Annual Report

Building Affinity Groups to Enable and Encourage Student Success in Computing

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Abstract

The affinity group concept and model provides an innovative way of structuring research groups that involve undergraduate and graduate students. Built on a cooperative model, affinity groups include students with a wide range of experiences and skill levels, and provide them with an opportunity to deepen their knowledge in a technical area. Through structured activities, students develop skills and strategies that will make them effective leaders and successful in academia and industry.

1 Introduction to The University of Texas at El Paso

The University of Texas at El Paso (UTEP) is the second oldest academic component of the University of Texas system, and serves a rapidly growing binational and bicultural community. The university is a regional school in which 85% of the students come from El Paso County; 62% of the student population is Hispanic, closely reflecting the cultural composition of El Paso. The students frequently come from families with little disposable income and with greater demands on that income; almost 75% of the students work at least part-time and only 2% live on campus. The average age of the undergraduate and graduate students is 25 and 35, respectively, and almost two-thirds of the students are first-in-their-families college students.

2 Introduction to the Project

The affinity group concept and model provides an innovative way to involve undergraduate and graduate students in research and other technical activities outside of the classroom, and to involve capable students who are not fulfilling their potential. Through methodic and structured activities, students deepen their knowledge in a technical area and develop skills and strategies that will make them effective leaders and successful in academia and industry. It is anticipated that the affinity group experience will instill in many of the students the desire to continue their education and development.

Numerous studies have served as a guide for developing the affinity group concept. Studies show that fewer than one-fourth of the subjects mentioned ability and intelligence as keys to their academic success, but instead rated persistence as the single most important characteristic. The following factors have been identified as important for persistence in school:

- students provide role models for each other,
- faculty and students interact outside the classroom,
- students have settings in which they can competently interact and discuss issues,
- students see continual improvement in their abilities and skills,
- students receive help in clarifying and maintaining their goals, and
- students are involved in their college learning experience.

While these all apply at some level to all students, they are particularly relevant to students like those who attend UTEP. Students learn by becoming involved, and success in learning leads to improved retention of students. This is critical for minority as well as low-income and otherwise disadvantaged students who have been found to be passive in academic settings. It is clear that isolation and alienation are the best predictors of failure. The affinity group concept incorporates mechanisms that address each of the persistence factors. For example, affinity groups provide an atmosphere in which students can become involved and serve as role models for each other, and a platform for students to set and assess personal and group goals throughout their education. A person's own self-worth is raised when a representative of his or her group succeeds by sustained effort. Clearly, this concept provides a "small school" environment at a large, commuter university in a cost effective manner.

3 Goals and Objectives

The *goal of the affinity group project* is twofold: to increase the retention and participation of traditionally underrepresented groups in the computing areas, and to provide the framework that involves these students in activities that include research, curriculum development, support projects, and outreach programs. The *objectives of the affinity group project* include: to provide an environment that supports persistence; to define activities that develop the student's research, technical, group and communication skills; to document and disseminate the infrastructure for creating and managing effective research groups that involves students with a wide range of abilities and experiences; and, to develop a formative evaluation instrument that can be used to provide users with feedback for refining the model.

4 Activities

Currently, there are three affinity groups. The Software Engineering (SEAL) and the Systems (SAG) Affinity Groups reside in the Computer Science Department. Drs. Ann Q. Gates and Dan E. Cooke are the faculty mentors for the SEAL group, and Drs. Andrew Bernat and Patricia Teller are the faculty mentors for the SAG group. The Signal Processing and Communications (SPC) Affinity Group is in the Electrical and Computer Engineering Department under the direction of Drs. Sergio Cabrera and Bryan Usevitch. The affinity groups provide support for existing research grants and for proposal development. While many of the undergraduate students are integrated with graduate or experienced students on research projects, some of the students work on software or engineering projects, and provide technical and curriculum support. Many of the students are active in creating, documenting, and presenting components for existing outreach programs.

