Research Experiences program for Undergraduates in an Historically Black college and University.

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Abstract

Involving undergraduate students in research has been recognized as a method of developing the intellectual capacity of undergraduate student. This paper reports operation, achievements and challenges of a Science Engineering and Mathematics (SEM) Summer Research Training program, which has been in operation for over seven years at Morgan State University. The objective of this program are to (a) increase the number of students who participate in undergraduate research; (b) enhance student’s learning and commitment to their studies; (c) increase the number of students attending graduate schools; (d) and provide students with professional development training. Two hundred and thirty eight (238) students have participated in the program since its inception. Out of the ninety-two participants since 1999 over 18% have gone on to graduate school.

Introduction

National concern have been expressed about the status of the U. S. science and engineering base-specifically the human talent, knowledge and infrastructure that generate innovations and under gird technological advances to achieve national objectives. Analyses have shown that there may be a significant shortage in the entry-level science and engineering labor pool, and that scientific and technical fields could be significantly affected. Demographic data show a future with proportionately fewer young people and a work force comprised of growing numbers of minorities and the economically disadvantaged. These groups, which the economy must increasingly rely, have been historically underrepresented in science, engineering and related fields. The added dimension of a projected shortage of qualified science and mathematics instructors at the pre-college and undergraduate levels could have serious consequences for the nation’s scientific and technological literacy and, therefore for our capabilities to compete economically with other industrialized counties. In 1990 less than 2% of the Science Engineering and Mathematics (SEM) workforce hailed from the African-American community. While African-Americans Hispanic/Latinos and American Indians comprise 23% of the U.S. population, they make up only 4.5% of those holding scientific doctorates. In a report to the Maryland Higher Education Commission in March 1992, the Task force on Engineering Education wrote, “The representation of Africa-American almost disappears at the graduate level, with only 3% of all Maryland master’s degrees granted in 1990 going to African-Americans. There are no doctorates awarded to African-Americans”.
Based on these facts a proposal with the specific objective directed at increasing the number of minority graduates prepared to effectively contribute to the U.S. SEM workforce was submitted by Morgan State University (MSU) to the Department of Defense to establish the Infrastructure Support Education Program (ISEP), National Science Foundation (NSF) and Office of Naval Research (ONR).

Morgan State University is a Historically Black College and University (HBCU), located in Baltimore, Maryland and enrolling over 6600 students. In 1988, Morgan was designated as Maryland’s Public Urban University, addressing the needs of the residents, schools and organizations of the Baltimore Metropolitan area. Morgan’s mission is consistent with its designation and one component of its mission is “to enroll an undergraduate student body that is diverse in its socioeconomic characteristics and its Pre-College academic preparation. It is to educate a broad range of students, including those who are among the best prepared as well as those who might not obtain the baccalaureate without the extra support that the University provides.” The University has a rich history in the sciences and has “attained national eminence among historically black institutions, especially for the production of African-American engineers,” according to the Maryland Higher Education Commission (MHEC) “Educating For the 21st Century: The Maryland Plan for Postsecondary Education.”

In 1993 Morgan State University was funded through the Office of Naval Research’s (ONR) Infrastructure Support Education Program (ISEP) for multifaceted intervention and outreach programs with Dr. P. Mack as the principal investigator. This grant was implemented in order to strengthen and integrate the University’s science, engineering and mathematics (SEM) projects and initiatives directed at increasing the number of minority students who graduate prepared to effectively contribute to the SEM workforce. The primary objectives of the program were to:

1. To double the number of SEM degrees awarded to African-Americans from 140 to 280 in three years and to triple them in five years.
2. To achieve this by increasing the first and second year retention rates of SEM majors from 75 to 85% (1st year) and 60–80% (2nd year) respectively
3. To maintain a 30% graduate school going rate for SEM graduates. The number which is about 10% percentage points above the National average, should have a significant impact on future industries leaders and SEM faculty
4. To increase the number of graduates in each of the SEM majors offered so as to become the largest per capita producer of African-Americans receiving the degrees in each of the fields in the MSU curriculum base.
5. To raise two year retention rate in Engineering from 1993 rate of 60% to 80% in 1996
6. To raise the number of engineering degrees awarded from 50 in 1993 to 80 in 1996
7. To graduate students from a program that incorporates a more applied, product-oriented curriculum.

