IMPACT OF A SHORT PRE-FRESHMAN PROGRAM ON RETENTION*

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ABSTRACT
The Biology Intensive Orientation for Students (BIOS) Program at Louisiana State University was designed to increase the success of incoming freshman biology majors in the first course in their major. The program combined content lectures and examinations for BIOL 1201—Introductory Biology for Science Majors, the first course in their major, as well as learning styles assessments and informational sessions intended to provide the students with a preview of the requirements of biology, and the pace of college. BIOS participants showed increased success and retention in the biology major, and remained on track to graduate in 4 years at a significantly higher rate than students who did not participate in BIOS.

INTRODUCTION
In an effort to improve the success and retention of biology majors, the authors developed a 1-week content and learning skills orientation program at Louisiana State University. This work was supported in part by the Louisiana State University College of Science, and partly from a grant to LSU from the Howard Hughes Medical Institute through the Undergraduate Biological Sciences Education Program.

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State University (LSU). The Biology Intensive Orientation for Students (BIOS) Program gives incoming biology majors a short, intensive preview of the expectations of the introductory biology course at LSU and helps them learn the skills required to succeed in biology courses and college. The program combines content lectures, examinations, learning styles assessments, study skills discussions, group work, and informational sessions over a period of 5½ days.

In Phase 1 of this study, Wischusen and Wischusen (2007) reported the success of students during their first three semesters. The 2005 cohort showed improved grades and success in introductory biology courses, and this trend continued during their third semester biology courses (the first semester of their sophomore year). The 2006 cohort showed the same trend through their first semester. Phase 2 includes subsequent tracking of these students through 2 full years (4 semesters) of college in order to study the potential longer-term impacts of a short, intensive pre-freshman program.

Major national reports cite the need to increase the number of students pursuing bachelor and advanced degrees in science and math (Augustine, 2006; Stryer, Breslow, Gentile, Hillis, Hopfield, Kopell, et al., 2003). The solution on which these and many other reports have focused involves increasing the numbers of students entering baccalaureate degree programs in science and mathematics, “expanding the pipeline.” In addition to this, it is important to find ways to retain the students currently pursuing science and math degrees, “plugging the leaks in the pipeline.” Retention of students in the major field of choice, as well as retention at the college or university in general, is increasingly important to postsecondary institutions (Cuseo, 2003). University-level retention predictors include academic preparation (as measured by SAT or ACT scores), academic ability (as measured by high school academic ability [GPA]), learning styles, motivation (Garton, Dyer, King, & Ball, 2000; Upcraft, Gardner, & Barefoot, 2005), and confidence in study habits (Tester, Scott, Hatfield, Decker, & Swimmer, 2004). Studies show that in the United States over 50% of new students entering higher education leave their first institution without completing a degree, and over 42% leave higher education all together (Cuseo, 2003). Students at LSU exhibit these trends (LSU Office of Budget and Planning, 2008), and in all cases the most critical time is the first year (Lee, 1999).

Student failure in courses is costly both to the university and to the student. Nationwide, college remediation is estimated to cost as much as $1 billion a year (Somerville & Yi, 2002). Retaking coursework accounts for approximately 20-30% of the enrollment in BIOL 1201, the first course in LSU’s introductory sequence, according to data from the LSU Office of Budget and Planning (University & College Trend Data, 2006). General science courses can have high un-met demand; that is, many more students wish to enroll than there are spaces to accommodate them. LSU and other large universities waste resources when students drop courses and re-enroll in subsequent semesters. The failure or withdrawal from a required course means the student must enroll in that
class again. This delays the student’s progress toward graduation. Not only is this costly from a resource perspective, but this increase in the time to degree ultimately results in many students being discouraged and changing majors, thereby reducing the retention of students in the major.

In the past few years, over 25% of students in LSU’s Introductory Biology for Science Majors I (BIOL 1201) have failed to earn a grade of C or better in the course, leading to a high DFW rate (grade of “D,” “F,” or Withdrawal from the course) (University & College Trend Data, 2006). Although many factors are likely involved in this high DFW rate, one critical factor is the time required for new students to learn and implement the skills required to meet the expectations of college courses (Upcraft et al., 2005). A lack of an understanding of the expectations and the skills needed leads many capable students to perform poorly on the first, and sometimes second, exam. As a result, these students either drop the course or finish the semester with a low grade (University & College Trend Data, 2006).

