

Successful Interventions for Engineering Student Retention

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Abstract

The College of Science, Engineering, and Technology (CSET) at Norfolk State University (NSU) offers a rigorous honors program for students who major in engineering and other science and technology disciplines. The program was established in 1986 to reduce the shortage of minority scientists by producing highly trained graduates capable of earning advanced degrees. Students receive full scholarships, book stipends, and other special considerations for their participation in the program. Students are also encouraged to apply for and participate in summer research programs. Currently, the graduation rate for students who enter the honors program is approximately 70%. The average graduation rate for the university is approximately half this number. In order to enhance retention and improve the graduation rate of these students, a more proactive and integrated set of activities has been introduced. Interventions include an enhanced summer bridge program for entering freshmen with a greater emphasis on mathematics skill development; socialization to the discipline; and required peer-tutoring, collaborative learning, and mentoring activities. The goal of these initiatives is to create a comprehensive and supportive learning environment that promotes student success in engineering as well as other science and technology disciplines. An analysis of academic performance data for the past few years suggests these integrated approaches have been effective in enhancing the success of engineering students. Moreover, these structured academic support initiatives may be considered as “best practices” that can be expanded to include all STEM students at Norfolk State University. This paper will present details on the interventions and student accomplishments.

Introduction

The Dozoretz National Institute for Mathematics and Applied Sciences (DNIMAS) was established at Norfolk State University (NSU) in the fall of 1985. The Institute is named for Dr. Ronald Dozoretz, a psychiatrist, philanthropist, founder and CEO of First Hospital Corporation, who now lives in Washington D.C. with his wife and their two children. Dr. Dozoretz’s gift to the University established what is now known as DNIMAS, and thereby launched one of the finest undergraduate science institutes in the country.

DNIMAS is a rigorous honors program for biology, chemistry, computer science, engineering, mathematics, and physics majors. The Program is designed to address the severe shortage of minority scientists by producing graduates who are capable of entering and successfully completing graduate studies in the basic and applied sciences. This educational opportunity should better prepare students to enter occupations in academia, industry, government, and other fields that require advanced scientific degrees. Graduates of the Institute will also be capable of entering medical or other health professional schools.

The DNIMAS Program began in the summer of 1986 with an enrollment of 20 freshman students. Each student admitted was required to have at least a 3.00 (now a 3.20) grade point average from high school, strong scores on the College Board exams and high grades in science and mathematics courses.

The key features of the DNIMAS Program are a four-week summer bridge program (pre-freshman), four-year academic scholarship which includes tuition, fees, room, board, and textbook allowance; specialized curricula in biology, chemistry, computer science, engineering, applied mathematics, and physics; internships and/or research experiences; career counseling; and seminars. DNIMAS scholars participate in internships and/or research programs at the nation's premier government and corporate laboratories and prestigious universities. Placement sites have included NASA, Jefferson Lab, Lucent Technologies, Harvard, M.I.T., Georgia Tech, Virginia Institute of Marine Science, General Mills, Fermi Laboratories, and many more.

Fall 2007 Student Profile

Currently, there are 93 students enrolled in the DNIMAS Program. As depicted in Figure 1, females comprise 64% of the student population, while 36% of the students are male. Student enrollment by classification is illustrated in Figure 2. There are 38 freshmen, 14 sophomores, 19 juniors, and 22 seniors enrolled in the DNIMAS program. The majority of the DNIMAS students major in biology followed by computer science, and then chemistry, mathematics, engineering, and physics, respectively (see Figure 3). Engineering degrees are expected to increase substantially now that the degree program is again an option for DNIMAS students.

