

Supplemental Information

Looking Back: What do Geoscience Graduates Value Most from their Academic Experience?

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1. Methods

The alumni survey included questions about satisfaction, endorsement, learning outcomes, current employment, and future education. Two versions of the survey were developed. The version sent to the 962 alumni who graduated prior to 1996 did not include a learning outcomes question (question 2). The post-1995 version, was sent to 141 alumni who graduated between 1996 and 2013 and contained individualized Earth Sciences course information for the learning outcomes question. The individualized course data lists were drawn from the 76 Earth Science courses offered between Summer term 1998 and Spring term 2013 (314 unique instances of courses by term). Dartmouth's Office of Institutional Research administered the survey and aggregated responses by course (over time) to ensure confidentiality. All participants were invited by email to answer the survey. There were 286 undeliverable emails, making the final number of participants 817.

The retrospective responses from the alumni on learning outcomes for each course were compared to the results from the end-of-course evaluation completed at the time the course was offered. Three questions from the standard course evaluation were included in the analysis. The first question asked the student to rate the overall quality of the course, the second asked the student to rate the effectiveness of the teaching in the course, and the last asked the student to rate the amount they learned in the course. All ratings were on a five point scale ranging from excellent (rating =1) to poor (rating = 5). Separate analyses of the student responses to other questions on the course evaluation that address specific aspects of course quality, such as the extent to which course objectives were clear, assessment of how much was learned in the course, and course organization, were found to be highly correlated with assessment of the overall course quality, teaching effectiveness, and amount. Thus only these three questions from the standard course evaluation were used here.

To determine which skills students thought a particular course emphasized, we added five questions to the online course evaluation survey that students are asked to complete at the end of a course (Table 1). The five questions asked the student to rate the relative emphasis the course placed on a particular skill. Students ranked each skill on a five point scale ranging from they strongly agreed the course improved their familiarity or ability in that skill (ranking = 1) to they strongly disagreed the course improved their familiarity or ability in that skill (ranking = 5). Students could also select “not applicable”. We cautioned the student that courses are designed to focus on particular skills so may not address all the skills listed. Some caution is also warranted in interpreting the results from this survey as no attempt was made to formally validate the skill ranking questions.

Table S1. Questions added to the online course evaluation*

Question 1

This course improved my quantitative and analytical skills

Question 2

This course improved my ability to communicate scientific concepts, data, and results in written and oral form

Question 3

This course improved my familiarity with sources and the use of scientific literature

Question 4

This course improved my familiarity with the process of science

Question 5

This course improved my ability to obtain, analyze, and interpret scientific data

*Students were asked to rank the relative emphasis the course placed on the following skills. Students ranked the emphasis on each skill on a five point scale ranging from "Strongly Agree" to "Strongly Disagree".

Between fall 2009 and spring 2013, end-of-class online evaluations containing the three standard course evaluation questions and the five skill ranking questions were given in 86 different classes. Students completed the online course evaluations outside of class anytime within a window that extended from the last week of the classes to the fourth day of the next term. Students were not required to complete the evaluations, however those that did could see their course grades earlier than those that did not complete the evaluations. The 86 different classes surveyed had a total enrollment of 2661 students. Survey completion rates ranged between 77 – 100% and averaged 88%.

2. Selected Results

Of the 817 alumni asked to respond, 369 did so for a 45% response rate. Alumni from the pre-1996 cohort responded at lower rates ($\chi^2 = 6.94$, $p < .01$) than their counterparts who attended Dartmouth post-1995 (32% vs. 43%). Of the 369 responses, 308 graduated prior to 1996. Three-quarters of respondents graduated from Dartmouth with a bachelor's degree, 18% a master's, and 7% a PhD.

Q1 Thinking back to your degree program in Dartmouth earth sciences, did you receive training that helped you develop the following skills and abilities? Results in parentheses are for (pre-1996 / post-1995) cohorts.

