effect exists for faculty rank. Students tend to be slightly less satisfied with a course if it is taught by a full professor or an instructor as compared to one taught by an assistant or associate professor.

Course format. We examined the four course format types (tutorial, discussion, taught in section, and lecture/section) as well as any differences that might exist by size of the course. Not surprisingly, being in a tutorial is strongly associated with satisfaction. This particular relationship is the strongest in the model, as being in a tutorial increases satisfaction by more than half a standard deviation. Tutorials vary little in size, so no relationship exists between size of tutorial and satisfaction.

Discussion courses and courses taught in section do not differ in their student satisfaction from courses taught in lecture/section. This suggests that large lecture courses emulate their smaller counterparts (discussion courses and those taught in section) by offering small section meetings.

We find little effect for differences in course size (except, of course, for tutorials whose main feature is their small size). For discussion courses (these are courses without sections), we find that satisfaction decreases slightly with increases in course size, but no difference exists for large lecture/section courses versus small lecture/section courses. It appears that sitting in a lecture hall with 400 students is not different from sitting in a lecture hall with 100 students, as long as you have an opportunity to meet in sections.

Course difficulty. We find that the overall effect of course difficulty is a positive one: *the more difficult the course, the better students like it.* Recall, however, that a within-class effect exists -- a student in a math, science, or humanities course who finds the course harder than a classmate does will like it less, and a student in a social sciences course who finds it harder than another classmate will like it more.

Proportion of concentrators. As mentioned earlier, the effect of the proportion of concentrators on satisfaction is positive; as the proportion of concentrators increases, satisfaction ratings increase.

Proportion of students taking a course as a requirement. The effect of being in a course with a high proportion of students taking it as a requirement is substantial (about half a standard deviation in satisfaction) and negative. The higher the proportion of students taking a course as a requirement, the lower the mean satisfaction rating for the course.

Department-level findings

Division. We identified a main effect of division, with students in humanities courses reporting higher satisfaction than those in social science courses, and students in math and science reporting lower levels of satisfaction than these two divisions. Interestingly, students taking Core courses appear the most satisfied (although this difference is not large). This finding would take the Harvard community by surprise because of the widespread perception that students are dissatisfied with the series of Core courses that they are required to take for graduation. The key word here is "required"; the satisfaction ratings that we see in this positive parameter estimate exist *after controlling for the fact that these are required courses with no concentrators.* We know courses with a high proportion of students taking the course as a requirement tend to get low ratings, and courses with a low proportion of concentrators tend to get low ratings. This is a double whammy for Core courses which meet both of these conditions. Levels of satisfaction in Core courses are actually better than one might expect given their attributes, although still lower than courses without these attributes.

Summary

The three-level hierarchical model confirms much of what is known from previous research and, in addition, allows us to expand on the knowledge of how course difficulty affects student satisfaction within the classroom. Here are some key findings from the study:

These factors have a positive influence on course satisfaction:

- Being in a social science, humanities, or Core course
- Being in a more difficult course
- Being in a course with a high proportion of concentrators
- Being in a tutorial course
- Being in a course taught by an assistant or associate professor
- Being in a social science course AND finding it more difficult than others in the class find it
- Being a freshman in a class with few other freshmen

These factors have a negative influence on course satisfaction:

- Being in a math or science course
- Being in a course with a high proportion of students taking it as a requirement
- Being in a math or science course and finding it more difficult than others in the class find it

Of course, all of the caveats about causality apply and we should not be tempted to change our courses based on these findings to increase student CUE ratings. For example, we cannot expect that increasing a course's difficulty will result in an increase in student satisfaction ratings. Rather, these findings help us interpret the variations that we see in CUE ratings. There are, however, some policy implications that may flow from these data. First, it is reassuring to know that the resources allocated to support both tutorial courses and section leaders for lecture courses seem to pay off in terms of student satisfaction. Students in tutorials are the most satisfied among the four formats we examined, and those in lecture/section courses are as satisfied as those in discussion courses and courses taught in section. Second, the student-level findings concerning difficulty and satisfaction suggest that certain "at-risk" students can be identified. For example, students in math and science courses who find the course more difficult than others, and students in social sciences courses who find the course less difficult than others are likely to have low satisfaction. Ways to identify and assist such students may be warranted.

Finally, while we cannot assume that course evaluation at Harvard is generalizeable to other institutions, we believe that the use of HLM to analyze the data gives us some answers about the unit of analysis dilemma faced by researchers in this area of study. By modeling the student effects in the classroom while controlling for course effects and modeling course effects while controlling for student effects, we are able to confirm many existing findings in the literature. Additionally, we are able to identify and disentangle the complex effects of course difficulty as it exists within and between courses.