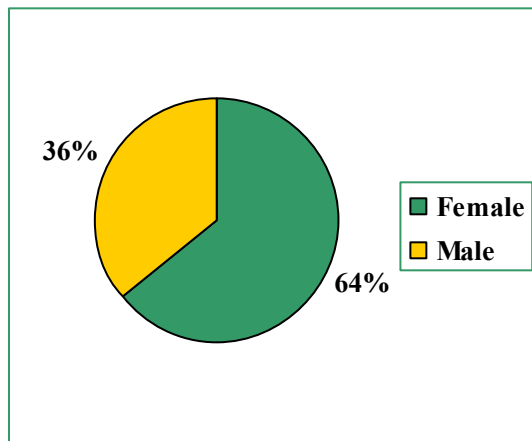


Figure 1. Enrollment by Gender

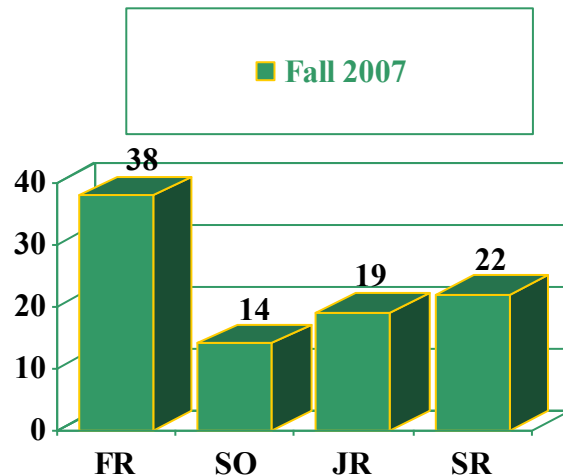


Figure 2. Enrollment by Classification

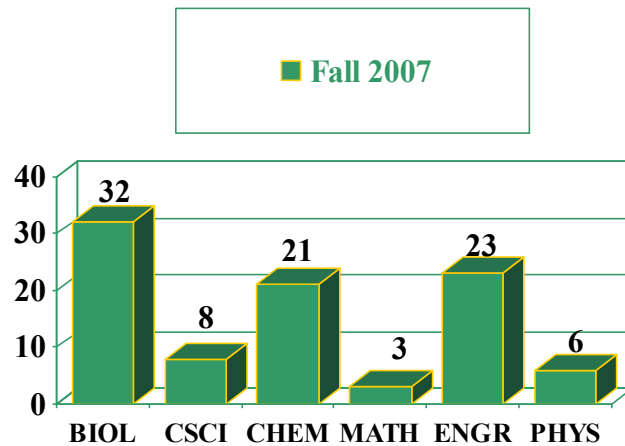


Figure 3. Enrollment by Major

Norfolk State University provides an annual operating budget over \$2 million dollars to support the DNIMAS program. Additionally, approximately \$186,000 comes from external sources to fund tuition, room, and board for selected students.

Graduation Statistics

From 1990 to 2007, 275 students completed degree requirements in a DNIMAS curriculum. As illustrated in Figure 4, this number includes 194 women and 81 men. The largest number of undergraduate degrees has been awarded to biology majors. Engineering degrees are expected to increase substantially since the degree program has returned as an option for DNIMAS students. Figures 5 and 6 show the number and percent of DNIMAS graduates by discipline, respectively. The graduation rate for all students who entered the NSU as DNIMAS students is 75%. Their names are etched in the annals of NSU history, not just for their personal success, but for their collective contribution to academic excellence at Norfolk State University and the nation.