In this section, the orientation that was developed for new members of the affinity group is discussed. In addition, the activities and structure of the groups are discussed. Because the activities of the SEAL and SAG groups are closely related, they are discussed in the same subsection.

4.1 Orientation

The Affinity Group Orientation was developed principally because of the dynamic membership of the groups, *i.e.,* members graduate and new members join, and students come to a group with different levels of knowledge and skills that grow at different rates. As a result, it is necessary that new members understand the goals of the affinity group, become familiar with the resources that are available to them, learn the basis of the cooperative paradigm, and become aware of the expectations of the group.

The orientation also provides the established members with an opportunity to renew their commitment to the group and to improve their cooperative group skills. From the faculty leaders' point of view, it facilitates their awareness of members' misgivings and expectations of the affinity group experience. Group processing provides an opportunity to reevaluate the model, its success, and its possible shortcomings.

The annual orientation consists of five components: student and faculty introductions, affinity group philosophy and goals, cooperative skills, research activities and skills, and student and faculty concerns. The orientation models the cooperative atmosphere of the affinity groups and is a valuable tool for maintaining functioning groups.

The first orientation occurred during the Fall 1996 semester. The students completed pre- and post-test self-evaluation questionnaires before and after the orientation. These questionnaires were targeted at assessing the effectiveness of the orientation in increasing student interest in and commitment to the affinity groups, and student levels of knowledge of the affinity group concept, cooperative group skills and research skills. In addition, students were asked to complete an orientation feedback form with respect to what worked well during the orientation and what could be improved.

The evaluation instrument indicated that the orientation was responsbile for increasing student understanding of the philosophy and goals of the affinity groups, knowledge of skills that can be attained by participating in an affinity group, interest in affinity group activities and skills, and commitment to an affinity group. It also was responsible for causing students to recognize their deficiencies in communication and research skills.

4.2 Software Engineering and Systems Affinity Groups

SEAL and SAG members engage in a number of activities that range from weekly group meetings, small group meetings (that are held throughout the semester for students working on related research), outreach development and involvement, and technical seminars. Although the groups worked separately over the past year, many of the activities were coordinated.

At the beginning of each semester, students set personal and research-oriented goals. Each student identifies and documents activities that will help realize his or her goals. In addition, the student writes how the activity will be accomplished, who is involved in the activity, the projected finish date, and appropriate indicators of success. It is critical that the students set distinct milestones on semester-long projects and discuss them with fellow group members to evaluate the feasibility of their goals.

A major feature of the affinity group model is the structured activities that develop the members' technical, communication, research and group skills. The students develop research skills throughout the semester by working with the faculty mentor and by pairing novice with experienced researchers in the group. Several research projects are defined within the scope of an affinity group. Students develop a background in their area of interest by extensive reading and regular project group discussions. A summary of some of the activities follow:

- Technical paper discussions are used primarily to develop the students' technical and group skills. In this activity, a student presents an overview of a paper that has he/she has selected with approval from the faculty mentor. All members of the group are required to read the paper before the discussion. After the overview presentation and a brief question and answer period, students work in cooperative groups to answer a list of questions on the article, gaining a deeper understanding of the concepts and terminology used in the paper. The groups are composed of three students (a mixture of graduate and undergraduate students) and roles are assigned by a predefined scheme. Roles such as idea integrator, answer summarizer, and active participation checker, are discussed before the groups are formed. The faculty mentor facilitates an open discussion of the answers at the end of the group session. The activity ends with group processing.

- Students give presentations on their research to the group prior to giving the presentations at conferences or seminars. The student creates slides and refines them based on peer-review. A students presents a talk on his or her research topic and the audience is asked to critique the presentation based on criteria presented in a form provided to them. This activity teaches constructive criticism, *i.e.,* criticizing the idea and not the person. In addition to hearing a technical presentation, the skill of asking questions is reinforced and the presenter gains experience in answering questions.

