

Humanities Awareness: A Comparison Between Honors Program and Traditional Undergraduate Engineering Students

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Introduction

The importance of the humanities in engineering education has not been without controversy. Reflecting current ABET criteria, engineering students are expected to develop a high level of cultural, societal, and ethical awareness, with such awareness permeating the future professional practice of engineering. Defining and achieving desired objectives in humanities education is formidable for undergraduate students in general. At one extreme, there are so-called traditionalists who hold the position that all “educated” individuals should demonstrate a mastery of specified topics (for example, Greek classics), with the topics more or less representing the entire history of western civilization. Examples of adherents of this position are Allen Bloom and Ed Hirsch, academics who have authored the controversial books *The Closing of the American Mind*¹ and *Cultural Literacy*² respectively. Traditionalist curriculums tend to be very homogenous, with minimum flexibility regarding course selection. Taking an opposite position, there are so-called modernists who maintain that the traditionalist viewpoint is inappropriate for contemporary society; humanities and social topics should be emphasized which prepare student for today’s complex diverse world. Modernist curriculum tends to be more diverse and flexible regarding course availability and selection.

At this point in time, most engineering faculty recognize the value of humanities. Past AIEE president C. P. Steinmetz claimed that the purpose of providing a broad education was “... to produce the intellectual development and broadening of the mind which create not merely intellectual machines, but citizens capable of taking their proper place in the industrial and social life of the nation.”³ Engineering educator Ben O’Neal has observed “Humanities courses should furnish our students with the opportunity for personal reflection on the communal and personal meanings of the central ideas of culture ... the humanities should provide the student with self-knowledge, the skill of critical thinking, and the ability and desire to be a productive member of the community.”⁴ Similarly, engineering professor J. M. Prausnitz similarly reflected: “Chemical engineers do not live or work in a vacuum ... he must have some understanding of the ever-so-complex human soul, and that inevitably leads him to history, to psychology, and to art - in short, to the humanities.”⁵ Of related interest, studies of professionals in industry clearly indicate a value on such skills which come from humanities courses.⁶

Engineering faculties probably reflect more of the modernist viewpoint regarding the liberal arts component. As Schumacher and Gabriele have observed: “The complex, multidisciplinary challenges of the twenty-first century demand leaders trained to understand problems from all relevant perspectives and to integrate these perspective into creative design solutions.”⁷ Indeed, many campuses have developed course selections which acknowledge the reality of diversity in our “western” culture. Engineering curriculum further must address the current ABET philosophy which requires that students be knowledgeable in humanities and contemporary cultural issues so that they can recognize the impact of technology on society (both on the “local” level and the global level). The liberal arts courses play a significant role in this objective.

Reported investigations in this area are limited. In one study, two thirds of the surveyed students (wide range of majors not including engineering) anticipated continued interest in the humanities following graduation; one third of the students predicted that the humanities would have no significant presence in their post-graduation lives.⁸ In another study, engineering students were specifically studied.⁹ The investigators reported that 63% of the respondents felt that humanities and social sciences (H&SS) courses were meaningful to their engineering education; 57% felt that this meaningfulness extended to their future professional careers. Furthermore, 67% felt that H&SS courses did develop their critical thinking skills and 69% thought that such courses made them more aware of social issues. They also found that 46% of the students planned to further study an area of the H&SS while still in school.

In this paper, the term “humanities” is taken to be the summation of literature, philosophy, art, music, religion, and language. This is consistent with the definition typically cited by the National Endowment of the Humanities.¹⁰ Also, “humanities” is synonymous with “liberal arts”.

Study objectives

The purpose of this study was to explore the attitudes of senior undergraduate engineering students towards the humanities. More specifically, this study sought to explore factors which influenced attitudes and beliefs related to the perceived importance of the humanities both in present time (e.g., role in college education) and future time (e.g., role in future career). One definite factor of interest was the comparison of attitudes and educational experiences of university honors program students to that of traditional students (each group satisfied the liberal arts requirements by totally different pathways). It was felt by many engineering faculty that honors program students were somehow receiving a “better” education in the humanities area. Thus this study had a specific objective of exploring the validity of this viewpoint. As a minimum, the fact that engineering students could satisfy the same liberal arts requirements (in terms of total hours in area) via two different pathways on the same campus allowed the exploration of “how you get there”. To further assist in exploring this area, a general assessment

of humanities knowledge acquisition and how such knowledge was acquired was also included in the study design.