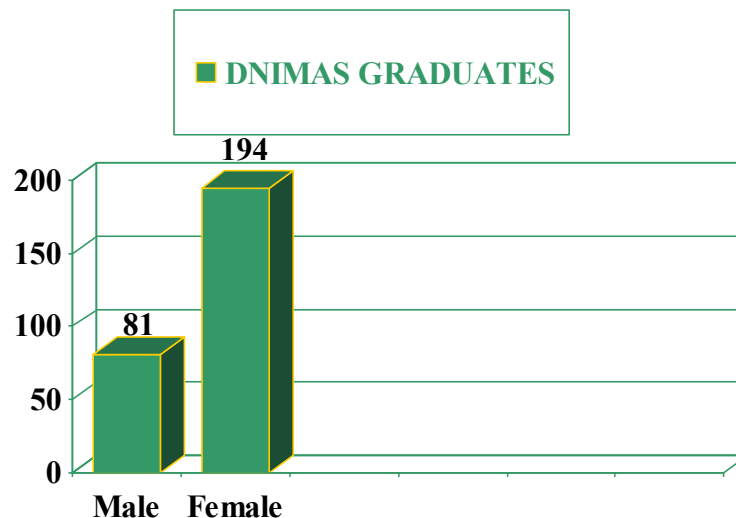


Figure 4. Degrees Earned by Gender

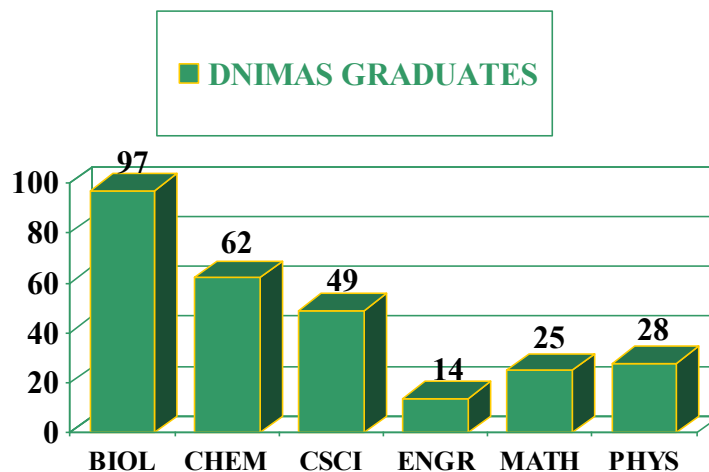


Figure 5. Number of Degrees Earned by Discipline

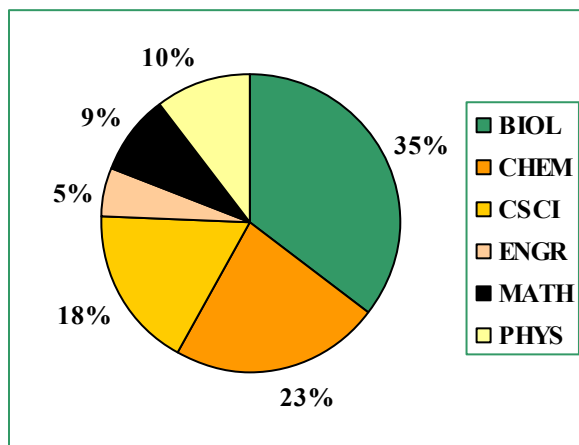


Figure 6. Percent of Degrees Earned by Discipline

In fact, consider a few facts about these scholars in relation to performance benchmarks for African American students at Norfolk State and throughout the nation. The cumulative graduation rate for all students who entered the DNIMAS Program is 75%. This is nearly 3 times the 28% graduation rate of NSU's entire student body. Nationally, only 25.4% of African American students attain their bachelor's degrees in four years or less. In mathematics and science curricula, the four-year completion rate for minorities is much less, only 5.3%. To underscore the scarcity of minority graduates in science and technology note that only 3.6% of bachelor's degrees awarded in biology and life science and 2.9% in computer/information systems went to African Americans during 1992-95. The number minority science and mathematics majors who plan to attend graduate or professional school is small. African Americans taking Graduate Record Examinations (GREs) in biological sciences represented only 5.7% of all people taking the GREs. In physical science, mathematics and computer science, African Americans represented

5.77% of all people taking the GREs. African Americans earning doctoral degrees in computer science represented only 1.4% of all PhDs earned. African Americans earning doctoral degrees in physical science and biological science represented 4.3% and 7.2% of all PhDs earned, respectively. Contrast these small numbers with the fact that African Americans earned 37% of all doctoral degrees in education during that same period.¹ Simply put, science and technology careers in private industry and research laboratories have not been options for most minority students. The DNIMAS Program at Norfolk State University provides that very valuable choice for its graduates.

DNIMAS an Institute of Excellence

The DNIMAS Program inspires its students and motivates them to have significant career aspirations. Moreover, their success has been unparalleled. Seventy-six percent have been accepted to graduate, medical, or professional schools. More than 50% of DNIMAS graduates have earned advanced degrees from prestigious institutions such as the Harvard, University of Michigan, University of Wisconsin-Madison, and University of North Carolina (UNC) Chapel Hill, University of Virginia, University of Maryland, Johns Hopkins University, Georgia Tech, Emory University, and many others. Figures 7 and 8 show the number and percentage of advanced degrees earned by degree type, respectively. DNIMAS scholars support their graduate studies through lucrative fellowships that they receive from organizations such as the Packard Foundation, AT&T Foundation, National Physical Sciences Consortium, and the Graduate Education for Minorities (GEM) Program. Since 1996, DNIMAS graduates have been awarded over \$2.5 million in fellowships to attend graduate or professional school.