Students in general are taking longer to graduate. A 1998 report stated that fewer than 2 in 5 are able to graduate in 4 years (Levine & Cureton, 1998). Graduation rates at Louisiana State University are equally striking (University & College Trend Data, 2005), as shown in Table 1. Nationwide, 75% of high school graduates enroll in college within 2 years of high school graduation, and 50% of these must take remedial courses to learn the basic skills of reading, writing, and/or math (Somerville & Yi, 2002). Students who have to take more remedial courses will take longer to graduate (Levine & Cureton, 1998).

The ideas of students, parents, and high school teachers can add to the misperceptions about college. Students often enter college with optimistic goals of how much they will study as well as unrealistic ideas of how much work will be expected of them by college instructors. Many have been successful in high school with minimal effort and see no reason to change their study habits, or

Table 1. Graduation Rates at Louisiana State University

<table>
<thead>
<tr>
<th>Incoming cohort</th>
<th>4-Year graduation (%)</th>
<th>5-Year graduation (%)</th>
<th>6-Year graduation (%)</th>
<th>Total graduation at 6 years (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>23.1</td>
<td>26.5</td>
<td>8.4</td>
<td>58.0</td>
</tr>
<tr>
<td>1997</td>
<td>23.0</td>
<td>26.1</td>
<td>8.3</td>
<td>57.5</td>
</tr>
<tr>
<td>1998</td>
<td>25.4</td>
<td>25.0</td>
<td>7.1</td>
<td>57.5</td>
</tr>
<tr>
<td>1999</td>
<td>26.5</td>
<td>24.8</td>
<td>7.6</td>
<td>58.9</td>
</tr>
</tbody>
</table>

*Percentage of incoming cohort who graduated with a baccalaureate degree during each time period: 4 years or less, more than 4 but less than 5; more than 5 but less than 6; and the total percentage who graduated in 6 years or less.
lack thereof, for university coursework (Upcraft et al., 2005). Parental expectations are high. Nine out of ten 6th through 12th graders had parents who expected them to continue their education beyond high school (Lippman, Guzman, Keith, Kinukawa, Schwalb, & Tice, 2008). Confounding students' misperception of their abilities is a perception gap between high school teachers and college/university faculty regarding how prepared students are for college work (Sanoff, 2006). Over 44% of polled college faculty thought students were not well prepared for college work, while only 10% of the high school teachers questioned indicated they thought students were not well prepared. In a survey of new freshmen at Wayne State University, respondents to the questions "What is the one piece of information that you think is most important for an incoming college student to know, and why?" typical responses included "Go to class," "Get out there and meet new people," "Know where and how to get help" (Building Bridges for Access and Success from High School to College, 2005, p. 37).

There is little literature describing a 1-week stand-alone intensive format similar to BIOS. Administrations of many universities across the United States have recognized the need for some sort of intervention to bolster student success and retention rates in specific majors. They employ varieties of approaches, including short (less than 2-week) orientation sessions or multiple-week summer programs in conjunction with freshman year seminars and/or specific course loads; and sometimes even complete undergraduate academic interventions (Chevalier, Chrisman, & Kelsey, 2001; Fletcher, Newell, Newton, & Anderson-Rowland, 2001; Gordon & Bridgllall, 2004; Malave & Watson, 1998; Reyes, Anderson-Rowland, & McCartney, 1998). Participation in a first-year seminar has been shown to have a significant positive impact on student success (House & Kuchynka, 1997; Minchella, Yazac, Fodrea, & Ball, 2002). Longer-term bridge and orientation programs are common and effective in specific fields and/or for targeted groups, such as engineering majors (Soulsby, 1999), minority engineering (Grimm, 2005; Marable, 1999; Reyes et al., 1998), women in engineering (Fletcher, Newell, Newton, & Anderson-Rowland, 2001), and first-generation college attendees (Pascarella, Pierson, Terenzini, & Wolniak, 2004).

Two short engineering programs show some similarities to the BIOS Program, in that they are short and content-intensive. The FORTRAN Programming Course "Boot Camp" at the University of South Florida in Tampa (Fujinoki, Christensen, & Rundus, 2001) for undergraduate computer science and engineering majors provides a 3-day workshop to prepare students for the mandatory first course in the major. The authors compared subsequent grades of participants and non-participants, and further offer the utilization of observational study (Cochran, 1965) to help remove the potential bias of self-selectivity of program participants. Using "matched sampling" Fujinoki and colleagues demonstrated that students who participated in their program were 2.7 times less likely to drop the required course than non-participants (Fujinoki et al., 2001, p. 9). The other short program is the Discover Engineering (DE) Program at the Massachusetts Institute of
Technology. This program is 4 to 5 days and includes content, faculty and graduate student participation, and social activities. After participation in the program, enrollment in subsequent courses went from 29% to 72% of the entering class (Thompson & Consi, 2007). The MIT DE Program is part of a campus-wide Freshman Pre-Orientation Program network in several areas that allow over half the incoming freshman class each year to gain college experience before their first fall semester.