Summary of the traditional and honors program tracks

The traditional students liberal arts requirements are summarized as follows: 1) students select from a “menu” of courses, taking at least one course in each of the following areas: English, social science, fine arts, historical perspectives, and African, Latin-American, Middle Eastern, or Asian Perspectives; 2) general faculty from the associated departments teach these courses; 3) no systematic curriculum reviews or assessments are conducted; and 4) courses can range from relatively small (20-30 students) to large (100 or more). For the honors program, the liberal arts requirements are described as follows: 1) all students follow basically the same curriculum, taking courses available for the honors program students only; 2) only “invited” faculty serve as instructors, faculty recognized by their peers as excellent educators; 3) the faculty frequently assess the effectiveness and appropriateness of the curriculum; and 4) there is an effort to keep class sizes small (ideally less than 20) in order to maximize teacher-student interactions. Total credit hours for either track are identical.

Survey methodology

This study was conducted over a two year period, surveying senior engineering students during the 1999-2000 and 2000-2001 academic years. A total of 180 students were surveyed, with the participants broken out as follows:

By discipline	Chemical	35
	Civil & Environmental	31
	Computer Science & Engineering	35
	Electrical	35
	Industrial	14
	Mechanical	30
By program	Traditional	145
	University honors program	35
Gender	Male	116
	Female	64
Years since high school graduation	5 or less	94
	6 - 10	58
	11 - 20	27
	more than 20	1

Liberal arts	Completed	126
requirements status	One class left	52
	More than one class left	2

“University honors program” students were those formally participating in the program. This is a university-level administered program open to any academic major which typically only admits students either as freshmen or new junior college transfers. Engineering is typically one of the most popular disciplines. “Traditional” students were all others. One limitation of this study was the relatively low numbers of honors program students. However, the honors program participants were relatively uniform in their responses.

Students were asked to complete a survey form which consisted of four sections, with the description of each section as follows:

Section 1 This section focused on student familiarity with humanities concepts. The list of concepts was developed in consultation with several humanities faculty and was felt to capture significant concepts (as opposed to specific individuals or works) from all areas of the humanities. On this campus, there is a Humanities Department with full-time faculty; none of the assisting faculty were instructors in the honors program. Almost all the undergraduate courses address a specific cultural period (for example, the Renaissance), with all forms of arts and letters covered for the period. Students were asked to indicate their familiarity with each item using the following 0 - 4 scale:

- 0 No familiarity with the concept.
- 1 Have heard of the concept, but unable to explain
- 2 Have some familiarity with the concept; can explain in very general terms
- 3 Have familiarity with the concept, can explain in some detail
- 4 Am very familiar with the concept; can explain in detail.

The items presented in this section were:

- deconstructionism
- postmodernism
- dadaism
- impressionism
- sonata
- sonnet
- bauhaus
- baroque
- renaissance

existentialism
fugue
aesthetics
flamenco
neoclassicism

Section 2 Students were asked to indicate their attitudes and beliefs towards the humanities component of their education via their responses to the following questions.

1. How important are the liberal arts courses to your overall education?
(0 - 5 scale: 0 = “not important at all” 5 = “very important”)
2. How important do you feel knowledge from the liberal arts will be in your future professional careers?
(0 - 5 scale: 0 = “not important at all” 5 = “very important”)
3. How important do you feel knowledge from the liberal arts will be in your future general lives?
(0 - 5 scale: 0 = “not important at all” 5 = “very important”)
4. How integrated are the liberal arts with your engineering courses?
(0 = not integrated 1 = minimal integration 2 = some integration 3 = integrated)
5. How extensive do you feel that the liberal arts should be integrated into your engineering courses?
(0 = not integrated 1 = minimal integration 2 = some integration 3 = extensive integration)
6. Regarding the present liberal arts requirement, do you think it should be reduced, kept the same, or expanded? (assume the total hours required for the engineering degree remained constant)
(0 = reduce significantly 1 = reduce some 2 = keep the same 3 = expand some 4 = expand significantly)
7. Do you feel your knowledge of liberal arts will be poorer, equivalent, or better than that which students from other majors will achieve by the time of graduation?
(0 = significantly poorer 1 = poorer 2 = about the same 3 = better 4 = significantly better)
8. What is your thoughts regarding the flexibility of liberal arts course selection?
(0 = should be more flexible 1 = about right 2 = should be less flexible)

Section 3 Students were asked to respond to specific questions which explored other factors related to their humanities educational experiences.

