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Experience with the First Three Years of an Accelerated Dual-Degree Program in Biomedical Engineering

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Abstract—**Our Department of Bioengineering has instituted a pilot program aimed at helping a select group of highly qualified students obtain both bachelor's and master's degrees in an accelerated timeframe—approximately four years from the beginning of their university studies. A key element of this program is the introduction of the students to research in their second year of studies via a directed and closely supervised cohort mechanism. These students also come to the university with substantial AP credit and spend two summers fulfilling some general education requirements of the university. Our first three years with the program have shown positive results, with most students on track in both academics and research. There have been some challenges, however, with regard to tight scheduling, leaves for religious missions, and continued student stipend funding.**

Keywords—**Accelerated, dual-degrees, education**

I. Introduction

The field of biomedical engineering is rapidly advancing, making it more and more difficult for a student to obtain an entry-level knowledge with just a bachelor's degree. Several educators and employers have suggested that the master's degree be considered the minimal training needed to adequately prepare students for modern bioengineering practice [1,2]. However, the student then typically faces five or six years of study to obtain the necessary degrees.

To help speed up the process of obtaining the master's degree in a shorter time, we have initiated a pilot program at the University of Utah that guides a select group of highly motivated and qualified students to finish the requirements for both a bachelor's and master's degree in about four years from the beginning of university studies. This program, which began almost four years ago in fall 2000, is called the Accelerated Dual-Degree (ADD) program.

It accomplishes its goal by saving time for the students in three ways:

1) The students are individually counseled in a small cohort environment and given a choice of research topics at the beginning of their second year of studies. They select and begin this research early, starting them up the research "learning curve."

2) These students enter college with a considerable amount of AP credit in subjects such as calculus, chemistry, physics and biology, allowing them to skip some early required courses.

3) The students are expected to attend summer sessions at least two years, where they fulfill many of the campus general education requirements.

We have now had over three years of experience with the program and will graduate our first accelerated student in spring 2004. The following is a description of some of the features of the program and some results we have found so far.

II. Student Selection

We recruit promising high school students through departmental brochures, university outreach efforts and web-based advertising [3]. Since the program is time-accelerated, the students must have a head start on university work through a good amount of advanced placement (AP) credit in high school (particularly in math, chemistry, and physics or biology). They must be academically sharp and highly motivated to handle the accelerated pace. The selection of the students for each year's cohort is based upon high school grade point average, ACT or SAT scores, letters of recommendation, and a personal or phone interview. The statistics of the students chosen to participate in the first three cohorts are given in Table I.

TABLE I
STATISTICS OF STUDENTS IN FIRST THREE COHORTS

	Cohort 1	Cohort 2	Cohort 3
Date entered university	fall 2000	fall 2001	fall 2002
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

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III. Program Features

Individual and frequent advising is an important part of the success of the program, since it helps the students avoid time-consuming scheduling and decision-making errors. Our guidance of the ADD students is framed around a cohort mechanism. The ADD students are individually evaluated and advised about timely scheduling of their coursework once every semester. In their first year, they join with the rest of the Department's students in taking two semesters of Fundamentals of Bioengineering, along with other first-year courses. At the beginning of their second year, they are enrolled together in a small cohort seminar class, which serves several purposes: It discusses professional topics such as ethics and career paths; it introduces research techniques (including literature searching, problem solving, and research team dynamics); and it stresses oral and written communication practice.

Most important, the cohort class also exposes the students to a choice of available research topics. Each student chooses a topic by the middle of the second year and begins working with his/her research team the next semester. This research becomes the topic of his/her senior thesis and then master's thesis. Table II lists some of the topics covered in the cohort seminar course.

The full four-year ADD program curriculum is given in [3]. All University requirements for both the B.S. and M.S. are met separately in terms of quality and quantity [4].