The programs were divided into semi-distinct components; namely Pre-College, Enrichment and Support, Undergraduate Researcher/Trainee Opportunities and Faculty Development. In pursuit of the third objective the SEM Summer Research / Trainee program was started in 1994 to provide financial support to Morgan State University underrepresented minority students in science, engineering and mathematics the opportunity to gain research experience by allowing them under the supervision of a faculty member or professional scientist mentor at an industrial, governmental or
university laboratory site. The objectives of this program are:

- To increase the number of students who participate in undergraduate research.
- To enhance students’ learning and commitment to their studies.
- To increase the number of students attending graduate schools.
- To provide students with professional development training.

Research in the undergraduate engineering curriculum remains a significant contributor to the educational preparation of new practitioners for an increasingly complex technical society. Continued specialization is needed to provide the basic foundations of new and emerging technologies. It is therefore, important to modify curricula continuously to incorporate more applied, product-oriented programs while maintaining the concepts of basic science, mathematics and engineering sciences. It is also important to periodically refocus the research paradigm. Today, that means a shift towards the nation’s domestic welfare needs as well as global economic competitiveness. The engineering research programs at MSU have a discipline-based focus in various sub-specialties in civil, electrical and industrial engineering. However, increasing attention is being paid to cross-disciplinary studies. Our undergraduate research agenda includes increased emphasis on applied topics, including total quality management, design for manufacturing, and continuous product/process improvement with attention to client satisfaction, environmental considerations, and global economics.

During the first year, ISEP funds in this category were mainly used to support undergraduate research and traineeships at Morgan, although through ISEP interventions, there were students placed in REU (Research Experience for Undergraduate) programs at other Universities and Industrial labs with little to no matching from ISEP. A total of 20 students were supported and assisted with travel, housing and/or a stipend.

### Table 1 Academia, Industry and Government Agency Participants

<table>
<thead>
<tr>
<th>Participating Universities</th>
<th>Participating Industries</th>
<th>Participating Government Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUNNY Binghamton, University</td>
<td>John Hopkins University Hughes Space Center</td>
<td>Polygram Group Distributors New York Department of Health</td>
</tr>
<tr>
<td>University of Wisconsin</td>
<td>University of Virginia TRW John Hopkins Hospital</td>
<td>Department of Defense (DOD)</td>
</tr>
<tr>
<td>Carnegie Mellon</td>
<td>University of Florida EDS</td>
<td>Bell Atlantic National Aeronautical Space Administration (NASA)</td>
</tr>
<tr>
<td>MIT</td>
<td>Princeton University GTE</td>
<td>NYMA Water Quality Management</td>
</tr>
<tr>
<td>University of Baltimore</td>
<td>University of South Carolina Clorox</td>
<td></td>
</tr>
<tr>
<td>University of Illinois</td>
<td>Morgan State University Booz Allen &amp; Hamilton</td>
<td></td>
</tr>
</tbody>
</table>

During the second year, thirty-nine students were funded. There were a variety of internships funded, particularly at industrial sites. More participants were partially supported who worked in industry. Since housing cost varies from state to state and some states like California, Northern Virginia and New York can have exorbitant costs,
the students’ housing was subsidized in some instances. Table 1 provides a summary of the numerous university, industry and governmental locations which participants of this program were located ⁴.

In 1996, the Summer Science Engineering Mathematics (SEM) Undergraduate Research/Trainee program was established at Morgan with the same objectives. The average number of participants in the SEM Summer Undergraduate Research program was twenty-six for the first four years but the number has decreased as a result of decreased funding. Table 2 provides a summary of the number of participants over the duration of the program. Although the number decreased, more financial support was provided to students in academic settings. In many cases, students were fully funded.

