

An Understanding of the Improved Grades, Retention and Graduation Rates of STEM Majors at the Academic Investment in Math and Science (AIMS) Program of Bowling Green State University (BGSU)

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Background:

Due to the severe shortage of highly skilled STEM students and professionals and the lack of under-represented minorities and women in STEM disciplines, Bowling Green State University has developed the AIMS undergraduate program. Initiated in 2001 by President Sidney Ribeau, the AIMS undergraduate program was initially designed to increase the number of female and under-represented minority STEM graduates, thus:

1. Improving conditions, which provide a more inclusive workforce that draws on all available talent (e.g., minorities, women and associate degree recipients) for the future.
2. Graduating more knowledgeable STEM students.
3. Purposefully providing equal opportunities for minorities and women who traditionally have been excluded from STEM areas (Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, 2000; Gandara, 2001; National Science Foundation, 2002; Thayer, 2000; Trower, 2002)
4. Preparing more high-potential students for terminal degrees in the STEM-based disciplines (Fields, 1998).

These needs are substantiated by national statistics (Bae & Smith, 1997; Farrell, 2001; Hayes, 2002), which show a lack of graduates among minorities and women in the STEM fields. Trends are reflected by graduation rates at the bachelor's degree level (Hayes, 2002).

NSF data from 91 "selective colleges" similar to BGSU were studied (Hayes, 2002). According to Hayes, "selective colleges" admit students with average ACT scores of 21-24. Hayes revealed that, on an average, 21.3 % of students across the majors graduate in four years. However,

Abstract

The Bowling Green State University Academic Investment in Math and Science (BGSU AIMS) program was founded in 2001. This 4-year undergraduate program has grown from one class with 10 inaugural members to four classes with 69 members majoring in science/technology/engineering/math (STEM)-based areas.

Average grade point averages (GPA's) of the AIMS students are ca. 3.0 after the first semester. After seven semesters, the AIMS 2002 cohort had retained its GPA at 3.0, whereas a BGSU control group had an average GPA of ca. 2.5 after semester-1 and that 2.5 average GPA was only slightly changed in the following six semesters. Retention of AIMS students at the University and in the STEM fields has been outstanding—retaining ca. 93% of the 2002-2004 cohorts after the first year, and 89% of the 2002 cohort after 3-1/2 years. Normally, year-1 is the year of greatest attrition. Based upon National Science Foundation (NSF) data, a contrast exists between first-year retentions of 93% for AIMS 2002-2004 cohorts and 60-65% for STEM majors at the national level.

Several 4-year program components contribute to this success, but early campus acclimation through a 5-week Summer Bridge Program is critical. More specifically, knowledge of math, emphasized during the summer, correlated with improved overall GPA's for the fall semester. Educators should increase their emphasis on early success to freshmen and better connections to influence them to work harder, succeed in their first semester and, more specifically, succeed on the first set of exams. A balance of activities through the four years in college must be in place to sustain positive momentum and facilitate commendable progress toward graduating.

this percentage is reduced when considering students in STEM disciplines, especially students from under-represented minorities. For example, the percentage of graduates in four years for all STEM majors is 14.4% versus 7.6% for under-represented minorities (URM). (See Table 1).

Data published in the Chronicle of Higher Education (Farrell, 2001) and elsewhere (Gandara, 2001; Maton, Hrabowski, & Schmitt, 2000; Trower & Chait, 2002), accentuate the disproportionate number of under-represented minorities and women in these fields at the graduate level. According to Farrell (2001), in engineering, the under representation of women is clearly illustrated with a meager 15.7%

of women earning doctorates, while women compose over 50% of the general population. Women obtained only 24.1% of the earned doctorates in physical sciences while doing somewhat better in life sciences with 46.9% of the earned doctorates. An associated shortage is shown for Blacks and Hispanics, who receive only ca. 3% of the earned doctorates (while each group makes up ca. 13 % of the general population) in both engineering and the physical sciences.

There are disparaging numbers of women and minority graduates, doctoral candidates and recipients in STEM fields. Thus the AIMS program focuses on those segments of the population.