IV. Experience with Student Cohorts

1) *Cohort 1*: The first cohort entered the university in fall 2000. Five students were enrolled in this cohort. Two of the students subsequently withdrew—one for personal reasons and one because of a change of major. Another student (who was progressing on time) has taken a leave of absence after her second year to pursue a religious mission; she will rejoin the program soon. The other two students are generally on schedule: both have finished the requirements for the B.S and are now completing the requirements for the M.S. One will graduate in spring 2004 and the other in summer 2004.

TABLE II
TOPICS COVERED IN COHORT SEMINAR COURSE

- Research planning – case studies
- Literature searching and discovery
- Effective communication
- Ethics and dilemmas
- The development process
- Patents and intellectual property
- Career paths for bioengineers
- Communication skills, written and oral
- Preparing posters and conference talks
- Preparing for the thesis defense

2) *Cohort 2*: Four students entered in this cohort, two as graduating high school seniors and two during their first semester in college. One has taken a two-year leave to pursue a religious mission (the break was between his first and second years). One has withdrawn for scheduling reasons. The other two students are on schedule, having chosen their research topics, and are now completing the requirements for the B.S.

3) *Cohort 3*: Five students are enrolled in this cohort, all as graduating high school seniors. All five are now completing the second-year cohort seminar. They have selected their research topics and are progressing on schedule.

4) *Cohort 4*: This cohort has just begun its first year of studies. Three students (two selected as graduating high school seniors and one during his first college semester) are enrolled in this cohort.

V. Accomplishments and Challenges

Thus far the program has met many of its goals. We have also faced some challenges, both expected and unexpected. Below is a summary of these accomplishments and challenges [5].

A. Accomplishments

- The students have all chosen substantial research projects for their master's degrees. This is due in large part to the cohort system and the cooperation of the Department faculty. The faculty recognizes the potential of these bright students to carry out worthwhile research, even beginning as undergraduates.

- We have been able to attract students of high quality to the program and to the Department. Based on personal interviews, some of these students would likely have chosen different majors or universities if the program had not been in existence. We have attracted students from five different states.

- Two new courses have been spun-off from the ADD program into the general biomedical engineering curriculum. One is Careers in Bioengineering (which introduces students to various career paths in the profession), and the other is Junior Seminar (which covers ethics, communication skills [oral and written], research tools, and research opportunities in the Department). Both were suggested by the success of the cohort seminars, and are now required for all major students.

B. Challenges

- Course scheduling of the ADD students has at times been difficult given the accelerated nature of their studies. This has required us to be flexible with regard to the particular courses taken in each student's specialty track in order to accommodate these occasional scheduling conflicts.

- Leaves for a religious mission have been more frequent than we had anticipated (about 20% of the students so far). But the impact of these leaves is lessened by the fact that most occur between the first and second year of the program, before the students have begun research. Also, the benefits of the program still help these students finish their degree requirements earlier when they return.

- Modest student stipends are offered to help offset potential wages that these students forego during their two summers of study. National Science Foundation funding provided these stipends during the first years of the program. Continued funding is now being sought from private donors, but the economic downturn has made this problematic. We are uncertain of future funding, but scholarships from the Department and College may provide some student support.

VI. Conclusion

The accelerated program has met many of its goals, and has provided enhanced educational and research opportunities for the students enrolled. It has also resulted in the spin-off of two courses into the general Department curriculum. The challenges listed above need to be addressed to assure continued success of the program.

Acknowledgment

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References

[1] E. T. Smerdon, "Let's make engineering a profession," *ASEE Prism on-line*, Mar. 1999.
[2] ASCE's Task Committee on the First Professional Degree, "Why we must raise the bar," *Civil Engineering*, vol. 72, no. 4, Apr. 2002.
[3] http://www.bioen.utah.edu/Undergraduate/AccPgm.htm.
[4] http://www.utah.edu/graduate_school/index.html.
[5] D. A. Christensen and K. W. Horch, "Experience with a new accelerated dual-degree program in biomedical engineering," presented at the Biomedical Engineering Society Annual Meeting, Nashville, TN, 2003.