- All students are required to write at least one paper by the end of the semester (this may be a paper submitted for publication) that summarizes their work. Each member reads the other members' papers and critiques them using an evaluation form. In this activity, students give 10 minute presentations followed by a question and answer period. The critiques are integrated and discussed with each student who uses them to improve his/her work.

The students in the SEAL and SAG groups are encouraged to work on projects that reach out to high school and junior high school students. This not only educates the students about the issues of retention, but also provides them with an opportunity to serve as role models to others. There is an emphasis on collaboration and leverage with programs that already exist and reusing components that work. The outreach programs in which the students were involved follows:

1. *Expanding Your Horizons* is a program for junior high school girls. The computer science component, developed by the SEAL group, uses graduate and undergraduate facilitators. Each facilitator discusses their experiences, why each chose this field, and the scholarships, internships, co-ops and job opportunities that are available to students in this area. The project that the students developed in the first year of the affinity group involvement is a spin-off of a program from the Women & Science Conference.

2. The *Science and Engineering Expo* provides the community with an opportunity to visit the departments in the Colleges of Science and Engineering at the university. SEAL and SAG members were involved in several computer science components centered around animation, fractals, and the Internet.

3. The *Summer Engineering Enrichment Experience* (SEEE) program consists of six week-long sessions that exposes entering freshmen engineering majors to the professors, students, and buildings of the university as well as involvement in a project in their area of interest. The computer science component exposes students to the Sun machines, the X-window environment and web pages, and to projects that were completed in a variety of Computer Science classes.

4. The *Summer Animation Workshop* is designed to interest high and middle school students in computer science. The workshops focus on involving non-computer-types by using very high-level programming to develop animations. The high-level animation tools requires the participants to logically define a series to steps to attain their goal, *i.e.,* an animation.

5. The *Excellence in Technology, Engineering, and Science* (ExcITES) program involves sophomores, juniors and seniors in high school. The computer science components involve students in robotics, graphics and high-level programming.

4.3 Signal Processing and Communication Affinity Group

Through careful planning and execution, the SPC group was structured to provide identity and effective and efficient routine operation by: (1) introducing a student management structure to assist faculty in overseeing ongoing activities, running the by-weekly meetings and insuring that tasks are completed; (2) creating a group membership electronic documentation system to facilitate the management of the group including tracking all current and past activities, saving data about members, saving meeting records, managing the reference book library, keeping e-mail lists, etc.; (3) defining a system of temporary task forces to carry out needed work for the development and the continuing operation of the group (purchasing, planning a furniture budget, documenting the library references, recruiting new members, etc.); (4) formulating governing by-laws and defining other operational issues such as meeting formats, presentation schedules, rules for laboratory operation and maintenance, membership benefits and obligations including restrictions on the use of facilities, etc.; (5) creating Web pages for the affinity group where all activities and members are described; (6) using brainstorming and questionnaires on a regular basis to steer the direction of the group's structure and goals; (7) purchasing T-shirts for all members, etc.

The physical facilities of the SPC group include two adjacent laboratories, the Real-Time Digital Signal Processing (RTDSP) Laboratory and the Signal and Image Processing (SIP) Laboratory. The space that houses the RTDSP laboratory has been renovated recently.

The accomplishments of the SPC group follow:

1. A new senior level Electrical and Computer Engineering elective course entitled "Applied Signal Processing and Communications" was created and taught for the first time by Dr. Bryan Usevitch during Fall 1996. Most SPC students that completed Senior Projects during this year took this class to get the needed background. This course made use of the MII funded equipment which was purchased to establish the RTDSP Laboratory during year-1.

2. Four Senior projects involving 11 group members have been carried out within the group in CISE areas not previously represented at this institution (real-time Digital Signal Processing and its use in Telecommunications).