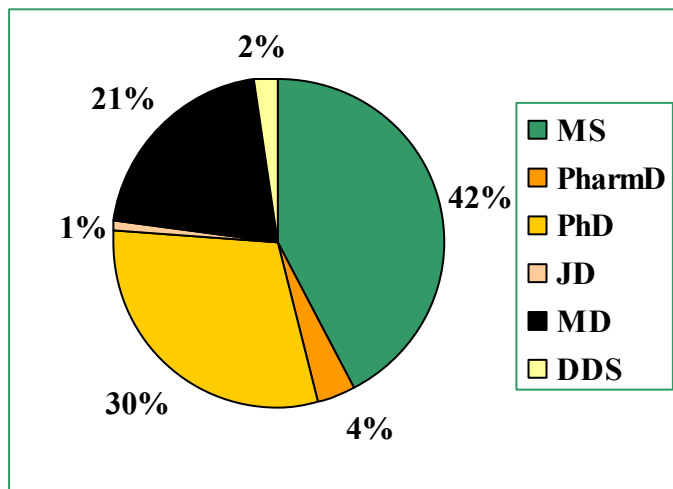


Figure 7. Percent of Degrees Earned by Degree Type

¹National data cited are 1992-95 average, the most current available for these fields. The African American Education Data Book, Volume 1. Frederick D. Patterson, Research Institute of the College Fund/UNCF, 1997.

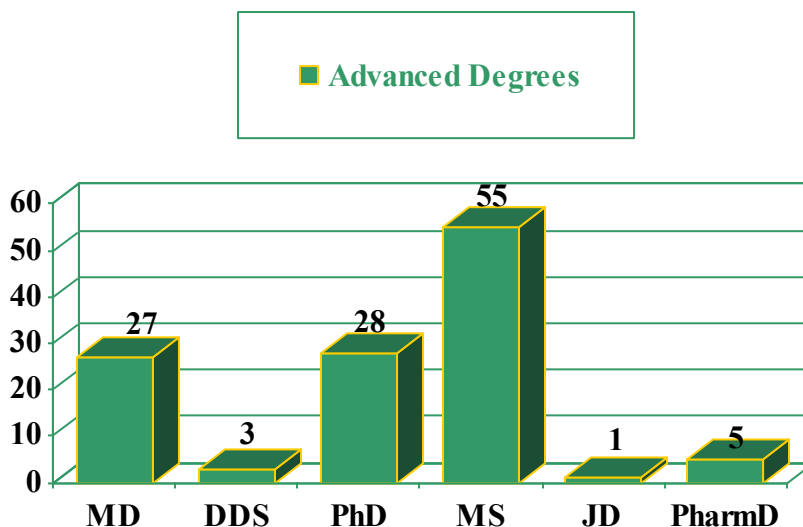


Figure 8. Number of Degrees Earned by Degree Type

In addition to providing students an excellent education in mathematics and sciences, the DNIMAS Program is very important to the Commonwealth of Virginia. In fact, 25% of DNIMAS graduates are attending or have completed graduate or professional schools in Virginia. Most have remained in Virginia and are established in careers serving the people and the economy of the State. Moreover, seven DNIMAS alumni who earned graduate degrees returned to Norfolk State as members of the science and technology faculty.

DNIMAS Peer Tutoring and Mentoring Program

In Fall 2004, the DNIMAS Program implemented three academically based intervention programs that were designed to increase retention and graduation rates. These programs are prototypes of models that exist at Auburn University². The goal of these three intervention programs is to increase the graduation rate of the DNIMAS students to 100%. These programs were also designed to help prepare DNIMAS students for graduate or professional schools by getting them involved in peer-tutoring and mentoring. In these programs, each DNIMAS student was required to spend two hours per week participating in the Peer-Tutoring Program and at least one hour each week in a Collaborative Learning Group. Students were also required to participate in a two-hour evening study/ tutorial/workshop for a total of five hours per week. These 3 intervention programs were designed to help both the tutor and the student being tutored.

The Peer Tutoring Program included one-on-one or peer group tutoring led by a team of volunteer upperclassmen in DNIMAS who were proficient in a given course. The tutorial format fostered peer group learning as well as one-on-one learning. The Peer Tutoring

² Dennis Weatherby. Bell South Minority Engineering Program, Auburn University, August, 1996

Program operated in collaboration with NSU’s STARS Tutoring Center located in the College of Science, Engineering, and Technology.

