
ACTUATION

An Educational Pipeline into Pharmacy for Minority Students

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SUMMARY. During the past fifteen years Xavier University of Louisiana (XU) has grown to become #1 nationally in placing African Americans into pharmacy (and #2 in placing African Americans into medicine). While many factors have contributed to this success, one of the most visible is the "educational pathway" developed by Arts & Sciences faculty to motivate and prepare African Americans for entry into pharmacy, medicine, and similar health professions. This pathway currently includes science-related summer programs for students every year beginning in junior high

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and continuing until entry into college, as well as extensive revision of Xavier's entry-level science and mathematics courses including almost all of those required in the prepharmacy curriculum, so as to promote student success.

INTRODUCTION

Over the past fifteen years, a period during which the number of students entering college interested in science-related careers was decreasing nationwide, Xavier University of Louisiana (XU) more than doubled the number of students it placed into health professions schools from an average of 43/year in the mid-70s to over 100/year over the past three year period. Of even greater importance, more than 90% of the XU students who gained entry into health professions school over this period were African Americans, a group whose severe underrepresentation in the health professions adversely affects the health care received by African Americans. Over the past three-year period, Xavier was #1 nationally in placing African Americans into schools of pharmacy and #2 in the nation in placing African Americans into medical school.

Xavier's success in preparing African Americans for entry into pharmacy is the result of a number of factors, many of which are described elsewhere in this publication. The purpose of this article, however, is to describe efforts in Xavier's College of Arts and Sciences to recruit and prepare African Americans (including prepharmacy students) for a broad spectrum of the health professions.

Xavier University of Louisiana is a historically Black Catholic institution whose enrollment in the fall of 1990 was slightly less than 3,000—an increase of one-third from five years ago. The primary focus of Xavier's undergraduate programs is the liberal arts. Natural science majors in the College of Arts and Sciences are required to take 45 semester hours of courses outside the sciences, the majority of which are in the humanities (including languages, literature, history, philosophy, and theology). The distribution of Xavier's undergraduates by major, however, is very unusual for a liberal arts institution. In the fall of 1990, 23% of the University's undergraduates were enrolled in prepharmacy or pharmacy, and another 23% were enrolled in chemistry or biology. Most of the latter are interested in medicine or dentistry. Substantial enrollments in engineering, computer science, and related disciplines gave the sciences at Xavier approximately 50% of the student body.

SOME REASONS FOR XAVIER'S SUCCESS

Xavier is a small institution with meager financial resources located in a state not noted for educational achievement. In spite of these limitations, XU has had much greater success in preparing African-American youth for entry into the highly competitive health professions than more affluent colleges and universities. Research has shown that Xavier's success is not the result of recruitment alone. While Xavier is not an open admissions institution, it also does not accept only the cream of African-American high school graduates. In the recent past, freshmen entering Xavier have had an average high school grade point average of 2.80 and an average ACT score (old scores, not the "enhanced" test given since the fall of 1989) of approximately 16. This ACT score is approximately equivalent to a combined SAT score of 760. Instead, Xavier's success is a direct result of the various activities implemented by the University to increase the probability that African-American students will succeed in the health professions.

This is illustrated by comparing the percentage of African-American freshmen who succeed at Xavier versus those who succeed nationally. A recent ETS study indicates that only 24% of high ability African-Americans (defined to be the top 2% of ACT/SAT scores) who enter four-year colleges complete a degree program and gain entry into any graduate or professional school (1). Studies at Xavier indicate that 40% of those with ACT scores from 12 to 17, 49% of those with scores of 18 to 23, and 80% of students with scores of 24 and above completed the Prepharmacy program and gained entry into Pharmacy (2). These results have been verified by a similar study of Xavier's premedical program (3).

Much of Xavier's success in placing African Americans into pharmacy is the direct result of careful implementation and continuing improvement of programs developed by the University's science and mathematics faculty (within the College of Arts and Sciences). These programs are effective because, taken together they form an educational pipeline which identifies students with potential and interest early, and provides encouragement and academic enrichment on an ongoing basis until completion of sophomore-level mathematics and science courses. In retrospect, this pipeline appears to have been designed rigorously from first principles and as a result of extensive planning (4). However, it is important to note that instead it developed as science and mathematics faculty attempted to address problems, one at a time, starting from the critical transition from high school to college, and then proceeding on to address other

problems as time permitted (and sometimes when it didn't). This "educational pipeline" is described below.