3. Research skills development was institutionalized in the SPC group by creating a sub-group of interested students that meet separately on a volunteer basis to expose undergraduates and new graduate students to the process of research, to promote better management of research by current graduate students, to learn better approaches and strategies to carry it out, to read and discuss tutorial, representative or seminal papers in the area, to learn Latex and other tools needed by most graduate students, etc.

4. The development of communication skills was also institutionalized in the SPC group by requiring and scheduling presentations involving each member once per semester. An evaluation form was developed and is used at the end of all presentations to provide feedback to the speaker.

5. Other professional skills and operational techniques have also been institutionalized in the SPC group such as: running meetings with prescribed agendas and time limits, assigning a recorder and a time-keeper at each meeting, saving minutes of each meeting, tracking attendance, etc.

An important special activity made possible by this MII grant is the very visible and effective participation of the SPC group in the pre-college Expo (Open House) organized by the Colleges of Science and Engineering during February 1997.

5 Components and Materials Required

An important component of the project is to provide the students with a place in which they can interact and work. Although the affinity group laboratories presently are not equipped satisfactorily, a university match provided each of the three groups with space and some furniture. The SPC group has had its space renovated at the beginning of Year 2 and will be completely furnished at the end of Year 2. Because of the growth of the affinity groups and recent grant awards, the SEAL and SAG groups are in the process of consolidating space and resources. Consolidation of computer equipment and space will reduce the resources needed to sustain the two groups.

During Year 2, a Unix workstation was purchased to replace an outdated server for the Image Processing laboratory. The SEAL and SAG groups are in the process of combining their resources from this grant and the recently awarded NASA and DARPA grants to purchase an extensible multiprocessor (2 - 8 processor) system.

In addition to computers and peripheral equipment, the groups purchased books, software licenses, and supplies for the students. Yearly expenses include software licenses, book purchases, equipment repair and replacement, and materials and supplies to support the groups' activities, *e.g.* presentation preparations.

At least one faculty mentor is required for each group. Currently, each group has two faculty mentors, one of which is a PI on this MII-funded project. A group's lead faculty mentor works with the students an average of eight hours per week, and an average of six additional hours per week is devoted to development and documentation of the model.

A laboratory Teaching Assistant (TA) funded by the University as a match is needed to assist in the newly created Real-Time Digital Signal Processing laboratory used in the new course. The TA also assists in the set-up and maintenance of the equipment, and in the development and improvement of laboratory assignments for related courses that use the SPC laboratory. A paid TA ensures that at least one student is available to maintain the laboratory even though this task is spread out among all the members. Departmental support is needed to set up and repair equipment.

The grant also provides money for student travel to conferences and workshops, and PI travel for dissemination of the model. The project requires little additional cost.

Assessment and documentation of the project is being conducted by an independent professor from the Department of Communication at no cost, although we are currently searching for outside funding for her support. The grant pays for a graduate student to assist in the assessment and documentation process. See section 7 for a description of the evaluation instrument and results.

6 Indications of Success

The award has developed infrastructure for the following: 1) the creation of three affinity group laboratories with computers and other equipment that provide the students with a place to work on research and projects, 2) the development of the affinity group model and activities that address the issues that are critical for retaining traditionally underrepresented groups in the CISE areas, and 3) the development of the affinity group orientation, which is important for sustaining and running effective groups. A general discussion of each follows.

The award has provided a stimulating environment for 51 students: 27 are from underrepresented groups, 11 are women, 16 are graduate, and 35 are undergraduate. Tables 4, 5, and 6 provide a summary of the students who participated in the affinity groups during the reporting period.

A strong sense of positive interdependence is present in the groups. Non-affinity group students use the laboratory to work in study groups with affinity group members. It is common to find the laboratories filled with students using the equipment and involved in technical discussions. Laboratory visitors from outside the department comment on the students' poise and confidence.