AIMS Participants:

AIMS Scholars (students selected to participate in this 4-year program) are accepted into the program based upon: a) high school achievements (GPA's, ACT/SAT scores and school/community involvement), b) expressed interest in STEM or STEM-based disciplines and c) the expectation of taking pre-calculus, calculus or a higher math course their first semester of college. Minimally, they must have a 3.0 high school GPA on a 4-point scale and a 21 on the ACT exam or 1000 combined score (math and verbal) on the SAT exam. Table 2 shows the number of participants from our targeted populations and associated high school academics for the 2001-2005 groups. Discounting the pilot year of 2001, 20 students per year are accepted into the program. About 36% are male with 64% being female. Among those selected for AIMS, 28.7% have been white females.

As demonstrated in Table 2, the AIMS cohorts are diverse for gender and ethnicity ((black, white, Hispanic and other (Asian, bi-racial, Native American)), but they are also geographically diverse since the student members come from a wide range of states. Three-fourths of the students are from Ohio. Other AIMS Scholars come from regional states, such as Michigan, Indiana, Illinois, Pennsylvania and Wisconsin. A few come from distant states, such as New York, Texas and Minnesota.

Program Description:

Overview

AIMS is a dynamic program modeled on key elements from nationally established programs

Cohort	% Loss after Year-1	% Loss after Year-2	% Graduated Year-4
NSF-All Majors 1994-2000	21.6	32.5	21.3
NSF-STEM 1994-2000	35.8	53	14.4
NSF-STEM-URM 1994-2000	35.4	55	7.6
BGSU-STEM 1995-2001	36.1	53.6	25.7
AIMS (2002-04)	8.0	12.4	66.7 (2002 cohort)

NSF data from 91 selective colleges, ACT 21-24, akin to BGSU.
Data from Grant Report #REC9903426, University of Oklahoma-Normal.
URM, underrepresented minorities (Blacks, Hispanics, and Native American)

Table 1. Retention and Graduation Rates for NSF and BGSU-STEM surveyed cohorts

with similar objectives like the Meyerhoff Scholars Program (Collins, 2000/2001; Maton et al., 2000;) at University of Maryland Baltimore County and the pre-engineering programs for under-represented minorities at the University of Akron (Lam, 2005). Some unique features have been added by the creative thinking of 25 Advisory Board members and their resources. The AIMS mission statement is "Bowling Green State University's AIMS program channels its work to establish a world-class training center to graduate under-represented minorities and women in math and science-based majors (STEM, science/technology/engineering/math), many of whom will proceed to get a terminal degree in their field and ultimately perform cutting-edge research and/or teaching." The 4-year under-graduate program encompasses three major phases:

1. A 5-week Summer Bridge Program
2. A freshman-sophomore phase
3. A junior-senior phase, ending in graduation

Its Summer Bridge Program is aimed at providing a pre-college experience to high-school graduates accepted in the program and enhances preparedness to succeed in the fall. The freshman-sophomore phase builds the foundations for retention of students within the STEM areas. The junior-senior phase completes

graduation requirements and prepares students to readily compete for post-baccalaureate programs or the job market within STEM disciplines. Included in the comprehensive 4-year program is a provision that allows for a fifth year in the program. The three phases will be discussed further in the next three subsections.

AIMS Scholars are expected to be high achievers in college. Accordingly, to remain in "Good Standing" with the AIMS program, there are curriculum and GPA requirements.

The initial test is to see how the students perform in the 5-week Summer Bridge Program. If students successfully complete the Summer Bridge Program, they receive a \$1000 stipend and are officially welcomed into AIMS as college matriculates for the upcoming fall.

Starting their first academic year, students are awarded a 4-year academic scholarship of \$1500 that increases annually by \$500 increments if one remains in "Good Standing." To stay in "Good Standing" in the AIMS program, a student must remain in majors consistent with a 45-hour STEM-based curriculum, including at least one laboratory sequence, and show academic success by achieving at least:

1. A 2.75 GPA after year-1
2. A 2.85 GPA after year-2
3. A 3.0 GPA after year-3

Conceptually, if they remain academically in "Good Standing" after year-3, one could have much greater than a 3.0 GPA and thereby be readily positioned for admission into the graduate program. Annual increases in scholarship amounts are monetary incentives that encourage the students to excel academically. Members must remain in STEM fields. We have observed that students who are on a GPA cusp (borderline "Good Standing" or slightly under the threshold), will work harder during the academic year or take summer courses to bring their GPA's up. Students with less than a 2.75 GPA are in "Poor Standing" and forfeit all incremental increases. The AIMS students exhibit pride in earning annual incremental increases and tend to work harder and smarter to ensure that they receive the increases.