### Table 2. SEM Undergraduate Internship/Trainee Program

<table>
<thead>
<tr>
<th>Year (Summer)</th>
<th># of Participants</th>
<th>MSU</th>
<th>Univ. (Other)</th>
<th>Industry</th>
<th>Government</th>
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<tbody>
<tr>
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<td>14</td>
<td>4</td>
<td>2</td>
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<td>2003</td>
<td>11</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>238</strong></td>
<td><strong>166</strong></td>
<td><strong>22</strong></td>
<td><strong>43</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>

### Description of the Program

The SEM Undergraduate Summer Research/Training program is a ten-week long. The participants are selected based on the following eligibility criteria:

- Underrepresented minorities who are US citizens
- Full-time student during the academic year
- At least a sophomore (25 credits or more by the end of Spring 2001 semester)
- Minimum CUM GPA of 3.0 (exceptions may be made based on the review of the applicant’s last coursework and faculty recommendation)
- Show significant interest in research and participating in ongoing research.

The financial support depends on the student’s academic classification. Seniors and juniors are awarded $5000 and $4000 for rising sophomores over the 10-week period. This includes a research stipend of $3500 for juniors and seniors and $2500 for sophomores, and a $1500 allotment toward room and board for resident participants.

Students are required to abide by the following regulations:

- Students selected for the program may NOT enroll in summer courses.
- Students may NOT work at any other employment during the course of the program.
• Each student will be required to participate in the research training, and attend and
give technical presentations throughout the program.
• Participants will be required to submit weekly journals.
• Each student will be required to prepare a written and oral final report describing the
results of her/his research.
• Each student is required to participate in the research symposium once a week prior to
the end of the program.
• Students not living in close proximity to the University must live on campus. On
campus housing will not be provided for students living close to the University,
unless there are extenuating circumstances.

The program is divided into two phases is shown in Table 3. The first phase, which
lasts 1-2 weeks, includes a series of lectures on research methodology, technical writing
(e.g. proposals, reports and papers), keeping research records in journals and effective
communications. Each student presents a proposal of his/her research project during the
professional Development Activity (PDA). The second phase, which lasts 8-9 weeks,
involves students working on the projects under faculty supervision; weekly meetings
also take place during which participants report on the progress of their research (PDA
II). The titles of the projects worked on by participants since 1999 are listed in Table 4.
The program ends with a one-day symposium during which students give either an oral
presentation or a poster presentation. Professionals from the funding agencies and other
governmental agencies attend the symposium. In 2001 the symposium was jointly
organized with the Washington Baltimore Hampton Roads- Louis Stokes Alliance for
Minority Participation (WBHR-LS AMP) with students from Bowie State University,
Hampton University, Howard University, Norfolk State University, and University of
District Columbia, Virginia State University presenting papers.