The affinity group project also promotes excellence. Within the Electrical and Computer Engineering (ECE) Department, the SPC group has obtained the reputation of producing the most interesting and most challenging Senior Projects. Also, other ECE faculty have noticed that the two Laboratories that belong to the SPC group are very active not only during the day but also in the evenings and week-ends. The excellence is achieved by a combination of having developed an environment where students with similar and superior technical background help with the technical problems and hard work is the norm.

Also, one cannot deny the fact that since membership implies additional work and responsibilities beyond the course work, the SPC group has attracted a large percentage of the most talented undergraduate students in the Department. Many of the undergraduates in the SPC group are officers in other professional and honor Engineering organizations.

A number of activities have been defined that develop the members' technical, communication, research and group skills. The students work with the faculty mentor (usually in groups of 3-4 students who are working on related areas); novice researchers are paired with experienced ones. Several research projects (funded through JPL, ONR, ARO, Army Corps of Engineers, the Texas State Advanced Technology program, DARPA, NASA, and DOE) are defined within the scope of the affinity groups. Example activities include: setting personal and research-oriented goals; small group discussion of technical papers that targets development of technical, cooperative group and oral communication skills; research paper preparation that works on students' written communication skills and peer review; and, student research presentations that work on oral communication skills and constructive criticism.

Eleven students completed senior projects. 14 students authored and co-authored papers that were accepted to national and international conferences. 16 students co-authored papers that were accepted to student conferences. Five students presented talks at national and international conferences; 13 presented talks at student conferences. See Tables 4, 5, and 6 and sections 10 and 11 of the report.

Francisco Fernandez (graduate student) received the Best Student Paper Award from the Pan American Center for Environmental Students (PACES) at the NASA University Research Centers Technical Advances in Education, Aeronautics, Space, Autonomy, Earth and Environment Conference. Lori Alvarado (undergraduate student) received the Best Student Paper/Presentation Award at the 10th Annual International Conference of Women in Higher Education. Francisco Fernandez, who joined the SEAL group as an undergraduate, received a National Security Agency Fellowship to continue his graduate studies. He and Jesus Acosta received a scholarship from the National Hispanic Scholarship Fund in Spring 1997 and Fall 1996 semesters, respectively. Lori Alvarado was asked to serve as the student representative for UTEP's Women Advisory Committee to the President.

Undergraduate students who have graduated and will continue their graduate studies include 3 students from SEAL, no students from SAG (none graduated this year) and 8 from SPC. Four students completed the Masters program from the SPC group. Students who participated in internship or industry co-op programs during the reporting period and through the 1997 summer session: 1 from SAG, 5 from SEAL and 3 from SPC.

During the reporting year, four Senior Projects were completed within the SPC group. The three projects completed in May 1997 all won awards in the ECE Department competition (two projects tied for first place and another one tied for third place).

This year an orientation was developed (see Section 4.1) that educates new members on the goals of the affinity group, disseminates information about available resources, teaches basic co-operative group skills, and provides students and faculty with an opportunity to understand each other's concerns and expectations. Important by-products of the annual orientation are: faculty reevaluation of the model and assessment of the model's success; reinvigoration of student and faculty efforts towards achieving effective groups; recognition of misalignment of goals; adjustments that may be needed as a result of changes in group composition or attitude; and other issues that need to be addressed. The orientation is a valuable tool for maintaining functioning groups. Because the orientation is run by the students, transfer of roles and enpowerment of the students occurs.

Many of the students work on projects that reach out to high school and junior high school students. See sections 4.2 and 4.3 for a description of the outreach activities. This promotes awareness of the issues in encouraging others to pursue science and engineering degrees, encourages community involvement, and provides the students with an opportunity to serve as role models to others. There is an emphasis on collaboration and leveraging with programs that already exist, and reuse of components that work both from inside and outside the university. A total of 33 students were involved in outreach projects throughout the year.

