

The AB and SB at Harvard: A Comparison

Marie Dillon Dahleh
Division of Engineering and Applied Sciences
Harvard University

B.A in Engineering

Abstract: Harvard College offers two degrees in engineering science, the A.B. and the ABET accredited S.B. degree. The A.B. degree is intended to provide a broad background in engineering which allows students to pursue further studies, either in engineering or a professional school, and to prepare students to enter the engineering workforce. One of the educational objectives for the S.B program is “To provide students in Engineering Sciences a solid foundation in engineering within the setting of a liberal arts college for preparation for a diverse range of careers in industry and government or for advanced work in engineering, business, law or medicine.”¹ Although these two programs have different requirements, they share educational objectives. In this paper the author explores the technical backgrounds and career goals of the students in the two different degrees. The two degree programs will be described and the differences will be discussed. The introductory course selection of both A.B. and S.B. students will be identified from transcript analysis for the class of '06. The differences between the choices in both courses and careers that A.B. and S.B. students make will be discussed.

Harvard College is a liberal Arts institution which is deeply committed to the ideals of the liberal arts education. Recently as part of the on going discussion on curriculum reform, the students were asked to compose essays on the purpose and structure of the Harvard education. Repeatedly the students echo the sentiment that their education must go beyond a preparation for a career. A student with a special ²concentration³ explains: “A “liberal education” prepares students for lives that go beyond the short term, practical problem solving; it leaves them with critical skills and interests in the larger problems of living in society” [2, p56]. This sentiment is not restricted to students in the humanities. A mathematics concentrator comments, “The purpose of a Harvard education must be precisely this: to expand one’s ability to reason more critically and creatively.” [3, p. 59] One should keep in mind that the only bachelor’s of science degree offered by Harvard College is in Engineering Science and there are no pre professional degrees such as business.

¹ The educational objectives are listed on the web site at (<http://www.deas.harvard.edu/undergradstudy/engineeringsciences/index.html>).

² These are concentrations which are designed by the student and approved by a committee. Typically they are interdisciplinary.

³Harvard refers to majors as concentrations.

Description of degree requirements

All undergraduate degrees at Harvard consist of 32 semester courses. It is important to note that all courses carry an equal weight. In other words Harvard does not have variable unit courses. All undergraduates must take a writing course (Expos 20) and pass a foreign language requirement. This can be satisfied by AP results, a Harvard placement exam, or two semesters of an introductory language. A student can use anywhere from no courses to 2 courses to satisfy this requirement. The core⁴ requirement takes seven courses. The S.B. degree in engineering sciences consists of 20 courses and the A.B. degree is completed with between 14-16 courses depending on the specialization. The minimum number of courses which constitutes a concentration at Harvard is 10. For example, one can complete the computer science concentration with 10 courses. Both of the engineering science degrees take a significant proportion of the degree to complete. For students who satisfy the foreign language requirement at Harvard, the S.B. allows them two free electives and the A.B. allows them between six to eight free electives.

There are six specializations in the A.B. program. They are biomedical sciences and engineering (BSE), decision and control (DC), electrical engineering and computer science (EECS), engineering physics (EP), environmental sciences and engineering (EECS) and mechanical and material science and engineering (MMSE). Four of these are also specializations in the S.B. program: biomedical sciences and engineering, electrical engineering and computer science, environmental sciences and engineering and mechanical and material science and engineering.

All students in the A.B. program complete the second year of calculus, one year of physics and one semester of introductory computer science. There are three different physics sequences which can be used to satisfy the degree. The remaining 9-11 courses are determined by the specialization which is pursued. The S.B. program consists of the same math, physics and computer science requirement. In addition the students must complete one year of chemistry, an electronics course, a mechanics course, an advanced applied math course, a materials course, a probability and statistics course, and two courses in design. The remaining 4 courses are determined by the specialization. [1, pp151-155]

The engineering concentration currently has 119 students in the sophomore through senior year. All freshmen at Harvard College are undeclared. There are 49 sophomores, 20 in the A.B. and 29 in the S.B. There are 40 juniors, 20 in the A.B. and 20 in the S.B. There are 30 seniors, 13 of whom are in the A.B. program and 17 of whom are in the S.B. Of the 119 students 36 are women and 83 are men. Thus in engineering about 30% of the undergraduates are women. The A.B. program has 12 women which constitute 26% and the S.B. program has 24 female students which represents 36%. It is interesting to note that the S.B. degree is larger than the A.B. degree and that it has a significantly larger

⁴ This is the general education program at Harvard College.

proportion of female students. Historically the largest specialization has been mechanical engineering, followed by electrical engineering. The environmental and bioengineering have been small. Very few students choose the decision and control option. The engineering physics option which is a joint venture with the physics department has only just begun this year. For the current class, class of '06, the specialization breakdown is given in Table 1. This class follows the trend mentioned above; however, there is an increased interest in bioengineering which will impact future classes.