Table 3. 2003 SEM Summer Research Program May 27 – August 2, 2003

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Activities</th>
<th>Time/Room Assignment/ Coordinator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>May 27, 2003 Tuesday</td>
<td>Participants staying in the Hall of Residence arrive.</td>
<td>9:00 AM /Check-in Male Pete Rawlings Hall; Female Harper/Tubman</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reception and Welcoming SEM Participants &amp; Faculty- Mentors.</td>
<td>2:00 P.M./MEB 122/ M &amp;O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduction to The Program by Dr. P. Leigh-Mack (PI);</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>May 28, 2003 Wednesday</td>
<td><strong>Effective Communication.</strong></td>
<td>9:00 AM – 12:00 Noon MEB 122/W All Afternoon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meeting with mentors</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>May 29, 2003 Thursday</td>
<td>Meeting with Mentors</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>May 30, 2003 Friday.</td>
<td><strong>Effective Communication</strong></td>
<td>9:00 AM – 12:00 Noon MEB122/W</td>
</tr>
<tr>
<td>Date</td>
<td>Day</td>
<td>Event Description</td>
<td>Time</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>June 2, 2003</td>
<td>Monday</td>
<td>Effective Communication: Meeting with Mentors</td>
<td>9:00 AM - 12:00 Noon</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>All Afternoon</strong></td>
</tr>
<tr>
<td>June 3, 2003</td>
<td>Tuesday</td>
<td>Meeting with Mentors; PDA II Discussion of Proposal</td>
<td>All Morning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6:30 PM – 8:30 PM/ O</td>
</tr>
<tr>
<td>June 4, 2003</td>
<td>Wednesday</td>
<td>PDA II Discussion of Proposal</td>
<td>6:30 PM – 8:30 PM/ O</td>
</tr>
<tr>
<td>June 5, 2003</td>
<td>Thursday</td>
<td>PDA II Discussion of Proposal</td>
<td>6:30 PM – 8:30 PM/ O</td>
</tr>
<tr>
<td>June 6, 2003</td>
<td>Friday</td>
<td>Effective Communication</td>
<td>9:00 A.M – 12:00 P.M</td>
</tr>
<tr>
<td>June 9, 2003</td>
<td>Monday</td>
<td>Proposal Due</td>
<td>12:00 Noon</td>
</tr>
<tr>
<td>June 10, 2003</td>
<td>Tuesday</td>
<td>PDA III Technical Paper Presentation</td>
<td>6:30 PM – 8:30 PM</td>
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<tr>
<td>June 11, 2003</td>
<td>Wednesday</td>
<td>PDA III Technical Paper Presentation</td>
<td>6:30 PM - 8:30 P.M</td>
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<tr>
<td>June 13, 2003</td>
<td>Friday</td>
<td>Journal Due</td>
<td>12:00 Noon</td>
</tr>
<tr>
<td>June 18, 2003</td>
<td>Wednesday</td>
<td>PDA III Technical Paper Presentation</td>
<td>6:30 P.M - 8:00 P.M</td>
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<tr>
<td>June 20, 2003</td>
<td>Friday</td>
<td>Journal Due</td>
<td>5:00 P.M</td>
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<tr>
<td>June 25, 2003</td>
<td>Wednesday</td>
<td><strong>First Draft of Report Due (Introduction, Background, Bibliography)</strong></td>
<td>5:00 P.M</td>
</tr>
<tr>
<td>June 27, 2003</td>
<td>Friday</td>
<td>PDA II Discussion of Report. Journal Due.</td>
<td>6:30 P.M - 8:00 P.M</td>
</tr>
<tr>
<td>June 30, 2003</td>
<td>Monday</td>
<td>PDA II Discussion of Report</td>
<td>6:30 P.M - 8:00 P.M</td>
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<tr>
<td>July 2, 2003</td>
<td>Wednesday</td>
<td><strong>Preliminary Title Due</strong></td>
<td>12:00 Noon</td>
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<tr>
<td>July 4, 2003</td>
<td>Friday</td>
<td>Journal Due</td>
<td>12:00 P.M</td>
</tr>
<tr>
<td>July 7, 2003</td>
<td>Monday</td>
<td>PDA III First Presentation of Project (Group I)</td>
<td>6:30 PM – 8:30 PM</td>
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<tr>
<td>July 9, 2003</td>
<td>Wednesday</td>
<td>PDA III First Presentation of Project (Group I). Journal Due</td>
<td>6:30 PM – 8:30 PM</td>
</tr>
<tr>
<td>July 11, 2003</td>
<td>Friday</td>
<td>PDA III First Presentation of Project (Group I). Journal Due</td>
<td>6:30 PM – 8:30 PM</td>
</tr>
<tr>
<td>July 14, 2003</td>
<td>Monday</td>
<td>PDA III First Presentation of Project (Group, II)</td>
<td>6:30 PM – 8:30 PM</td>
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<tr>
<td>July 16, 2003</td>
<td>Wednesday</td>
<td>PDA III First Presentation of Project (Group, I)</td>
<td>6:30 PM – 8:30 PM</td>
</tr>
<tr>
<td>July 18, 2003</td>
<td>Monday</td>
<td>PDA III First Presentation of Project</td>
<td>6:30 PM-8: 30 P.M.</td>
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</tbody>
</table>
Profile of Students

The profiles of students that have participated in the program in the last four years are shown in the tables 5 & 6. Fifty three percent of the students who have participated in program over the past five years were male, twenty five percent were sophomore, 42% were juniors and 33% were seniors. Two percent of the students that have participated in the program in the last five years were from the civil engineering department, 87% were from the electrical and computer engineering department, 5% from industrial manufacturing and information engineering, 3% from Engineering Physics department, 3% from computer science department, 1% from mathematics department and 12% from the biology department.