THE SUMMER SCIENCE ACADEMY

The primary focus of Xavier's science-related activities for precollege students is a series of four summer enrichment programs designed to prepare students for the major mathematics or science courses they will take during their freshman and sophomore (Prepharmacy) years. These programs are known collectively as the Summer Science Academy. The specific programs are:

- **MathStar**, a two-week summer program that prepares students for algebra courses, usually the first rigorous math course they encounter. Students usually enroll during the summer between the 8th and 9th grades.
- **BioStar**, a three-week summer program that prepares students for high school biology. Students typically attend during the summer between the 9th and 10th grades.
- **ChemStar**, a three-week summer program that prepares students for high school chemistry (4-6). Students usually attend the ChemStar program in the summer between their 10th and 11th grades.
- **SOAR (Stress On Analytical Reasoning)**, a four-week, problem-solving based high school/college bridge program (4,7,8). Students attend the program following either their junior or senior year in high school. Those who complete the SOAR program after their junior year may enter Xavier during the summer after their senior year under a newly developed program that gives them a head start on their college requirements.

Xavier's precollege summer programs were developed one at a time by mathematics and science faculty over the past fifteen years. Experience gained from previous development was used when proceeding to new endeavors, as was the expertise of dedicated teachers from a variety of local schools. Although the four programs in Xavier's Summer Science Academy differ in response to content demands and the educational level of the participants, all contain the following features to some degree:

- *Integration of problem-solving with content.*
- *At least two hours of homework daily.*
- *Daily quizzes which test the previous day's work.*
- *Rapid grading so students can use past performance to help prepare for the future quizzes.*
- *Emphasis on vocabulary and/or reading skills.*
- *Group competitions designed to promote the formation of peer support groups based on academics.*
- *The use of successful Xavier students as role models.* These students serve as group leaders. Each organizes a group of students for competitions, inspires by example, calls all who are tardy or absent, and generally serves as an older brother or sister for the summer program participants.
- *Parental involvement.* Parents are invited with participants to an opening ceremony and orientation the day before the beginning of each program, and are sent report cards at least once per week. Parents are also invited to an awards ceremony at the end of the programs at which all students receive graduation certificates and are given the opportunity to show their parents what they have achieved.
- *Social activities* which let the program participants see that students who succeed in the sciences are not necessarily nerds. These include pizza parties, dances, and (for older students) a walking tour of the French Quarter.

The success of the programs is indicated by the fact that 1,260 students applied to the programs in 1990, and funds were available to accept 643 students into the programs. Over 99% of the participants were African-Americans; 82% were female.

**THE MODIFICATION OF ENTRY-LEVEL MATH
AND SCIENCE COURSES
TO SUPPORT THE UNDERPREPARED**

Xavier's Arts and Sciences programs identify and encourage students capable of succeeding in pharmacy and other science based professions are not limited to the precollege years. The mathematics and science departments have taken equally unorthodox approaches to their entry-level courses (4). These courses are not viewed as filters designed to

eliminate the underprepared as they are at many other institutions. Key entry-level courses including general biology, general chemistry, organic chemistry, general physics, and precalculus, have been modified to provide extensive support for the underprepared while maintaining high standards (9-11).

The most basic change in the entry-level science courses was the adoption of the philosophy that course content, teaching methodology, and rate of presentation should be determined by the relevant department as a whole, and not by individual lecturers or textbooks. This standardization not only made it possible to improve support for the underprepared (for example, tutors know exactly what is covered in all lecture sections of a course), but also provided a strong support mechanism for part-time or new faculty. The system is sustained by a series of workbooks which tell the student exactly what he/she is to learn, where additional information about the topic may be found, and sample problems selected for their importance by faculty who actually teach the courses. Although the content of the workbook is determined by the department as a whole, it is not static. Workbooks are rewritten and revised frequently, responding to departmental decisions to stress different areas or to the development of new and better ways of teaching.