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COMMITTEE ON UNDERGRADUATE EDUCATION GENERAL COURSE EVALUATION QUESTIONNAIRE

The evaluation questionnaire is prepared and distributed under the auspices of the student staff of the CUE Course Evaluation Guide and the Office of the Associate Dean for Undergraduate Education at the request of the course head. Coursewide statistics and xeroxed copies of the forms are made available to the professors after the submission of final grades. The CUE Guide will be handed out to undergraduates at the start of the next academic year. As written comments provide the basis both for Guide writeups and feedback to the instructors, please comment as thoughtfully as possible. Tactful and constructive remarks are more effective than caustic criticism.

Please describe the characteristics of the course and instructor(s) as accurately as possible by darkening one circle for each of the following items. Please comment on the back.

RATING SCALE
1 = Very poor/Very low
2 =
3 = Average
4 =
5 = Outstanding/Very High
NA = Non-applicable

Course No. and Title: ____________________

Academic Year

BACKGROUND INFORMATION:

AFFILIATION → H/R ○ GSAS ○ Other ○

List your concentration ____________________ YEAR → ①②③④ ○F

Primary reason for enrolling in course: → ①②③④⑤ ○M

1 = Elective 2 = Concentration requirement 3 = Core requirement
4 = Elective within concentration 5 = Pre-med requirement

GENERAL EVALUATIONS OF COURSE:	NA	LO 1	2	3	4	HI 5
1. Stimulated interest in the subject matter	○	○	○	○	○	○
2. Quality of the reading and/or texts	○	○	○	○	○	○
3. Course workload overall (5 = very heavy)	○	○	○	○	○	○
4. Fraction of course work you completed (1 = none, 3 = half, 5 = all)	○	○	○	○	○	○
5. Difficulty overall (5 = very difficult)	○	○	○	○	○	○
6. Competitive atmosphere (5 = highly competitive)	○	○	○	○	○	○
7. Pace of course overall (1 = too slow, 5 = too fast)	○	○	○	○	○	○
8. Overall course rating	○	○	○	○	○	○

ASSIGNMENTS (e.g. papers, problem sets, lab reports, projects)	NA	1	2	3	4	5
9. Were well chosen and appropriate for the course (5 = strongly agree)	○	○	○	○	○	○
10. Instructors comments on written work were helpful (5 = strongly agree)	○	○	○	○	○	○
11. Were returned promptly (5 = strongly agree)	○	○	○	○	○	○

PROFESSOR/INSTRUCTOR EVALUATIONS: See blackboard for listing

Professor (A) ____________ Professor (B) ____________

	NA	PROFESSOR A (LO–HI)	PROFESSOR B (LO–HI)
12. Gave clear, well-structured presentations	○	①②③④⑤	①②③④⑤
13. Answered questions well	○	①②③④⑤	①②③④⑤
14. Encouraged participation	○	①②③④⑤	①②③④⑤
15. Was available to answer questions outside class	○	①②③④⑤	①②③④⑤
16. Used the blackboards, visual aids, handouts well	○	①②③④⑤	①②③④⑤
17. Overall rating	○	①②③④⑤	①②③④⑤

SECTION/LAB/STUDIO EVALUATION (If applicable)	NA	LO 1	2	3	4	HI 5
18. Fraction attended (1 = none, 3 = half, 5 = all)	○	○	○	○	○	○
19. Were well integrated into the course structure (5 = strongly agree)	○	○	○	○	○	○
20. Sections contributed meaningfully to the course (5 = strongly agree)	○	○	○	○	○	○

SECTION/LAB/STUDIO LEADER: See blackboard for names and numbers

LEADER A: ①②③④⑤ ⑥⑦⑧⑨⑩ LEADER B: ①②③④⑤ ⑥⑦⑧⑨⑩

Leader (A) ____________ Leader (B) ____________

	NA	LEADER A (LO–HI)	LEADER B (LO–HI)
21. Had a good understanding of subject matter (5 = strongly agree)	○	①②③④⑤	①②③④⑤
22. Gave clear, well-structured presentations	○	①②③④⑤	①②③④⑤
23. Was an effective discussion leader (5 = strongly agree)	○	①②③④⑤	①②③④⑤
24. Answered questions well	○	①②③④⑤	①②③④⑤
25. Encouraged participation by all students	○	①②③④⑤	①②③④⑤
26. Was available to answer questions outside class	○	①②③④⑤	①②③④⑤
27. Used the blackboards, visual aids, handouts well	○	①②③④⑤	①②③④⑤
28. Overall rating	○	①②③④⑤	①②③④⑤