Summer Bridge Program

The 5-week Summer Bridge Program is designed to assist student acclimation to this residential campus and to better prepare them to succeed academically in STEM fields, the first semester primarily. Rigor in the AIMS 5-week Summer Bridge Program is one approach

to help ensure academic success the first semester of matriculation. These five weeks should help freshmen adjust to the campus, build support systems, and, most importantly, expose students to course work very similar to what they will receive in the fall. The summer program consists of:

1. Two mini-courses in mathematics and computer science (CS) with ca. 30 classroom contact-hours during the five weeks (the normal semester has ca. 70 contact hours for the 5-hour math course and 42 contact-hours for a 3-hour course, such as, CS)
2. Science exposures with stand-alone science topics in biology, chemistry, physics, geology, astronomy that are presented in 3-hour blocks with a 1-hour lecture portion and an associated 2-hour laboratory portion.
3. Co-curricular half-day or full-day excursions to science-related facilities such as, Pfizer Pharmaceutical, Marathon Oil, the Toledo Zoo, and Medical University of Ohio's medical and research areas, BASF Corporation, NASA and Phoenix/Plastics Technology.

	2001	2002	2003	2004	2005	TOTALS
No. of AIMS admits	10	18	20	24	16	88
Male	2	6	6	10	6	30
Black	2	4	6	8	5	25
Hispanic	0	2	1	1	1	5
Other	0	0	0	1	0	1
Female	8	12	14	14	10	58
Black	5	6	5	5	4	25
Hispanic	0	1	1	2	1	5
Other	0	0	1	0	1	2
White	3	5	7	7	4	26
Average High School GPA	3.2	3.45	3.55	3.5	3.52	
Average ACT Score	23.2	24.3	25.5	25.3	23.9	

Table 2. Demographics and High School Academics for 2001-2005 AIMS Cohorts

4. Extra-curricular/recreational activities, such as cook-outs and fields trips.

The summer math course covers some fundamentals of algebra, trigonometry, geometry, and calculus (limits, derivatives and integrals). Weekly quizzes, homework assignments and a final exam are given in a manner similar to an academic year math course.

For the summer CS course Blackboard, email, PowerPoint, Excel and programming concepts are covered. Students have required homework, which is graded, take quizzes and have a final exam.

Typically, science exposures are in the afternoon in 3-hour blocks. They cover an array of science-based subjects. A few examples:

1. Exposing and processing of a photo-resist (photo-polymerization)
2. Analyzing and matching DNA (a 7-hour lecture and lab, not 3-hour block)
3. Making a polyamide: Nylon 6,10 (organic synthesis)
4. Investigating reptiles
5. Exploring the universe—visit to the planetarium and telescope use
6. Studying acceleration and motion of a roller-coaster
7. Differentiating between minerals/rocks
8. Illuminating matter with Lasers
9. Drawing via computer aided design (CAD)
10. Testing stress/strain behavior of common materials—tensile properties

For some of the science exposures, laboratory reports are required. They are graded and returned. These science exposures reaffirm some principles learned in high school and expose the students to new concepts, new laboratory environments, new equipment and provide more in-depth coverage of the specific topics.

Co-curricular activities in half or full-day blocks provide another type of learning and connecting for the students. In most of these sessions AIMS students see STEM principles in action and have an opportunity to interact with professionals in various STEM-based fields. For example, in visiting Pfizer Pharmaceutical, a favorite site for AIMS Scholars, students hear of the life cycle of a drug—from conception, to screening, to testing, to FDA approval, to the marketplace. That typical life cycle includes teamwork from many scientists, computer experts, engineers, statisticians/mathematicians and health professionals. Essentially all STEM disciplines are covered. These interactions

Grade Distribution	AIMS Cohorts	BGSU Controls
% A	28.8	10.8
% B	33.6	26.9
% C	13.5	8
% D	16	16.6
% F	2.5	35.8
% W	5.6	2
W, Withdrew from class with a passing grade (C or better)		

Table 3. Distribution of Grades for the 2002-03 cohorts after their first semesters

give the students a better chance to decide if a particular career path suits them.