Table 4. Title of Students’ Project

<table>
<thead>
<tr>
<th>Year</th>
<th>Science Project</th>
<th>Engineering Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5. Implementing The Effects Of Inelastic Behavior Into A Seismic Structural Analysis Program.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Digital Design Using Field Programmable</td>
</tr>
</tbody>
</table>
3. The Binding Characteristics Of P-Aminobenzoic Acid To Sulfanilamide.  
4. Determining The Function Of The Refusum Diseases Gene In The *Caenorhabditis elegans*...  
5. Polymerase Chain Reaction For The Detection of *Wuchereria bancrofti* in Urban Anopheles And Culex Mosquitos From Ghana.  
6. The Development of *Caenorhabditis elegans* Mutant Strain dpy-5fer-1.  
7. The Effects Of Sleep Deprivation On The Body Composition Of Rats.  
8. The Effects Of Sleep Deprivation on Stress Activated Protein Kinase (SAPK) Activity.  | Logic Devices.  
11. Implementing A Virtual Office for Website Development.  
13. Target Identification Using A Multiplayer Neural Network  
15. The Design of a Fourth Order Butterworth Bandpass Filter from a lowpass Prototype.  
<table>
<thead>
<tr>
<th>Year</th>
<th>Title</th>
<th>Title</th>
<th>Title</th>
</tr>
</thead>
</table>
| 2001 | 1. Assessing the Water Quality of the Patapsco/Back River Watershed to increase Public Awareness of the Impacts of land-use on Chesapeake Bay Tributaries  
2. Development of Students Understanding The Function Concept.  
3. Effects of Early Stressors on Abnormal Cortical Development.  
4. Effects of Early Stressors on Behavior Resulting from Plasticity in Mouse Cortex.  
3. 4-Bit Analog to Digital Converter.  
4. Design and Development of Data Logger to Monitor Bacteria.  
Modifying The (Rc, Crf) Branch To Result In Optimal Performance Of The Angelov Model  
7. The Development of a Field-Effect Transistor (FET) Small Signal Model Using TOTEX and DTEP  
8. The Development of a Small-Signal Model to be used in the Development of a Broadband Amplifier.  
9. The Study of Object-Oriented Modeling for Use in Developing Model Based and Executable Requirements.  
10. Using Neural Networks to Incorporate Scaling Techniques to Predict I-V Curves for FETs. | For A High Electron Mobility Transistor. (HEMT) Device. | |
2. Application to Air Quality Control of A Novel Quantitative Pyrogen Assay Based on IL-1beta Production by Human Blood  
3. Characterization Of The Biological Function Of Three Expressed Genes In Caenorhabditis Elegans.  
4. Methods For Detecting and Handling NEW Operator Memory Allocation Failures In C++.  
5. Multi-Variant Chemometric Analysis of Major Blood Components.  
6. Selection of Polymer Substrate As a Basis for a Fluorescence Resonance Energy Transfer Biological Sensor. | 1. A Haptic Computer Interface for the Blind and Visually Impaired.  
2. Implementation Of A User-Defined Field Effect Transistor (FET) Model In A Class A Amplifier.  
4. The Refurbishing of An Automatic Thermal Annealer and An Evaporator.  
5. The utilization of A Neural Network Model To Design solid State Power Amplifier Which Will Produce A Maximum Power Output At 10Ghz.  
| 2003 | 1. Interactive Tutoring And Question Answering Systems For Closed Databases.  
2. Development Of A Tutorial For Basic Circuit Analyzes Utilizing MATLAB.  
3. Implementing The Effects Of Inelastic Behavior Into A Seismic Structural Analysis Program.  
4. The Use Of Mutual Information For Image Registration Of Ophthalmic Images. | |

Table 5. Profile of Students

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Males</th>
<th>No. of Females</th>
<th>Sophomores</th>
<th>Juniors</th>
<th>Seniors</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>1999</td>
<td>14</td>
<td>14</td>
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<td>39</td>
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<td>92</td>
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Table 6. Students Profile by Discipline