1. Please rank the following factors regarding your selection of liberal arts courses to satisfy your degree requirements (1 = most important; 5 = least important)
 - Scheduling convenience
 - Interest level in the course topic
 - Perceived difficulty of the course (other than the writing requirements)
 - Extensiveness of the writing requirements
 - Perceived value of the course

2. How likely are you to continue your learning in one of the humanities areas after graduation?
 - (0 = very unlikely 1 = unlikely 2 = likely 3 = very likely)
3. Averaging over all your liberal arts course experiences to date, how enthusiastic were your instructors in your classes?
 - (0 = not enthusiastic 1 = some enthusiasm 2 = enthusiastic)
4. Averaging over all your liberal arts course experiences to date, how was your general enjoyment level of your classes?
 - (0 = not enjoyable at all 1 = somewhat unenjoyable 2 = neutral
 - 3 = somewhat enjoyable 4 = enjoyable)
5. Averaging over all your liberal arts course experiences to date, how would you rate the quality of instruction?
 - (0 = very poor quality 1 = poor quality 2 = neither poor nor good
 - 3 = good quality 4 = very high quality)
6. Averaging over all your liberal arts course experiences to date, how was class participation in your classes?
 - (0 = class participation was not encouraged 1 = limited class participation
 - 2 = class participation was encouraged)
7. Averaging over all your liberal course experiences to date, how was the class size in your classes?
 - (1 = less than 20 2 = 20 to 30 3 = 30 to 50 4 = 50 to 100 5 = more than 100)

Section 4 This section obtained basic demographic information regarding the otherwise anonymous respondents. This included the following information:

- Traditional or honors program student
- Department affiliation (chemical, civil & environmental, computer science & engineering, electrical, industrial, or mechanical)
- Extent of completion of liberal arts requirement (how many courses left?)
- Years since high school graduation
- Gender

In addition, random students were interviewed after completing the survey in order to solicit additional information. No particular format was followed in these interviews which typically lasted 5-10 minutes. A total of 40 traditional program and 25 honors program students were

*Proceedings of the 2002 American Society for Engineering Education Annual Conference & Exposition
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interviewed.

Results and discussion

This investigation was more “macroscopic” in that the intention was not to evaluate the specific contents of the liberal arts requirements, but rather to look at the bigger picture regarding how liberal arts instruction occurred and what kind of impact it had on the students.

A summary of the responses to Section 1 questions (“familiarity with the concept”) are summarized in Table 1 below.

Table 1
Summary of survey responses to the Section 1 “familiarity with concept” questions¹

<u>Concept</u>	(mean / std dev)	
	<u>Traditional students</u>	<u>Honors program students</u>
deconstructionism	0.4 / 0.42 *	2.0 / 0.51
postmodernism	1.7 / 0.69	2.4 / 0.58
dadaism	0.3 / 0.40 *	1.6 / 0.52
impressionism	2.2 / 0.50	2.9 / 0.55
sonata	1.3 / 0.68	2.1 / 0.61
sonnet	2.2 / 0.51	2.9 / 0.53
bauhaus	0.5 / 0.61 *	1.7 / 0.54
baroque	1.3 / 0.64	2.1 / 0.62
renaissance	2.4 / 0.45	3.0 / 0.44
existentialism	2.6 / 0.44	3.2 / 0.41
fugue	1.2 / 0.65	1.9 / 0.57
aesthetics	2.1 / 0.56	2.8 / 0.49
flamenco	2.1 / 0.67	2.3 / 0.57
neoclassicism	1.6 / 0.62	2.1 / 0.63

* indicates significant difference at the 95% confidence level

¹ The scale used in Table 1 was as follows:

- 0 No familiarity with the concept.
- 1 Have heard of the concept, but unable to explain
- 2 Have some familiarity with the concept; can explain in very general terms
- 3 Have familiarity with the concept, can explain in some detail
- 4 Am very familiar with the concept; can explain in detail.

These results indicate that student familiarity of the selected concepts is similar between traditional and honors program students. However, the level of familiarity is typically low, with the exceptions of terms common in the popular culture such as impressionism, renaissance, and existentialism. The three terms where honors program students displayed a significantly higher level of familiarity with the topic relative to traditional program students reflects the fact that these topics are specifically covered by many of the humanities honors program instructors.

The results to the Section 2 questions are summarized in Table 2 below.