CONTINUE EVALUATION ON REVERSE SIDE

Appendix B
HLM Fixed Effect Estimates

Final estimation of fixed effects:

Fixed Effect	Coefficient	Standard Error	T-ratio	P-value
For INTRCPT1, P0				
For INTRCPT2, B00				
INTRCPT3, G000	50.659898	0.738870	68.564	0.000
CORE, G001	1.994329	1.107523	1.801	0.078
HUM, G002	1.536700	0.673735	2.281	0.028
NSC, G003	-1.318250	0.734106	-1.796	0.065
For SIZE, B01				
INTRCPT3, G010	-0.001303	0.002717	-0.479	0.631
For RANK1, B02				
INTRCPT3, G020	-0.448234	0.491907	-0.911	0.363
For RANK4, B03				
INTRCPT3, G030	-1.013081	0.426643	-2.375	0.018
For DISCUSS, B04				
INTRCPT3, G040	0.362245	0.669912	0.541	0.588
For INSECTN, B05				
INTRCPT3, G050	1.219246	0.871909	1.398	0.162
For TUTORIAL, B06				
INTRCPT3, G050	6.441450	2.585277	2.492	0.013
For ZDISCUSS, B07				
INTRCPT3, G070	-0.034588	0.014481	-2.389	0.017
For ZINSECTN, B08				
INTRCPT3, G080	0.002654	0.005881	0.451	0.651
For ZTUTOR, B09				
INTRCPT3, G090	-0.220877	0.181198	-1.219	0.223
For DIFF, B010				
INTRCPT3, G0100	0.914456	0.348219	2.626	0.009
For CONCENTR, B011				
INTRCPT3, G0110	2.721311	1.075185	2.531	0.012
For REQUIRE, B012				
INTRCPT3, G0120	-5.227900	1.091772	-4.788	0.000
For CON_REQU, B013				
INTRCPT3, G0130	-2.236297	1.464337	-1.527	0.127
For FROSH slope, P1				
For INTRCPT2, B10				
INTRCPT3, G100	1.261195	0.322101	3.916	0.000
CORE, G101	-0.288885	0.329261	-0.877	0.381
HUM, G102	-0.666885	0.369943	-1.803	0.071
NSC, G103	-0.929697	0.427214	-2.176	0.029
For FROSH, B11				
INTRCPT3, G110	-2.474433	0.763409	-3.241	0.002
For CONCENTR slope, P2				
For INTRCPT2, B20				
INTRCPT3, G200	-0.309037	0.297593	-1.038	0.300
CORE, G201	-0.451255	0.434225	-1.039	0.299
HUM, G202	0.586646	0.372415	1.575	0.115
NSC, G203	0.770293	0.451688	1.705	0.088

For REQUIRE slope, P3				
For INTRCPT2, B30				
INTRCPT3, G300	-0.723040	0.453491	-1.594	0.111
CORE, G301	0.778125	0.706681	1.101	0.271
HUM, G302	-1.136706	0.418661	-2.715	0.007
NSC, G303	-0.157192	0.441677	-0.356	0.722
For CONCENTR, B31				
INTRCPT3, G310	-2.572916	1.241700	-2.072	0.038
For REQUIRE, B32				
INTRCPT3, G320	-3.095123	1.232628	-2.511	0.012
For CON_REQU, B33				
INTRCPT3, G330	3.083333	1.655905	1.862	0.062
For FROSH, B34				
INTRCPT3, G340	1.638381	0.697121	2.350	0.019
For CON_REQU slope, P4				
For INTRCPT2, B40				
INTRCPT3, G400	0.774579	0.385539	2.009	0.044
For DIFF slope, P5				
For INTRCPT2, B50				
INTRCPT3, G500	0.424818	0.202626	2.097	0.036
CORE, G501	-0.334898	0.330064	-1.015	0.311
HUM, G502	-0.446152	0.255232	-1.748	0.080
NSC, G503	-1.150554	0.256726	-4.482	0.000
For DIFF, B51				
INTRCPT3, G510	-1.915296	0.208624	-9.181	0.000
For CONCENTR, B52				
INTRCPT3, G520	2.655340	0.647078	4.104	0.000
For REQUIRE, B53				
INTRCPT3, G530	1.120308	0.497351	2.253	0.024
For CON_REQU, B54				
INTRCPT3, G540	-2.143237	0.817337	-2.622	0.009