<table>
<thead>
<tr>
<th>Year</th>
<th>CE</th>
<th>ECE</th>
<th>IMIE</th>
<th>Chemistry</th>
<th>Eng. Physics</th>
<th>Computer Science</th>
<th>Math</th>
<th>Biology</th>
<th>Total</th>
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<td>2</td>
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<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>56</td>
<td>5</td>
<td>11</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>11</td>
<td>92</td>
</tr>
</tbody>
</table>

CE: Civil engineering, ECE: Electrical and Computer engineering; IMIE: Industrial Manufacturing and Information engineering;

Program Evaluation

On the last day of the program, participants are afforded the opportunity to evaluate the program. They are provided with an evaluation form covering topics such as comments relative to the content, schedule, instruction, interaction with mentors and directors and any comments they considered pertinent to any aspect of the program. Recommendations for future programs are also requested. A summary of the student’s response is presented in Table 7. Some of the comments have been addressed in subsequent programs. For example the time spent on professional development have been reduced to one week so that most of the remaining nine weeks are devoted to research activities.

Table 7. Student’s Evaluation of Program

A. Research project Organization and planning:
1. Student’s Strongly Agreed that the mentors explained research Requirements.
2. The Students Strongly agreed that their mentor’s participation was evident.
3. Students agreed that the Mentors used their time well.
4. Student’s strongly agreed that their mentors were helpful.

B. Communications:
5. Student’s Strongly Agreed that their mentor’s instructions were clear.
6. Student’s Strongly Agreed that their mentor’s examples were clear.
7. Students Agreed that their mentor’s use of challenging questions and/or problems was useful.
8. Student’s Strongly Agreed that their mentors showed enthusiasm for the research project.

C. Mentor/Mentee Interaction:
9. Student’s strongly agreed that their mentors were helpful and responsive.
10. Students strongly agreed that their mentors were respectful.
11. Students strongly agreed that their mentors were concerned for their progress.
12. Students strongly agreed that their mentors were willing to listen to the students’ ideas and opinions.

D. Research Project Outcomes:
13. Students strongly agreed that they learned a lot from the project.
14. Students strongly agreed that they made progress toward achieving research goals.
15. Students Agreed that their interest in research had increased.
16. Students strongly agreed that the research actively involved them in what they had been learning.

E. Student effort and Involvement:
17. Students strongly agreed that they put effort into their research projects.
18. Students agreed that they were prepared for each research meeting.
19. Students Strongly Agreed that they were challenged by the research.

F. Research project Difficulty and Workload:
19. On a Scale of 1-5, students rated the level of difficulty of the research as 1.571, with 1 being the most difficult and 5 being the least difficult.
20. Students agreed that the workload for the project was appropriate.

G. Overall Evaluation:
21. On a Scale of 1-5, with 1 being the best and 5 being the worst, the students rated the quality of instruction/assistance in the project as 1.429

H. Pre-Research Preparation:
22. Students agreed that the research methodology lectures were useful.
23. The students agreed that the Effective Communications Skills lectures were useful.
24. The students Strongly Agreed that the time devoted to pre-research preparation was adequate.
25. On a scale of 1-5, 1 being the best and 5 being the worst, the students rated the quality of the instructors as 1.571

I. Future Goals:
26. All the students plan to attend Graduate School.

J. Presentation Skills:
27. Students mentioned an improvement in their
   - Presentation Skills,
   - Information gathering skills, and;
   - Scientific Research and Writing

K. Student Comments:
28. During the program, Students Enjoyed
   - Working with their Mentors
   - Giving Presentations
   - The feeling of doing something Worthwhile
   - Meeting stimulating people
   - Exploring their fields, and
   - Learning productive skills.
29. Students Disliked:
- The issue of how small errors could greatly set back the research process
- All the meetings they were required to attend during the program
- They did not get a chance to celebrate the success of the program

30. Students believed that the program could be improved by:
- lessening the intervention of the research
- More useful meetings
- More meeting between the students to enable networking
- more Presentations
- More leisure Activities
- Better organization
- Assignments should be well explained beforehand to eliminate redundancy
- Directors should be on one accord with regard to expectations from the students.