Table 2
Summary of survey responses to Section 2 questions (perceived importance, extent of integration, course requirements, acquired knowledge, and course selection)

Q	Brief description	(mean / std dev)	
		Traditional students	Honors program students ¹
1	Importance of liberal arts to overall education (0 - 5 scale) ¹	3.1 / 0.82	* 4.2 / 0.45
2	Importance of liberal arts to future professional career (0 - 5 scale) ¹	2.6 / 0.84	* 3.8 / 0.47
3	Importance of liberal arts to future general lives (0 - 5 scale) ¹	2.5 / 0.80	* 3.7 / 0.49
4	Perceived extent of liberal arts integration into engineering courses (0 - 3 scale) ²	0.4 / 0.45	0.3 / 0.41
5	Desired extent of liberal arts integration into engineering courses (0 - 3 scale) ²	0.8 / 0.75	* 1.9 / 0.76
6	Present liberal arts requirements: reduce/keep same/increase (0 - 3 scale) ³	1.2 / 0.66	* 2.6 / 0.53
7	Engineering students liberal arts knowledge versus other majors students liberal arts knowledge (0 - 4 scale) ⁴	1.1 / 0.61	1.3 / 0.59
8	Flexibility of liberal arts course selection (0 - 2 scale) ⁵	0.4 / 0.48	0.8 / 0.51)

* indicates significant difference at the 95% confidence level

The scales used in Table 2 were as follows:

¹ 0 - 5 scale: 0 = "not important at all" 5 = "very important"

- ² 0 - 3 scale: 0 = “not integrated at all” 1 = “minimal integration” 2 = “some integration”
3 = “integrated”
- ³ 0 - 4 scale: 0 = “reduce significantly” 1 = “reduce some” 2 = “keep the same”
3 = “expand some” 4 = “expand significantly”
- ⁴ 0 - 4 scale: 0 = significantly poorer 1 = “poorer” 2 = “about the same” 3 = “better”
4 = “significantly better”
- ⁵ 0 - 2 scale: 0 = “should be more flexible” 1 = “about right” 2 = “should be less flexible”

These results indicate basic attitudinal differences between traditional students and honors program students. The responses to the “importance of” questions (Q 1-3) clearly suggest that honors program students place a higher value on humanities courses and the knowledge obtained from them. This difference was also noted in the post-survey interviews. Both groups felt that liberal arts were not particularly integrated into the engineering curriculum (Q 4), but the honors program students felt that there should be more such integration (Q 5). The honors program students felt the current liberal arts requirements were about right to maybe could be increased somewhat, while the traditional students wanted to see some reduction (Q 6). Regarding question 6, no traditional program students responded “expand significantly” (some honors program students did), while no honors program students responded “reduce significantly” (some traditional students did). In the post-survey interviews, a number of honors program students expressed a desire to see the liberal arts requirement increase, expressing concern about the often-held stereotype of the engineer being largely unaware of “culture”. Both groups felt that engineering students were receiving less liberal arts knowledge relative to other majors (Q 7). Both groups felt the liberal arts course selection should be more flexible (Q 8).

The results to the section 3 questions are summarized below.

Table 3
Summary of survey responses to Section 3 questions (course selection criteria, continuing education, courses assessment, and class size)

Q	<u>Brief description</u>	<u>Traditional students</u>	<u>Honors program students</u>
1	Course selection criteria:	(ranking) ¹	
	Scheduling convenience	1	1
	Interest level in the course topic	4	4
	Perceived difficulty of the course	3	2
	Writing requirements	2	3
	Perceived value of the course	5	5

¹ 1 = most important 5 = least important

(mean / std dev)²

2	Continued learning in liberal arts	1.2 / 0.56	*	2.2 / 0.50
3	Liberal arts instructor enthusiasm	0.8 / 0.49	*	1.8 / 0.31
4	Liberal arts courses enjoyment	2.3 / 0.52	*	3.4 / 0.44
5	Liberal arts courses quality	2.1 / 0.54	*	3.4 / 0.45
6	Liberal arts courses class participation	1.1 / 0.43	*	1.9 / 0.32
7	Class size	3.6 / 0.75	*	2.1 / 0.49

* indicates significant difference at the 95% confidence level

The scales used were as follows:

Q2: 0 = "very unlikely" 1 = "unlikely" 2 = "likely" 3 = "very likely"

Q3: 0 = "not enthusiastic" 1 = "some enthusiasm" 2 = "enthusiastic"

Q4: 0 = "not enjoyable at all" 1 = "somewhat enjoyable" 2 = "neutral"

3 = "somewhat enjoyable" 4 = "enjoyable"

Q5: 0 = "very poor quality" 1 = "poor quality" 2 = "neither poor nor good"

3 = "good quality" 4 = "very high quality"

Q6: 0 = "class participation not encouraged" 1 = "limited class participation"

2 = "class participation was encouraged"