One or more of these key mathematics and science courses have other unusual features which contribute significantly to the University's success in placing African-Americans into Pharmacy and other areas in the health professions, as follows . . .

- *Inquiry-based laboratory experiments* require students to "do science." That is, they collect data, analyze it, and make predictions based on that analysis, rather than merely verifying something already known in cookbook fashion (12-14).
- *Special exercises help students improve their test-taking skills.* Students in general chemistry, and to some extent in general biology, are repeatedly required to work sections from the quantitative or reading sections of published examinations used to judge the qualifications of students wishing to gain entry to graduate or health professional schools.
- *Systematic efforts throughout the freshman and sophomore years improve general, not scientific, vocabulary.* Students enrolled in general biology, general chemistry, organic chemistry, and physics must study from 40-80 general vocabulary words weekly. They receive points in each course for performance on short quizzes that check their mastery of the words. The vocabulary words are divided

into two sets, each of which is covered twice. The first set is used in general biology and general chemistry, the second in organic chemistry and general physics.

- *Systematic efforts help students learn to visualize in three dimensions.* Students in general chemistry, general biology, organic chemistry, and physics are all required to build appropriate physical models repeatedly, in an effort to improve their ability to visualize physical objects in three dimensions. This ability has been found to be related to the ability to perform well in many science courses.
- *A systematic effort is made during the freshman year to get students in general chemistry and biology to form study groups.* Members of these groups are expected to work together for the good of all. Students who do not perform up to expectations are advised individually to form study groups. In addition, effort is devoted to helping them find an appropriate study group. In some instances, study groups are formed by hiring a student who is doing well in the course to serve as a study group coordinator.

OTHER SUPPORT FOR THE UNDERGRADUATE STUDENT

Additional factors contribute to Xavier's success in preparing African-American youth for entry into the highly competitive biomedical sciences.

- *Most students entering Xavier declare a major when matriculating.* Prepharmacy students are immediately assigned an academic advisor in the College of Pharmacy. Close advisor-student interaction is both encouraged and expected at Xavier. In order to ensure that it really exists, all students enrolled in freshman biology and freshman chemistry receive points in both courses for keeping an up-to-date record of their grades on an "advisor's card" signed weekly by their academic advisor.
- *Xavier's science departments provide extensive tutoring for students in entry-level science courses.* The departments of Biology, Chemistry, Mathematics, and Physics all operate tutorial services designed to help students enrolled in the entry-level courses in their respective departments. Providing effective tutorial services is relatively easy in these courses because the courses are "standardized" as discussed above. The tutors in all of the services are upper-level students who performed well in the courses the previous year. They

know exactly what was covered, how problems were worked, and how the present topic is related to past ones. As a result it is relatively easy to prepare tutors for their jobs. Because the tutors are able to provide assistance directly coordinated to the courses for which they tutor, students are more willing to seek their assistance.

- *The faculty most concerned with the above efforts have voluntarily organized as the Science Education Research Group (SERG). This group meets weekly to plan and administer the programs discussed above (14). Perhaps even more importantly, the SERG provides support for the faculty involved. So far they have managed to avoid, or at least minimize, one of the most common reasons why successful educational innovations are terminated—burnout.*

Evaluation has provided two clear types of evidence that Xavier's modified entry-level science courses are more effective than traditional courses. First, more students pass the science courses at present than passed before the courses were modified. For instance, the percentage who pass freshman-level courses in biology and chemistry with a "C" or higher has increased from approximately 40% before modification to 60% or so at present. Second, those who are passing these courses now are also scoring higher (on the average) on comparable final exams and/or appropriate standardized exams than did their counterparts before the courses were modified.

Although there is extensive support in the freshman-level biology and chemistry courses at Xavier, this support is purposely decreased at the sophomore level so that the students can perform at a competitive level without "crutches" when they enter the College of Pharmacy.

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- and support students in SOAR, the University's high school/college bridge program.
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