	Dartmouth provided training, but it was NOT effective	Dartmouth provided some training, but more was needed	Dartmouth provided effective training	Dartmouth did not provide training, but training would have been helpful	Dartmouth did not provide training, and training is not necessary	Number of respondents
Analyzing or synthesizing data -----	1% (1%/4%)	23% (24%/21%)	69% (69%/73%)	5% (5%/2%)	1% (2%/<1%)	287 (235/52)
Designing and executing research -----	1% (1%/<1%)	34% (34%/35%)	53% (52%/60%)	9% (10%/6%)	2% (3%/<1%)	283 (231/52)
Presenting orally -----	1% (1%/<1%)	37% (40%/27%)	35% (29%/58%)	23% (26%/13%)	4% (4%/2%)	283 (231/52)

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Thinking critically/problem-solving	1% (1%/2%)	14% (15%/13%)	82% (81%/83%)	1% (1%/2%)	1% (1%/<1%)	283 (231/52)
Working collaboratively	2% (2%/2%)	23% (25%/14%)	65% (62%/78%)	8% (8%/6%)	2% (3%/<1%)	284 (233/51)
Writing reports, articles, books, etc	<1% (<1%/2%)	31% (28%/43%)	58% (59%/51%)	8% (9%/4%)	3% (3%/<1%)	284 (233/51)
Identifying a problem and formulating a solution	2% (2%/<1%)	28% (29%/25%)	64% (63%/67%)	5% (4%/8%)	1% (2%/<1%)	283 (231/52)
Understanding the process of science	1% (1%/<1%)	20% (20%/23%)	73% (73%/69%)	5% (4%/6%)	1% (1%/2%)	285 (233/52)
Quantitative analysis	3% (2%/8%)	37% (38%/31%)	52% (51%/55%)	7% (8%/6%)	1% (1%/<1%)	281 (230/51)
Locating and applying published information	1% (1%/<1%)	24% (24%/20%)	66% (66%/65%)	7% (6%/14%)	2% (3%/2%)	285 (234/51)
Foundational ideas in earth sciences	2% (2%/2%)	9% (7%/17%)	88% (90%/81%)	1% (1%/<1%)	<1% (<1%/<1%)	286 (234/52)
Teaching or training groups of people	1% (1%/2%)	21% (20%/27%)	32% (33%/31%)	33% (34%/31%)	12% (12%/10%)	284 (232/52)

Q3 Please indicate how valuable the following have been to your career. Results in parentheses are for (pre-1996 / post-1995) cohorts.

	Not at all valuable	Moderately valuable	Very valuable	Extremely valuable	Not applicable	Number of respondents
Faculty/Staff mentorship -----	3% (3%/2%)	6% (6%/8%)	24% (21%/35%)	63% (65%/53%)	4% (5%/2%)	295 (244/51)
Classroom experience -----	1% (0%/4%)	5% (5%/6%)	43% (41%/51%)	51% (53%/37%)	1% (0%/2%)	295 (244/51)
Independent research experience -----	1% (1%/2%)	3% (2%/4%)	20% (21%/16%)	59% (57%/71%)	17% (19%/8%)	294 (243/51)
Experiential learning -----	1% (1%/<1%)	2% (1%/6%)	16% (17%/14%)	69% (68%/75%)	12% (14%/6%)	295 (244/51)
Peer learning experience	1% (1%/2%)	11% (11%/12%)	39% (38%/41%)	40% (40%/41%)	8% (9%/4%)	292 (241/51)

Q7 If you are currently employed, current area of employment. Results in parentheses are for (pre-1996 / post-1995) cohorts.

Industry	Percent
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Academia	27% (27%/25%)
Energy	14% (12%/20%)
Environment	4% (3%/9%)
Gov't	13% (12%/14%)
K-12	5% (4%/9%)
Mining	5% (5%/2%)
Other	23% (24%/18%)
Unspecified	9% (11%/2%)

The learning outcomes question on the alumni survey presented an individualized list of earth science courses the respondent had taken at Dartmouth and asked them to rate each course on how effective the course was in developing the skills and abilities they use in their career. Table 2 summarizes the Pearson correlation between the alumni retrospective ratings of each course and the end-of-course evaluation questions.

Table S2. Pearson correlations between end-of-course evaluations and alumni retrospective ratings

Course evaluation question	Correlation with alumni rating	Statistical significance
Overall quality of the course	0.40	$p < 0.0001$
Amount learned in the course	0.39	$p < 0.0001$
Effectiveness of teaching	0.33	$p = 0.0008$
Emphasis on science communication	0.39	$p = 0.005$
Emphasis on analysis of scientific data	0.23	$p = 0.11$
Emphasis on use of scientific literature	0.24	$p = 0.095$
Emphasis on process of science	0.36	$p = 0.0092$