Recreational activities provide a balance to the summer program. Students connect on a non-academic level, travel to different cities and participate in activities that are fun and new. Key weekend excursions have been to:

- a) The Rock n' Roll Hall of Fame in Cleveland
- b) The Toledo Art Museum
- c) The African-American History Museum in Detroit
- d) Sauder's Village in Northwest Ohio—Historic German Village
- e) Detroit Tigers baseball game—Comerica Park

Our students treasure these breaks from the curriculum/classroom and co-curricular activities and embrace these opportunities to venture further and enjoy themselves.

Freshman-sophomore phase

Program components of the first two years are designed to ensure early academic success and persistence in the STEM discipline.

These activities are:

1. Cluster courses, especially math, since all AIMS Scholars must take math their first year
2. AIMS Seminar I and II, 1-hour graded courses
3. STARS (Students Teaching And Reaching Students)—group study

4. Mentoring programs
5. Exposure to undergraduate research, or starting research
6. STEM Exposures (engagement with STEM-based activities)
7. One-on-one meetings with the Director or his surrogate
8. Weekly AIMS members' meetings (one-half hour)

Math cluster courses for the first academic year are arranged so that AIMS Scholars have at least three program members in their pre-calculus and calculus classes. This assures a level of comfort and a built-in support system for minorities and women who often feel isolated in classes where few typically attend. The cluster classes minimize "stereotype threat" (Anderson, 2002; Even, Robinson, & Carmeli, 2003; Fields, 1998; Hyde & Gess-Newsome, 1999; Niemann, 1999; Steel, 1999), which has been attributed to the under-achievement of many minority groups when students perceive that they do not belong or are expected to be low achievers.

AIMS Seminars I and II are 1-hour graded courses. They help prepare students for careers in STEM-based areas, as experts refer to: 1. curriculum requirements and degree audits for specific degrees, 2. scientific research and opportunities, 3. career options, 4. publications versus patents, 5. resume writing/mock interview, etc. Both courses incorporate brief oral presentations by the students who cover routes to defining one's career objective and means to navigate one's career path. These courses are open to all BGSU students but are required for all AIMS Scholars.

The STARS activity is required of all first, second and third year AIMS Scholars. They are required to attend the STARS room a minimum of two hours per week, but many exceed that minimum. STARS, although not as structured, is designed somewhat after Treisman's Academic Excellence Workshops where students work, learn, and tutor together to reach academic excellence. Such peer teaching/learning arrangements (Collins, 2000/2001; Garland & Treisman, 1993) have been shown to assist under-represented groups to excel in courses where they typically lag behind, such as mathematics. Frequently, sets of our students come to the STARS room immediately after their cluster math class and work on math together.

During the summer program, each new AIMS member is assigned a mentor, generally a faculty member who has the same discipline interest as the student. AIMS Scholars are

required to meet with their mentor at least once a semester to build a campus support system, to learn how the mentor selected his/her career and to learn of research interests. These relationships help the student feel connected to the campus (Newton & Wells-Glover, 1999; Richardson & Skinner, 1992). The initial AIMS mentor/student pairings are expected to last for four years, but few do, unless the student does research with the mentor. We are looking for ways to improve and strengthen the mentoring aspects of the AIMS program.

Starting with the freshmen year, the advantages of getting involved with undergraduate research are discussed. In some cases, the involvement is simply attending regular research group meetings as an invited observer. Many researchers (Project Kaleidoscope, 2002; Seymour & Hewitt, 1997; Tinto, 1998; Zurer, 2002; Zydney, Bennett, & Shadhid, 2002) have reported on the positive effects of undergraduate research, as young students get early access to the research setting, graduate students and in-depth study. Often they are inspired by the research and are propelled to strive for better grades. Unfortunately, sometimes they find that they are not well suited for research. This recognition is equally important. Approximately 30% of AIMS Scholars have done undergraduate research. So far, those efforts have resulted in one paper (Connolly, 2005) while giving other students something to emulate.

STEM Exposures are activities where students are engaged in programs related to their career aspirations. All AIMS Scholars are required to attend two STEM Exposure sessions per semester. They are divided into six broad categories: 1. research group meetings, 2. STEM-based campus or off-campus seminars, 3. STEM-based conferences, 4. STEM-based organization/club meetings, 5. presentations

	% Retention for AIMS Cohorts	% Retention for BGSU Control Cohorts
2002 cohort after 7 semesters	88.9	72.2
2003 cohort after 5 semesters	94.7	63.2
2004 cohort after 3 semesters	95	68.2
a. In this table, retention refers to retention at the University, not necessarily retention in STEM disciplines. AIMS students are retained at the University and in STEM.		