7 Evaluation and Assessment

The evaluation of the Affinity Group Project is a multi-method approach designed to document and examine the processes, outcomes, and impact of the Affinity Group Project. In particular, the evaluation is designed (1) to provide information to program developers to improve the conceptualization and implementation of the project, and (2) to document and examine potential essential organizational structure and extended discussions of research problems. A pending DOE grant proposes to disseminate the model to other minority institutions. The evaluation is guided by two questions (1) what are the important student experiences (*i.e.,* activities designed by program developers or informal everyday activities with others) that enable and encourage student success in computing, and (2) what are the minimal organizational structures that support student success in computing. Briefly, the evaluation plan includes: the administering of a critical incidents technique instrument that is designed to systematically gather and categorize behaviors that have previously been critical to success or failure in a specific performance context or situations. This method capitalizes on the use of impressionistic data to provide a diverse sample of behaviors that are potentially critical to performance of a specific set of tasks in a specific context or situation. Students were asked to describe two situations: one in which the affinity group or subgroup worked well and one situation in which the affinity group or subgroup did not work well. Analysis of both situations should highlight those essential organizational structures that are needed for conducting research, developing projects, and supporting student success in computing.

Based on the analysis of the responses to the critical incidents technique and the responses to the items on the questionnaire, two other instruments will be developed and implemented: an observation system to be used to systematically gather and examine group behaviors and an interview protocol to be used to systematically explore and examine the student experiences around the affinity group project. Data collection using the critical incidents technique and student self-ratings have been conducted and are in the process of being analyzed and interpreted. Preliminary results of sections of the questionnaire are reported here. A full analysis of the data will be available at the end of summer 1997.

The following results are preliminary and descriptive in nature. Only those items that deal

Item	*Extremely Satisfied*	*Satisfied*	*Dissatisfied*	*Extremely Dissatisfied*	*Unsure*
I can contribute to team discussions.	25%	63%	8%	4%	
I can cooperate with other group members.	20%	76%	4%		
I can work in a group or work individually when needed.	48%	48%	4%		

Table 1: Satisfaction of group skills.

Item	*Extremely Satisfied*	*Satisfied*	*Dissatisfied*	*Extremely Dissatisfied*	*Unsure*
I can conduct research without supervision.	16%	52%	16%	4%	12%
I can design a project with minimal help from a faculty member.	16%	28%	28%	12%	16%

Table 2: Satisfaction of research skills.

with a students satisfaction with their current skills are reported in this section. Students were asked to rate their satisfaction with their current skills. See Tables 1 and 2. Seventeen items were designed to tap into a student's perceptions of her/his group, communication and research skills. The three items judged by the students as the most valuable skills that they have learned from their participation in the Affinity Group Project are listed below. Each item is presented with the percentage of students responding to the item in a particular way.

At least 84% of the students agreed that the following activities were important to the success of a team:

- Communicating information about meetings
- Building a supportive climate
- Keeping communication open
- Assuring that all members are heard
- Managing conflict
- Managing time
- Orienting a team to its task
- Encouraging critical analysis

Activity & Importance	Did well	Did okay	Did poorly
Communicating information about meetings	60%	32%	8%
Building a supportive climate	52%	36%	
Keeping communication open	56%	20%	16%
Assuring that all members are heard	44%	48%	
Managing conflict	28%	56%	4%
Managing time	8%	40%	40%
Orienting team to its task	20%	60%	12%
Encouraging critical analysis	44%	44%	
Creating a feeling of unity	44%	36%	4%
Being individually accountable	16%	60%	12%
Identifying with the group	36%	48%	8%

Table 3: Group performance rating.

- Creating a feeling of unity
- Being individually accountable
- Identifying with the group
- Implementing the plan
- Provide feedback
- Having fun

Students were also asked to rate the performance of their groups on each of the activities listed above. The results are presented in Table 3.

In general, when asked why they were participating in the affinity group project, students answered in one of the following ways:

- to gain knowledge of the field and/or research,
- to improve their research skills or their teamwork skills, and
- to collaborate with other students and professors.