Q7: 1 = "< 20" 2 = "20 - 30" 3 = "30 - 50" 4 = "50 - 100" 5 = "> 100"

Section 3 question 1 indicated very similar "what matters" in regards to course selection. Traditional students were more concerned with the total writing requirement relative to honors program students; this was repeated in the post-survey interviews. Honors program students were more likely to continue acquiring knowledge of the liberal arts after graduation (Q 2). No honors program students selected "highly unlikely" regarding this question (23 traditional students did). Significantly more honors program students described their liberal arts courses instructors as "enthusiastic" relative to traditional program students (Q 3); this was also communicated in the post-survey interviews. Honors program students found their liberal arts courses to be more enjoyable relative to traditional program students (Q 4); again, this was evident from the post-survey interviews. Honors program students felt their liberal arts courses were of higher quality relative to traditional students (Q 5). In the post-survey interviews, most honors program students expressed a high level of satisfaction with their liberal arts courses. Honors program courses also were more encouraging of class participation (Q 6). Traditional program students often described classrooms where class participation was not encouraged to any extent. Finally, honors program courses were significantly smaller (Q 7).

Regarding the responses to Section 3 questions 2 through 6, these responses were positively correlated at a statistically significant level (95% confidence). In one interpretation: students who were instructed by enthusiastic faculty in an environment where class participation was encouraged felt the overall instruction had "quality" and were more likely to want to continue their knowledge acquisition after graduation. Class size was also important (the smaller the better), but this was not a significant correlation except with class participation. A common

complaint among students is that large classes are impersonal, with class participation typically minimal. Honors courses have an enrollment cap (typically 15-20 students), with one objective being the encouraging of class participation.

Honors program instructors are recruited and continuously evaluated by the honors program director. Also, instructors cannot use such courses as part of their departmental teaching load requirements, i.e. instructors do this above and beyond their departmental obligations. Stated alternately, honors program instructors offer their services largely because of their personal sense of dedication and enthusiasm for the subject, not to satisfy a teaching load expectation. This translates to a more effective classroom experience for the students. Thus it is not surprising that honors program instructors are readily perceived as more “enthusiastic”.

These descriptions of fundamental differences between the honors program and traditional students provide definite insights into the survey results. For example, positive correlations were observed involving instructor enthusiasm. Stated simply, enthusiastic instructors motivate students in terms of both the course materials immediately at hand and (in many cases) continued appreciation and desire to learn more in the future. Also, an environment where instructor-student (and student-student) dialogues are encouraged have a beneficial effect. The honors program on this campus sought aggressively to use enthusiastic teachers in small classes which encouraged discussions. The traditional students were usually not recipients of such strategies. While not specifically addressed by the survey questions, during the interviews students often expressed a desire for their engineering instructors to be more enthusiastic. Students readily observe a correlation between a good classroom experience and an enthusiastic instructor for both engineering and non-engineering course work.

It is also important to consider the role of individual course and (on a larger scale) program evaluations. Constant assessment leads to continued course/program improvement; lack of assessment does not. Also, it is likely that “menu selection” approaches where many courses are made available with no significant thought applied as to the coherence of the overall program can be problematic.

Some students expressed the desirability of more integration of liberal arts into their engineering curriculum (at present, such integration is basically absent). It is a separate debate regarding the extent to which such integration should occur. Other engineering educators have addressed this issue.^{5,11} However, it would appear obvious that any such integration should involve interactions with both engineering and humanities faculty. Even if such integration is minimal, it is still appropriate for engineering faculty to consider what is being accomplished in the liberal arts courses. It has been noted by others that effective assessment of humanities courses (as it impacts engineering students) should include faculties from both engineering and the humanities.¹² It may be unfortunate that many engineering faculties may not exercise any responsibility in assessing the liberal arts requirements as it effects their students much beyond

simply insuring ABET compliance as appropriate.

The existence of two separate liberal arts tracks for engineering students on the same campus allowed this examination regarding different philosophies and implementations. On this campus, the honors program as offered can be thought of as more successful relative to the traditional program. However, such success is by no means restricted to honors programs only. Clearly, movement in the direction of enthusiastic instructors who provide instruction in an environment characterized by small classes and interacting students is desirable. Such movement can be initiated in any learning environment.

As noted by others, the humanities have a principle role in the development of methods of inquiry and expression.^{10,11} It addresses the issue of “why?”, an issue which may be notably absent when the humanities content of the engineering education is reduced.¹³ Engineering faculty should strive to create an environment where their graduates develop an appreciation for the humanities which continues after graduation, helping them to live meaningful complete lives in a broad sense.

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