Table 4. Retention Results for 2002-2004 AIMS vs. Control Cohorts

on novel and profound subjects or presentations by renowned speakers, and 6. preparations for selected opportunities ((interviews, test preparation, test taking (e.g., GRE), searching for internships/research opportunities/job opportunities)). Students are required to hand in a form to the AIMS Office, which describes what STEM Exposure they attended, the date, who they talked with, and the value of that exposure.

One-on-one meetings are held between each AIMS Scholar and the Director (or his surrogate) at least twice a semester. These short meetings typically last up to one-half hour and cover four categories of potential need: 1. academic, 2. social, 3. financial, and 4. personal. When unusual and difficult circumstances occur, we make use of all the resources within the AIMS program and the University to help resolve those problems. These meetings are crucial for some, but simple formalities for the others.

All AIMS freshmen and sophomores are required to attend weekly meetings. Students network, mingle and discuss policies. All upperclassmen are also invited. Upperclassmen give brief presentations. Bringing all the cohorts together promotes peer mentoring and role modeling.

Junior-senior phase

During the last two years of the program, three new components have been inserted although STARS involvement, the mentor/student program, research, STEM Exposures and one-on-ones continue from the first two years. The junior-senior activities are Experience Critiques, post-baccalaureate test taking (i.e., GRE exam), and job/graduate school searches.

Experience Critiques are 5 to 10 minute talks given by the juniors and seniors once a year during their last two years. Those presentations are given during the weekly AIMS meetings with the audience primarily being the AIMS freshmen and sophomores who are all required to attend. The purpose is to give the presenter more practice at public speaking and the opportunity to share their experiences with younger students. Such topics have been:

- a. Searching for a research experience for undergraduates (REU)
- b. Living off campus
- c. Graduating in four years, even when you change your major
- d. Searching for graduate programs/schools

These critiques have led to an engagement between the AIMS cohort members and are

Semesters completed	2002	2002		2003	2003		2004	2004
	AIMS	Control		AIMS	Control		AIMS	Control
	SCH	SCH		SCH	SCH		SCH	SCH
1	15	15		18	14		17	17
2	33	27		34	26		34	29
3	48	45		49	42		49	47
4	67	56		67	57			
5	82	68		82	72			
6	98	81						
7	113	99						
8								
a. For most STEM majors 122 hours (SCH, semester credit hours) are required to graduate.								

Table 5. Semester Credit Hours Accumulated—AIMS versus Control Groups, 2002-2004

a good “food for thought.” They provide a mechanism to connect the upper and lower classmen.

From the summer program to the junior/senior college years, we discuss the GRE exam and compare it to the SAT or ACT for high school graduates. Sample exam booklets are available in the STARS Room and the AIMS Office and students are encouraged to study for the exam. Additionally, they are informed about companies, which assist students with exam preparation, and they are encouraged to take the exams. Through our Student Financial Aid Office, students who are needy (Pell Grant eligible) can get reimbursed for GRE costs.

Much emphasis is placed on graduating the senior year and making a smooth transition to a professional position or graduate school. For the AIMS Scholars interested in working and in improving their interviewing skills, they should attend job fairs arranged by the BGSU Career Placement Center in both their junior and senior years. They are urged to refine their resumes and systematically select references. A similar plan is followed for those pursuing graduate school. They are shown how to research the graduate schools that provide the appropriate degree program. Students are advised to apply to several schools and in a timely fashion--with ample time for the recommenders to write the letters.

