

An Accelerated Dual-Degree BS/MS Program – Experience with the First Three Years

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Abstract –

We have initiated a pilot program that accelerates the studies of a small group of highly qualified students early in their college careers and allows them to earn both a bachelor's degree and a master's degree in about four years after starting college. It does this by introducing them early to research, taking advantage of their considerable high school AP credit, enrolling them in a closely monitored cohort environment, and asking them to take at least two summers of coursework. Our experiences with the first three years of the program have been positive, with some accomplishments but also challenges.

Introduction –

Advances in bioengineering technology during the past decade have increased pressure to include more and more topics in the curriculum leading to the bachelor's degree in the field of biomedical engineering and to increase the rigor of such undergraduate studies. This trend often results, in practice, in a lengthening of the time that a student takes to earn the B.S. Yet at the same time, many educators and employers consider the master's degree to be the minimal training needed to adequately prepare modern bioengineering student for practicing the profession.^{1,2} This presents a long and sometimes discouraging path (up to six years or more) to professional preparation for many students.

To speed up and facilitate the path to a master's degree for a select group of students, we have initiated a pilot project at the University of Utah that chooses a small number of highly qualified students and introduces them to research early in their undergraduate careers. Along with cohort support, some tailored academic advising, and a couple of extra summers of study, this early research start allows them to complete the requirements for a both a bachelor's degree and a master's degree in about four years from the beginning of their university studies. This program, named the Accelerated Dual-Degree (ADD) program, began four years ago in fall 2000, and students in the first cohort are now in the master's-degree phase of their studies. In this paper, we report on our experiences with the first three cohorts of the program.

Selection of Candidates -

Promising high school students are recruited through Departmental brochures, college outreach efforts and web-based advertising.³ Due to the accelerated nature of the program, the students chosen must have a significant amount of advanced placement (AP) credit from high school (particularly in math, chemistry, and physics or biology), must be academically bright, and must be highly motivated to handle the accelerated pace. We base our selection on the student's high school grade point average, ACT or SAT scores, letters of recommendation, and a

personal or phone interview. Table I lists the statistics of the students chosen to participate in the first three cohorts.

Table I – Statistics of Selected Participants

	Cohort 1	Cohort 2	Cohort 3
Ave. high school GPA	3.94	4.00	3.97
Ave. SAT score	1437	1390	1210
Ave. ACT score	31	31	31
Ave. number of AP courses	7.2	6.7	5.2
Ratio female/male	40% female/ 60% male	25% female/ 75% male	80% female/ 20% male

Features of the Program -

At the beginning of their studies and once during every subsequent semester, each student in the program is evaluated and advised about timely and efficient scheduling of their coursework. In the first year, the students enroll in the Fundamentals of Bioengineering courses along with other freshman students, and are usually enrolled in sophomore math, chemistry and biology classes. In the second year, they join their fellow ADD students in a small cohort seminar course, which has several purposes. Led by the cohort instructor, it discusses professional topics such as ethics and career paths, covers research preparation including literature searching, research group dynamics and problem solving, has the students practice oral and written communication skills, and, importantly, introduces the student to various research opportunities in the Department. After selecting three labs to investigate and visit, students choose a research project that becomes the basis for their senior thesis and then their master's thesis. Table II is a partial list of the topics covered in this second-year cohort seminar.

Table II – Topics Covered in the 2nd Year Cohort Seminar

<ul style="list-style-type: none"> • Research planning – case studies • Literature searching and discovery • Effective communication • Ethics and dilemmas • The development process • Patents and intellectual property 	<ul style="list-style-type: none"> • Career paths for bioengineers • Communication skills, written and oral • Preparing posters and conference talks • Preparing for the thesis defense
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Thus the ADD students begin their chosen master's thesis research project in the second semester of their second year. This early introduction to research—launching the students earlier into the 'learning curve' of research—is one of the factors that makes possible the attainment of both the B.S. and M.S. in about four years. Other factors allowing this accelerated pace are prior AP credit held by the entering students, at least two summers of study, careful monitoring of student progress and schedules, and a small amount of streamlining of academic credit (the senior thesis becomes the first part of master's research). However, all University requirements for both the B.S. and M.S. are still met separately in terms of quality and quantity.⁴ The full four-year ADD program curriculum is given in reference 3.