For example, students wrote:

- It has enhanced my view of [my field] and allowed me the opportunity to collaborate more closely with the students and professors in the department.

- To learn more about [my field] than what is taught at the course level, and to have experience with research and get to know more people.

In response to the item: "The one thing I accomplished...," students wrote about three areas: increased knowledge of the field and research, the completion of a specific project, and increased knowledge and ability to work in teams and communicate with others. For example, students wrote:

- I am more confident in my ability to ask questions and seek justification for answers rather than blindly accepting what others say. I have learned so much more about my field and improved my group and communication skills through the affinity group.

- To be more active with students and professors who are knowledgeable in [my field].

In describing their thoughts or impressions about graduate school, students wrote that:

- Graduate school increases your knowledge in the major chosen and provides the opportunity to specialized. It is a lot of hard work.

- I think as a female, a graduate degree is necessary to be taken seriously. I think a graduate degree in any field multiplies your marketability and opportunities that are beyond the scope of an undergraduate degree.

- I think graduate school will be fun and make me a leader instead of a follower in the professional world.

When asked to list the factors that one would take into account when deciding to go to graduate school, students mention: tuition, programs of study, marketability, learning more about a subject area, and continuing to work with a professor. Most of the students give themselves a 25% or greater chance of attending graduate school.

Some of the students felt that graduate school was not for them. For example, one student wrote that, "I am not willing to devote any time towards graduate school at this moment."

A few responses to a request for students to describe situations in which the members of their affinity group worked well and did not work well gives an idea of how one can examine the descriptions and come up with potential essential organizational structures. Some potential essential organizational structures are the following:

- Clearly stated goals or frameworks in which the student understands and experiences the complexity of research and project work. That is, things are not set in stone, but can adapt to the changing situation.

- Clearly established responsibilities and mechanisms to support individual accountability, such as regularly scheduled meetings for faculty coordinators and students, and students with their team members.

- Clearly defined timelines and due dates, interim reports and project meetings to discuss progress.

- Watch for signs of "clique-formation." Develop ice-breaking activities that are related both to the task and to the social dimension.

- Establish a culture of innovation and colleagueship. Students socialize each other. Reinforce appropriate behavior.

8 Names of Participating Students

Tables 4, 5, and 6 enumerate the students who were members of the affinity groups during the reporting period. The table also indicates whether the student participated in a conference, presented a talk at a conference, wrote a conference or journal paper, and/or was involved in an outreach project. It also indicates the student's funding source.

Senior Project and Thesis Titles are:

1. Jesus E. Arenas, "Evaluation of JPEG Compression Effects on Digital Mammograms," MS thesis, August 1996.

2. Art Caraveo, Margarita Faudoa, Laura Jacquez, Francisco Saenz and Thomas Watson, "An Interactive Conference Manager: From Software Requirements to Implementation and Delivery," Software Engineering senior project, May 1997 (the students listed above were members of three separate teams).

3. Gerardo Carrillo, "Wavelet Processing of Surface Mount Device (SMD) Images for Real-Time Inspection," MS thesis, May 1996.

4. Ke Liu, "Instantaneous Frequency and Parameter Estimation of SAR/ISAR Signal Models Using Time-Frequency Filtering", MS thesis, March 1997.

5. Nagabhushan Chitlur, "Design of a Radix-4 FFT Processor Using a Modular Architecture Family", MS thesis, March 1997.

6. Irene Richardson, Sunil Bhakta, Gerardo Lopez (non-member), "Video Digitizing and Image Processing", senior project, December 1996.

7. Carlos Betancourt, Mariano Aguirre, Carlos Mendoza, "Wireless BFSK Transmission System", senior project, May 1997. (tied for first place, Spring 97)

8. Shiu Chan, Miguel Ordaz, Estille Whittenberger, "High Frequency Spectrum Analyzer", senior project, May 1997. (tied for third place, Spring 97)

9. Gilberto Sada, Ivan Munoz, Kiyoshi Kawaguchi, "QAM Transmitter and Receiver Using the TMS320C30", senior project, May 1997. (tied for first place, Spring 97)

9 Papers on Education and Dissemination of Model

Students are noted by an asterisk.