Student Testimonials:

AIMS Scholars have given subjective testimonials as to their perceived value to them of some of the special activities provided for them. Some of those testimonials are listed below:

1. 5-week summer program, excursions and classes—"The summer program had a packed schedule, but we really learned what college would be like. I was excited to return to campus because I knew where things were and saw some familiar faces."—**2001 AIMS cohort member**

"The math summer courses really allowed me to improve my math skills. Without it, I doubt that I would have done nearly as well in the regular math course in the fall."—**2003 AIMS cohort member**

"The various science exposures and excursions we had in the summer were amazing! The trip to Pfizer really opened my eyes to what was available to science majors besides going into medicine and teaching."—**2002 AIMS cohort member**

2. Math cluster course—"It is nice being in a class knowing some of the students and not being the only minority. We have students to study with whom we became friends with during the summer. I'm more involved with class discussion and participate more because of familiar faces in the classroom. We're probably learning more."—**2002 AIMS cohort member**
3. AIMS Seminar—"I'm already enrolled in AIMS Seminar and I am finding it to be the single most influential and empowering course I have. The course is opening doors and ideas I never even thought about. I now realize how obtainable my career goal can be if I get the right assistance. The AIMS program is that assistance I need."—**2004 AIMS cohort member**
4. Peer teaching and learning (STARS): "The STARS room really gives us a place to meet to study together and socialize. Not only do we have the computers for email and reports, the room gives us a sense of belonging. It's not just about studying together, teaching and learning from each other."—**2003 AIMS cohort member**
5. Faculty/student mentoring program: "I like the mentor program. By getting paired with a professor in your major, you get advice on the do's and don'ts from someone

who has already gone through the process."—**2002 AIMS cohort member**

6. Undergraduate research: "Although I have only been in the laboratory for one week, this research experience is tremendous. I have learned so much: about radiation, chromophores and fluorescence in one week. It's nice being around real scientists and doing real chemistry. Now I know why I have chosen chemistry as my major."—**2003 AIMS cohort member**
7. STEM Exposures: "It's nice to have the option of going to various events related to our majors, but we get to choose which ones and we meet new people. Dr. Mae Jemison's session was great. She is so accomplished and what an inspiration!"—**2003 AIMS cohort member**
8. One-on-ones: "Often these sessions seem to be a waste of time for me. I feel totally in control of campus life."—**2003 AIMS cohort member**

Although these statements are from the individual AIMS Scholars, it can be inferred that other cohort members would hold similar opinions of the positive effects of elements of the program. These elements were designed to encourage academic excellence, interest in long-term STEM commitments, graduation and graduate work. More information about the program, its guidelines, regulations and policies and the AIMS Handbook can be found at www.bgsu.edu/aims.

Program Findings/Outcomes and Discussion:

Five aspects of the AIMS program are being assessed: success in math, GPA, semester credit hours (SCH), retention and graduation rate. Because the pilot year cohort (2001) did not incorporate all the elements described here, that cohort is not included in this assessment.

Success in mathematics courses is a key to success in STEM majors. Adelman (1991) reports that students who take and succeed in challenging math courses in high school and college have higher graduation rates.

A positive correlation between the achievements of AIMS Scholars in their summer math class and the ensuing first fall semester GPA's was found. Students received a final grade in the 5-week course based upon their number of points accumulated on a 100-point scale. Fall, semester-1, grades (0- 4 point GPA scale) were

plotted versus the students' summer math course scores (0-100 point scale). For the 2002 AIMS cohort, that correlation is shown in Figure 1. As displayed there, fall GPA's increase as summer math scores increase. The following linear regression equation expresses that correlation as: $y = mx + b$, where y is Semester-1 GPA, x is summer math score; m is 0.044 and b is -0.68 . The Pearson correlation value is 0.704 and the p -value is 0.002. A similar correlation was found for the 2003 cohort with the regression analysis expression being: $y = 0.050(x) - 1.2$, with a Pearson correlation value of 0.601 and a p -value of 0.011 for the 2003 cohort.

BGSU's Office of Institutional Research has tracked the GPA's, retention and SCH accumulated for AIMS cohorts versus BGSU control cohorts. The control groups are BGSU at-large students who have essentially the same high school academic profiles and demographics of the AIMS groups. See Table 2 for data on the AIMS 2001-2005 cohorts.

In scrutinizing the important first semester college grades of cohorts, we found that the AIMS cohorts were out performing the control groups. This better performance started the first semester and continued in subsequent semesters. Several factors are noteworthy. AIMS Scholars received about 65% A's or B's in their first semester math courses. No AIMS Scholar received an F in their fall math class. For overall grades distribution, AIMS cohorts received ca. 62 % A's or B's, whereas the controls received only 38%. See Table 3 for the distributions of grades for the 2002-2003 AIMS versus control cohorts.