Progress Report of Student Cohorts –

Cohort 1 – This group began their college studies in fall 2000. Five students were initially selected to participate. We have had mixed results with this cohort. Two of the students subsequently withdrew from the program: one for personal (health) reasons and one because of a change of major. Also, another student (progressing well) has taken a leave of absence to carry out a religious mission for 1 1/2 – 2 years. This is a cultural reality at the University of Utah, where many of the students are members of a faith that encourages them to pursue missionary work in their youth. We expect that those students who interrupt their studies for religious missions will do so between their first and second years (before starting the cohort seminar and research) and will return to the program as constituted when they return. We believe they will still benefit from the factors which allow accelerated study compared to non-ADD students. The remaining two students are generally on schedule. Both have essentially completed the requirements for the B.S. and are well into M.S. research and coursework. One is expected to defend his M.S. thesis during the spring semester of his fourth year; the other is about one semester behind.

Cohort 2 – Four students were chosen for this cohort (two as graduating high school seniors and two during their first semester in college). Of the four, one has taken a leave to pursue a religious mission (before beginning the second-year seminar and research) and one has withdrawn for academic reasons. The other two have completed the second-year cohort seminar, have chosen their research topics, and are engaged in research. They are reporting on their research progress in the senior project class and are progressing satisfactorily.

Cohort 3 – Five students joined this cohort, all as graduating high school seniors. All five are now enrolled in second-year cohort seminar, have recently chosen their research topics, and are progressing on schedule.

Cohort 4 – Three students (two selected as graduating high school seniors and one during his first college semester) make up this new cohort. They are in their first year of studies.

Accomplishments and Challenges –

Below is a summary of the accomplishments of the program thus far and some of the challenges (expected and unexpected) we've encountered:⁵

Accomplishments

1. All of the ADD students have been introduced to, and chosen, research projects that have substantial content for a master's project. This indicates that the faculty of the Department appreciates to a large degree the potential of the students to carry out worthwhile research, even beginning as undergraduates. That is, the faculty is 'on board' with the program.
2. The Department has attracted bright students who, based on personal interviews, may have otherwise chosen another major or another university. The ADD students come from five different states.
3. Two courses have been spun-off into the general biomedical engineering curriculum from the experiences of the ADD program. One is BIOEN 2000, Careers in Bioengineering, which is now required of all major students. It introduces students to various choices in the field and covers some professional development topics. The other course is BIOEN 3802, Junior Seminar, a new required course which prepares all students to begin work on a project during the second semester of their junior year to get ready for the senior thesis class. It covers some of the same topics from the cohort seminar, such as research techniques, ethics, literature searches, effective communication, and research opportunities in the Department.

Challenges

1. It has sometimes been difficult to schedule certain classes for individual ADD students in their tight schedules, since they are out of step with the normal pace of Department students. But some flexibility in the order of classes and in the courses chosen for the student's track specialty has given enough room to solve the scheduling conflicts.
2. Those students who choose to pursue a religious mission after starting the program will interrupt their studies and, of course, delay graduation. So far, the number of students doing so (about 20%) is larger than we anticipated. But the impact is lessened somewhat when they interrupt between their first and second years, and many benefits of the program still apply when they resume.
3. With the support of the National Science Foundation, we have been able to offer small stipends to the enrolled ADD students on an increasing scale as they progress. This helps compensate them for the wages lost during the two summers of extra study that are expected in the program. Continued stipend funding is being sought after the NSF funding expires, but the economic downturn has made this more difficult. Thus we are uncertain of solid funding in the future. College and Departmental scholarships may provide some program support.

In summary, the pilot program has proven the concept worthwhile, especially in the academic lives of the students chosen to participate. It has also paid dividends in the spin-off of two courses into the general curriculum. The challenges listed above need to be continually addressed for the ongoing health of the program.

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Bibliography –

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