While the students in these programs have shown short-term gains, we were interested in studying the impact that a short pre-freshman program would have on the retention of students in the major 2 years later. BIOS has been shown to have a very positive impact on student performance in the first and second semesters of introductory biology (Wischusen & Wischusen, 2007). Would the skills taught in such a short period have a lasting impact on the retention of students in the major?

**METHODS**

**Participants**

Participants included incoming, first-time freshmen at LSU who were self-identified as biological sciences majors (including “biology,” “biochemistry,” “microbiology,” or “pre-medicine”) and who had pre-enrolled in the Introductory Biology for Science Majors I (BIOL 1201) course for the upcoming fall semester. Program participants were chosen on a first come/first served basis to program capacity. The program enrollment maximum was set at 60 students for the first year and 120 for the second year. Additional applicants above these limits were placed on a waiting list. The wait-listed students who were not ultimately accepted into the program were asked to serve as part of the control groups for program assessment.

**Control Group**

Control groups for each program cohort were generated from the course rosters of the fall semester Introductory Biology in which the BIOS students were also enrolled. There were multiple sections of this course and the BIOS and control group students were dispersed among the sections. Members of the control groups were similar to the BIOS students in regard to high school grade point average, ACT/SAT score, gender, and intended LSU major. In order to help alleviate a potential self-selection issue with BIOS program enrollment, the students remaining on the wait-list, as mentioned above, were, after statistical comparison to both the BIOS and control groups, ultimately included in the control group.
Program Structure

The BIOS Program was designed to give participating students a realistic look at the pace of college life. Students were presented seven lectures (11 hours) from the first weeks of the introductory biology course, along with three exams on the material. A detailed program schedule has been published previously (Wischusen & Wischusen, 2007).

Analysis

To assess the long-term impacts of BIOS, the authors tracked participants during the four semesters following the program, and recorded their grades in the first four core courses in the biological sciences curricula (BIOL 1201 and 1202, introductory biology; 2051, microbiology; and 2153, genetics), overall GPA at the end of each semester and their major. These data were compared with the control group, as to the percentage of students on-track to graduate within 4 years (completing the four core courses with a grade of A, B, or C, retention in the major), and overall GPA.

Data were statistically analyzed using the non-parametric Binomial Test (Figures 1 and 2) or the Student T-test (Figure 3); \( p < 0.05 \) was considered significant.

RESULTS

On-Track to Graduate in 4 Years

The impact of the BIOS program on percentage of Biology majors on-track to graduate in 4 years was determined by comparing the percentage of the original BIOS participants and the control group who had completed the appropriate biological sciences core curriculum courses with a grade of "C" or better on their first attempt (Figure 1). BIOS participants, 2005 and 2006 cohorts, were on-track to graduate in significantly higher percentages than students in the control group at the end of each of the first four semesters, except for the end of the first semester for the BIOS 2005 cohort (Figure 1).

Retention in the Major

The BIOS program had a positive impact on the percentage of students who had entered LSU as biological sciences majors and who continued as biological sciences majors through the end of their fourth semester (second year) (Figure 2). Students in both the 2005 and 2006 BIOS cohorts were retained in the major at significantly higher percentages than students in the control group: 2005 BIOS = 76.92%, 2005 Control = 55.56%; 2006 BIOS = 49.11%, 2006 Control = 34.86%.
Figure 1. Comparison of BIOS participants (Dark Bars) and control students (Light Bars) in terms of the percentage of the initial biology majors on-track to graduate in 4 years. Original Ns: 2005 BIOS = 52, Control = 54; 2006 BIOS = 112, Control = 109. *Significantly different from the control, nonparametric Binomial test, $p < 0.02$. 