The 2002-05 AIMS cohorts had average first semester GPA's of ca. 3.1. Those respective GPA's were: 2.9, 3.2, 3.0 and 3.3. 2002-2005 control groups had average GPA's of ca. 2.6. The control groups had average GPA's of 2.1, 2.4, 2.8 and 2.9, respectively.

We have monitored the GPA's of all the AIMS cohorts and their control groups over time. In effect, we have found that individuals and cohorts establish levels of achievement the first semester and tend to sustain those levels. Students' first semester GPA's are often excellent indicators as to how they will perform over time. Graphically, this is demonstrated in Figure 2 for the 2002 AIMS and control cohorts over a 7-semester period. The average and fairly consistent delta GPA is 0.5 with the AIMS group performing better.

Indicators of plausible losses from the STEM

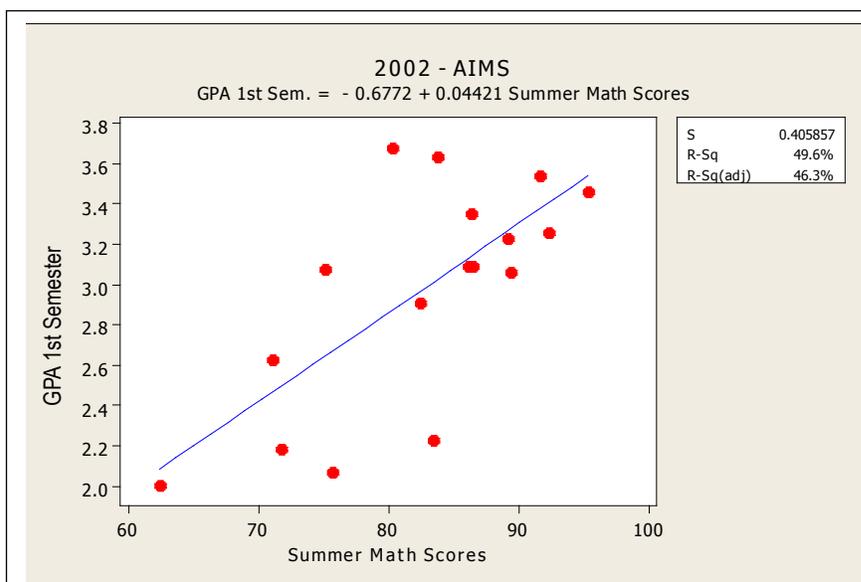


Figure 1. Correlation of Summer Math Scores to Semester-1 GPA's of 2002 AIMS Cohort

disciplines are shown as early as the first set of exams in the first semester math/science courses. During semester one, students entertain a decision to shift away from STEM areas, or change academic interests, due to perceived or real failure in math and science. Some will persist in their chosen majors into semester two (spring semester) by retaking a course that they dropped or received an F or D grade in the preceding fall. If they do not succeed in semester two, they often will change majors, and are forever lost from these STEM fields. During the five years of AIMS, we have observed this early withdrawal from the STEM curriculum of students who performed marginally in math and science the first semester and/or first year.

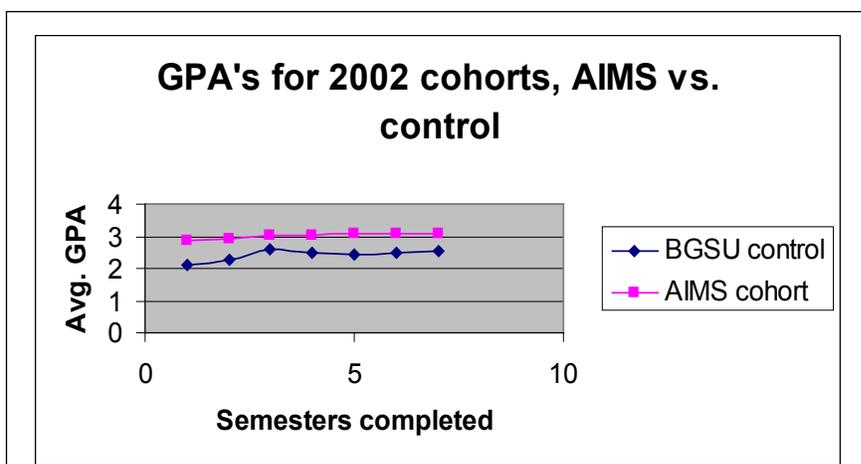


Figure 2.