The Collaborative Learning Group intervention organized participants into study groups based on a common technical course. Each group consisted of 4 to 6 participants. With the aid of 2 or 3 mentor-tutor facilitators (upper-class DNIMAS students), participants solved homework problems and prepared for exams as a cooperative group using open discussions. The mentor-tutor provided structure to the session and ensured that problem solving progressed at a reasonable pace.

The Evening Study/Tutorial sessions integrated a variety of tutorial formats to foster learning through student group and student-tutor interactions. Students openly exchanged problem solving ideas and methods. The idea was to create a forum where students in need of academic assistance were comfortable asking questions and to promote an environment conducive to camaraderie and studying.

Table 1-5 illustrates how the three intervention programs impacted the grade point averages (GPA) of DNIMAS engineering students. The majority of the students in each classification earned a semester GPA of 3.0 or higher. These students had almost 100 % participation in the three intervention programs. Tables 1-5 provides data that demonstrates that peer tutoring and collaborative learning are best practices which has been successful in the DNIMAS Program. An indicator of the success of these “best practices” has been the improved performance of engineering scholarship students as measured by their grade point averages at the end of the semester. The data was tracked each fall to see the percentage of students who earn grade point averages above 3.0. This number has steadily increased during the last five years from 63% in Fall 2003 to 76% in Fall 2007.

**DNIMAS GPA STATISTICS
FALL 2003 – 2007
ENGINEERING STUDENTS WITH SEMESTER GPA’S OF 3.0 OR ABOVE**

Table 1. Fall 2003 GPA Statistics Students with Semester GPA’s of 3.0 or above

Classification	3.0 or Above	Total Class	Percentage
Freshman	5	11	45 %

Total Students: 11
Total Students with a 3.0 Semester GPA or Higher: 5 45%

Table 2. Fall 2004 GPA Statistics Students with Semester GPA's of 3.0 or above

Classification	3.0 or Above	Total Class	Percentage
Freshman	5	5	100%
Sophomore	5	11	45 %

Total Students: 16
Total Students with a 3.5 Semester GPA or Higher: 10 **63%**

Table 3. Fall 2005 GPA Statistics Students with Semester GPA's of 3.0 or above

Classification	3.0 or Above	Total Class	Percentage
Freshman	8	11	72 %
Sophomore	5	5	100 %
Junior	7	11	63 %

Total Students: 27
Total Students with a 3.5 Semester GPA or Higher: 20 **74%**

Table 4. Fall 2006 GPA Statistics Students with Semester GPA's of 3.0 or above

Classification	3.0 or Above	Total Class	Percentage
Freshman	7	10	70 %
Sophomore	8	11	72%
Junior	5	5	100 %
Senior	8	11	72 %

Total Students: 37
Total Students with a 3.0 Semester GPA or Higher: 28 **76%**

Table 5. Fall 2007 GPA Statistics Students with Semester GPA's of 3.0 or above

Classification	3.0 or Above	Total Class	Percentage
Freshman	7	9	77%
Sophomore	7	7	100 %
Junior	4	8	50 %
Senior	4	5	80 %

Total Students: 29
Total Students with a 3.5 Semester GPA or Higher: 22 **76%**

A component of the effort to assist first year students in making a smooth transition to NSU is a student tracking/monitoring process called, Shadow Mentoring. The purpose of the program is to help first year students manage their academic schedules, provide proactive mentor support, and monitor academic progress. DNIMAS trains upperclassmen to serve as mentors in the Tutoring Center. Mentors meet with students on a weekly basis to ascertain information and to assist with issues and/or concerns students might have. A major meeting takes place with freshmen students just before the last day to drop a class to offer counseling. Both the mentor and the student meet together with the DNIMAS director, at least once during the semester, to discuss the student's academic progress and to share strategies to improve performance for the remainder of the semester.

Conclusion

- The peer tutoring, collaborative learning, evening tutorial sessions, and shadow mentoring are proven “best practices”
- An indicator of the success of these “best practices” has been the improved performance of engineering scholarship students as measured by their grade point averages above 3.0 at the end of the semester.
- This number has steadily increased during the last three years from 45% in Fall 2003 to 76% in Fall 2007.

References

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