Program Administration
The program is administered by a program director that is a faculty and an administrative assistant who is a staff or student. The program director for 1999, 2000, 2002 and 2003 has been Dr. Oguntimein while Professor Davy was the director in 2001. The administrative assistants were Ms Lila Curry 1994-1999, Elisha Duggins 2000, 2001, Adekunbi Adeyemo 2002 and Autumn Wallace 2003.

Pursuit of Graduate Studies
Seventeen participants have gone on to pursue graduate studies at Morgan state University, Howard University, University of Maryland Baltimore, George Mason University. Eight of these students are female and nine are male. Three are biology majors, three chemistry majors, one computer science major and ten electrical and computers engineering majors (Table 8).

Table 8. Number of SEM Participants in Graduate Schools

<table>
<thead>
<tr>
<th>CE</th>
<th>ECE</th>
<th>IE</th>
<th>Biology</th>
<th>Chemistry</th>
<th>Computer Science</th>
<th>Eng. Physics</th>
<th>Mathematics</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>10</td>
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<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>17</td>
</tr>
</tbody>
</table>

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Conclusion
The number of participants has decreased as a result of reduced funding. The program did provide the opportunity for undergraduate students to participate in research directed by a faculty member. The activities included in the program such as maintenance of a journal, instruction in effective technical writing and a series of sessions to improve the quality of presentation of their research results certainly were in keeping with the objectives of the program enabled frequent interaction with mentors. Perhaps the best way to assess the effectiveness of the program is to analyze the comments of the participants. It is clear from these comments that the participants valued the opportunity to perform and to present their findings in a forum of their peers, mentors and the wider

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academic community. One persistent comment was that the program should be extended from 10 to 12 weeks to give participants more time to round out their research efforts. Whereas some participants felt that aspects of the program could have been better organized or delivered, the prevailing sentiments suggested that they benefited very positively from the experience. In addition one of the feedback from the participants is that they have gained research and technical experience under the supervision of a faculty member, which has kindled their interest in pursuing graduate studies.

Based on data collected on graduate school enrolment eighteen percent of the students' who have participated in the program since 1999 have pursued graduate studies in universities the Maryland and Virginia states which is also one of the objectives of the program.

Acknowledgement
We would like to acknowledge the National Science Foundation and the Office of Naval Research for supporting the SEM summer Research/training program.

References

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Gbekeloluwa Oguntimein is an Associate Professor in the Department of Civil Engineering at Morgan State University in Baltimore. He is the Director of the Science Engineering and Mathematics Research Trainee program funded by The Office of Naval Research (ONR) and National Science Foundation in 2000, 2001, and 2003. Dr Oguntimein received his B.S. and Ph.D. degrees in Chemical Engineering from Iowa State University in 1974 and 1979 respectively

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Pamela Leigh-Mack is an Associate Professor and Chair of the Department of Electrical and Computer Engineering at Morgan State University. She is the Principal Investigator of the Infrastructure Support Education Program funded by ONR, which sponsored the SEM Undergraduate Research Program for several years. Dr. Leigh-Mack received her B.S. degrees in 1980 in mathematics and electrical engineering from Virginia Union University and Howard University, respectively. She received a master’s degree in electrical engineering from Howard University in 1982 and a Ph.D. in 1991 from the University of Delaware.
Bert Davy
Bert Davy is a lecturer in the Department of Civil Engineering. He was the Director of the Science Engineering and Mathematics Research Trainee program funded by The Office of Naval Research (ONR) and National Science Foundation (NSF) in 2002. Bert Davy received his Masters in Civil Engineering from University of Maryland College Park in 1984 and presently working on his Ph. D, here at Morgan State University.

John Wheatland
John Wheatland is the Director of Freshman Programs for in the School of Engineering. He has conducted the Effective Communication Workshops for SEM Summer Research Program since its inception. Dr. Wheatland earned a Bachelor degree in Electrical Engineering from the City College of New York in 1972, a Master of Science in Electrical Engineering degree from the University of Bridgeport in 1974, and an Ed. D. in Education Administration from Morgan State University in 2000.