In monitoring the retention of students, one can track either:

1. Retention at the University, or
2. Retention at the University and still in STEM fields.

For the 2002-2005 cohorts, AIMS Scholars have been retained at the University and in STEM fields at a rate of about 90%. After seven semesters, 88.9% (16 of 18), of the 2002 cohort members are still at BGSU and still in STEM-based disciplines. For the 2002 control group only 72.2% are still at BGSU. We are not certain as to what percentage of that 72.2% is still in STEM disciplines. Retention results are summarized for the 2002-2004 cohorts in Table 4.

Progress toward graduation and graduation rates are important program outcomes. At each semester juncture, we have found the AIMS cohorts (2002-2004) are progressing toward graduation faster than their respective control groups. Progress toward graduation is substantiated by examining the semester credit hours (SCH's) earned. See Table 5, where SCH's earned per semester for the 2002 cohorts after seven semesters, the 2003 cohorts after five semesters, and the 2004 cohorts after three semesters are reported. After seven semesters, the 2002 cohort had earned an average of 113 SCH's as compared to only 99 for the control group. On average it takes 122 hours to graduate. Thus, several AIMS 2002 cohort members were well positioned to graduate in eight semesters, or four years, by only taking another 9 hours if the proper set of course requirements are met. After seven semesters, 2002 control cohort members needed, on an average, 23 more hours (122-99) to graduate. Thus, during the spring of 2006, projections are that 2002 control students will need about nine semesters, versus eight semesters for the AIMS 2002 cohort, to graduate.

Lastly, via the mentoring program, pairings of each student with a faculty member were initiated during the 5-week Summer Bridge Program. Several of those pairings ultimately lead to AIMS Scholars doing undergraduate research with their assigned mentors. Among the 78 student members in the 2002-2005 cohorts, 16, or 20.5%, of the members have performed either academic year and/or summer undergraduate research. Several poster sessions and oral presentations have been given at local and regional meetings. To date, one student's work has resulted in a full publication (Connolly, 2005). His work was funded by an NSF Louis Stokes Alliance for

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In summary, the BGSU AIMS program has demonstrated success in the intended areas of improved GPA's versus control groups, good retention, improved progress toward graduation as measured by SCH's and graduation rates. Sixty-seven percent (67%), 12 of 18, of the original 2002 AIMS cohort graduated in four years. We project that 89%, 16 of 18, of the 2002 AIMS cohort will graduate in five years.

Conclusions:

Based on the present studies, the following conclusions can be drawn:

1. AIMS components, such as the 5-week Summer Bridge Program, STEM Exposures, AIMS Seminar, STARS peer teaching/learning, undergraduate research, faculty/student mentoring, help build a support system and encourage students to remain in STEM-based disciplines, strive for/achieve academic excellence, graduate, and seriously consider graduate study.
2. The 5-week Summer Bridge Program assists students in doing well in their first semester of matriculation.
3. Student performance in math during the Summer Bridge Program positively correlates with first-semester overall GPA
4. More AIMS Scholars obtain 3.0 GPA's (ca. 65% for AIMS cohorts versus ca. 38% for the control cohorts) their first semester of college than the BGSU control cohort students.
5. The level of academic achievement demonstrated in the first semester is often sustained long-term. The way students start their college career often indicates how they will finish.
6. Retention of AIMS Scholars after the first semester and subsequent semesters is better than the comparison groups (groups from national NSF statistics and internal BGSU control groups).
7. After the first year, ca. 92% of AIMS Scholars (2002-2004 cohorts) are retained at BGSU and in STEM-based disciplines versus ca. 63% retention of STEM majors from comparison "selective" colleges (colleges like BGSU, student admits with similar average ACT/SAT scores across the country).

8. At each junction point (after each semester), AIMS Scholars show better retention at the University than their control cohort members.
9. AIMS Scholars progress faster toward graduation, i.e., accumulate more hours, than control cohort students. On an average, they are slated to graduate in eight semesters versus nine semesters for control members.
10. Graduation rates of AIMS Scholars are higher than BGSU comparison groups and national comparison groups, as indicated by the 67% four-year graduation rate of the AIMS 2002 cohort

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Key words: STEM, retention, math and science, graduation rates, underrepresented minorities and women, doctoral degrees in STEM, summer bridge program

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