Table 1: The break down by specialization for the class of '06

	MMSE	EECS	ESE	BSE	DC	EP
AB	5	4	0	3	1	NA
SB	9	3	2	3	NA	NA

Course selection for the class of '06

Given that the A.B. has fewer required courses and much more flexibility in course choice to satisfy the requirements, one might think that the students who choose this option are technically weaker than the students who choose the S.B. In order to investigate this conjecture, the transcripts for the class of '06 were examined to determine the first math course taken at Harvard and the level of the physics taken. If in fact the A.B. students have a less technically background from high school one would expect that they would place into lower levels of math and physics. The usually calculus sequence for students in the sciences is Math 1a, Math 1b, Math 21a and Math 21b. Many students have taken AP mathematics in high school so they place out of the first semester or two of calculus. There are more abstract versions of the second year of calculus and occasionally engineering students do use these to satisfy the mathematics requirement. For the purposes of this paper, all students who placed into the first semester of the second year of calculus will be recorded as starting in math 21a.

As one can see from table 2, students in the A.B. and S.B. program start in all levels of mathematics. There is no correlation between the first math course and the degree choice.

Table 2: First Course in Mathematics at Harvard for students in the class of '06

	Math xa	Math 1a	Math 1b	Math 21a	Math 21b
AB	0	2	6	5	0
SB	1	5	1	9	1

Interestingly there is a student in the S.B. program who started in the math below the first year of calculus. Since the S.B. program is both course intensive and structured, the college often will allow students to take 9 semesters to complete the S.B. degree. This extra semester is crucial if a student enters in math xa.

There are three levels of physics each with an increasing level of sophistication. The physics 11 sequence is a calculus based two semester sequence and it is primarily designed for the physical science concentrations such as engineering science. The physics 15 sequence is a three semester sequence which is for the physics concentrators. Extremely advanced students may start in physics 16 which is the first semester physics for students who have already completed a course at another college or university. Again if one looks at the first physics course taken at Harvard (see Table 3), one does not see that the students in the S.B. program come to Harvard with better preparation in physics than the students in the A.B. program. For this particular group, the A.B. students choose the more rigorous physics.

Table 3: The number of students who start physics in each course

	Physics 11a	Physics 15a	Physics 16
AB	5	7	2
SB	11	3	2

What students do after Harvard

The S.B. program is so structured that one would assume that the only students who complete the program are students who want to pursue engineering. Given that there are fewer requirements in the A.B. program and it has fewer courses, it would appear that this option would be more popular with students who wanted to pursue professional schools such as medicine. The division of engineering and applied science has an exit survey for students in both the S.B. and A.B. program. Unfortunately less than a third of the students return the survey. If one aggregates the surveys from 2000 until 2005 there are 35 responses. Nineteen are students with the SB and sixteen are students with the A.B. For the purposes of this paper, the jobs have been classified as engineer, technical (non engineering), PhD, MD, non technical. A typical technical job which is not engineering would be an analyst for an investment firm. The non technical jobs include more or less everything. For instance, one of the S.B. students reported working as the news editor for *Auto World Weekly*. This job requires some technical understand and very good communication skills but it probably did not require an ABET accredited degree. The belief among undergraduates and the faculty is that students who want to go to medical school do the A.B. degree. As one can see from Table 4, students go to medical school from both groups. Given that the sample size is small it is difficult to make any generalizations. All that can be said is that students with both degrees are satisfying our educational objective and there does not seem to be a correlation between what a student does after graduation and the choice of degree.

Table 4: Number of students who reported type of job at the time of graduation. (Class '00- '05)

	engineer	Technical non engineer	Masters and PhD	MD	Non technical
AB	5	4	2	2	3
SB	7	2	4	1	5

Conclusion

Both the A.B. and S.B. engineering science degree are designed to provide a broad background in engineering which would allow a student to either enter the engineering workforce, go to graduate school in engineering or something else, or to pursue a non technical career. As we have seen above, there are not clear patterns which emerge about the difference between students who choose the two different paths. In both degrees the starting technical background of the students varies and there is not any indication that technically less prepared students pursue the A.B. degree.

References

Faculty of Arts and Sciences, Handbook for Students 2005- 2006, Harvard University, 2005.

Rakover, Jeff; Harvard's Mediocrity: Teaching, Advising, and the Curricular Review", in Student Essays: On the Purpose and Structure of a Harvard Education, Harvard College, 2005.

Reiehl, Emily; "The Importance of Critical and Creative Thinking", in Student Essays: On the Purpose and Structure of a Harvard Education, Harvard College, 2005.

Biography.

The author is currently the assistant dean for academic programs in the division of engineering and applied sciences at Harvard University. Her main responsibilities include academic advising, accreditation, and curriculum development. Prior to joining Harvard, she served as the acting associate dean for undergraduate studies at the University of California at Santa Barbara College of engineering. She received her PhD in applied and computational mathematics from Princeton University in 1990 and her Bachelors of Arts degree in mathematics from Mount Holyoke College.