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Retention in Biology Major

![Retention in Biology Major](image)

Figure 2. Comparison of BIOS participants (Dark Bars) and control students (Light Bars) based on the percentage of the initial biology majors retained as biology majors at the end of their fourth semester. 2005 BIOS N = 40/52, Control = 30/54; 2006 BIOS N = 55/112, Control = 38/109. *Significantly different from the control, nonparametric Binomial test, p < 0.002.

Retention at the University

In an effort to determine if the difference in retention in the major for BIOS participants and the control group was simply due to a difference in retention at LSU, we compared university retentions for both groups. The difference in university retention for BIOS participants was not significantly different from the control group for either the 2005 (p = 0.52) or 2006 (p = 0.27) cohorts; 2005 BIOS = 79.66%, 2005 Control = 70.00%; 2006 BIOS = 85.83%, 2006 Control = 84.07% (Figure 3).

DISCUSSION

BIOS participants had higher semester success rates and the percentages of BIOS students on-track to graduate in 4 years were almost double those of the
Figure 3. Comparison of BIOS participants (Dark Bars) and control students (Light Bars) based on the percentage of the initial cohorts who were still enrolled at LSU at the end of their fourth semester.

2005 BIOS N = 47/59, Control = 49/70;
2006 BIOS N = 103/120, Control = 95/115.
(2005 p = 0.52, 2006 p = 0.27.

control groups. Similarly, their retention rate in the major was also greater than that of the control group. While the trends for both these variables were the same for both the 2005 and 2006 cohorts, the 2005 cohort was consistently higher in all cases. One possible explanation was a difference in the recruiting strategies and program enrollments. In our first year (2005), the organizers capped the enrollment at 60 students, and the roster filled with students who had attended “Spring Invitational,” the orientation session for high-achieving high school students. In 2006, the enrollment was 120, therefore there was room to accommodate more students who had not attended the high-achieving student orientation session. The BIOS and control students showed no differences in retention at the university. These results suggest that the differences in retention in the major
are not simply due to students leaving the university but rather more control group students leaving the biology major but staying at LSU. These retention rates are very similar to those of the remainder of the introductory biology course enrollment (76.3%) and across the university (2005 = 72% and 2006 = 75%) (University & College Trend Data, 2007).

The data presented here support the hypothesis that a 1-week pre-freshman orientation can significantly increase student success and retention in the major. In addition to the quantitative data, student answers to qualitative questions in the exit evaluation and post-program focus groups indicated that the BIOS students learned valuable study habits and felt more comfortable about starting college than they had before BIOS. Students indicated they have formed and maintained study groups (i.e., “learning communities”), through their freshman year, and in many cases these communities have been sustained for several years.

While the BIOS program was designed to improve student performance during their first semester in college, the program has had a more lasting impact on the participants, including increasing their progress toward their degree and their retention in the major. The key components of the BIOS Program include:

1. Content focused on a specific course. This is critical to capturing students' initial interest in the program.
2. Assessment instruments which are comparable to those that will be used in their fall biology course. This provides the students with a realistic view of their performance and college-level expectations.
3. Students are divided into small groups during the program based on their fall courses, especially the sections of the specific content course. This facilitates the formation of study groups, and provides an instant connection to other students in the course in the fall.
4. The program is infused with study skills training. While the students are not initially interested in study skills, their comments suggest that later they realize the benefits of these skills.

Limitations of this Study and Further Research

There are threats to validity that must be addressed regarding BIOS. First, a major threat to validity that can confound research on any voluntary program is that of selection bias—are the people who are in the program equivalent to those in the population? When a student takes steps to apply, pay the fee, and attend a program that is not required, this self-selection can bias any research on the groups. In this study, the use of the wait-listed students alleviated this issue since those students applied to the program and were willing to pay the fee and wished to attend.

Testing exposure as a threat to validity is also an issue in the first semester after BIOS. Students who participated in BIOS had 11 hours of course content from the first weeks of the introductory biology course, as well as three small exams over
the course of the week. This material was repeated early in the semester, therefore BIOS students were expected to be more successful on the first exam of the introductory course. This threat no longer exists as the semester continues and new material is presented in class, nor does it extend to the subsequent core courses.

The BIOS model is flexible enough to be useful to other departments and other universities; however, further work should be done regarding its generalizability to other disciplines and on different size campuses. This study involved one science department at a large research extensive university over a 2-year period. Other science departments at LSU, as well as at least two at other large universities, have now offered a BIOS-based program, and the BIOS program has continued with increased enrollments in subsequent years. Careful analysis and comparison of the progress of students in these programs is essential to broaden the validity of this model.

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