1. Alvarado, L.* and A. Gates, "Affinity Research Groups: Attracting and Retaining Women in Computing," *Proceedings of the 10th Annual International Conference of Women in Higher Education*, Ft. Worth, Texas, January 1997, pp. 5–10.

Name	*Sex* *underrepresented	*Level* * graduated	*Support*	*Conference/ Talk/Paper*	*Outreach*
Mariano Aguirre	M	BS			yes
Jesus Arenas	M	MS*	NASA	P	no
Carlos Betancourt	M	BS	JPL	C/T/P	yes
Sunil Bhakta	M	BS*	NSF-MII	P	no
Alejandro Brito	M	PhD	Texas ATP	C	yes
Gerardo Carrillo	M*	MS*	Texas ATP	P	no
Shiu Chan	M	BS*			yes
Alex Contreras	M*	MS	Match		yes
Juan Guillen	M*	BS	JPL	P	no
Jose Gutierrez	M*	BS		C/T/P	yes
Eslie Holguin	M*	BS	other NSF		no
Kiyeshi Kawaguchi	M	BS*			no
Olga Kosheleva	F	PhD	NSF-MII	C/P	yes
Ke (Luke) Liu	M	MS*	ARO	C/P	yes
Luis Mejia	M	BS			no
Carlos Mendoza	M	BS*			yes
Ivan Munoz	M*	BS*	other NSF		yes
Chitlur Nagabhushan	M	MS*	other NSF	C/T/P	no
Miguel Nunez	M*	BS	NASA	P	no
Gabriel Osorio	M	MS			no
Miguel Ordaz	M*	BS*	JPL	C/T/P	yes
Jorge Perez	M	BS			no
Angel Portillo	M*	MS	NSF-MII	C	yes
Irene Richardson	F*	BS*	NSF-MII	P	no
Gilberto Sada	M	BS*			yes
Miguel Suriano	M*	MS	NSF-MII	C/T/P	yes
Gabriel Thomas	M	PhD	ARO	C/T/P	yes
Javier Vega-Pineda	M	PhD	NASA	P	no
Estille Whittenberger	M	BS*	NSF-MII		yes
Rashid Zaman	M	MS	NASA		no

Table 4: Members of SPC May 1996 - May 1997.

Name	*Sex* *underrepresented	*Level* * graduated	*Support*	*Conference/ Talk/Paper*	*Outreach*
Jesus Acosta	M*	BS*	NASA	C/T/P	yes
Lori Alvarado	F*	BS	NSF-MII	C/T/P	yes
Christina Ashmore	F*	BS	NSF-MII		no
Maria Beltran	F*	MS	NASA	C/T/P	yes
Nelly Delgado	F*	BS	NASA	C/T/P	yes
Francisco Fernandez	M*	MS	NSA	C/T/P	yes
Veronica Gallardo	F*	BS			yes
Ricardo Herrera	M*	BS	NSF-MII		yes
Michelle Lujan	F*	BS*	NASA	C/T/P	yes
Abdiel Quezada	M	BS			no
Lilly Romo	F*	BS	NASA Match	P	yes
Francisco Saenz	M*	BS	NSF-MII	C/T/P	yes
Thomas Watson	M	BS	NSF-MII	C/T/P	yes
Earl Yager	M	BS	NSF-MII		no

Table 5: Members of SEAL May 1996 - May 1997.

Name	*Sex* *underrepresented	*Level* * graduated	*Support*	*Conference/ Talk/Paper*	*Outreach*
Art Caraveo	M*	BS	NSF-MII	C/T/P	yes
Robert Calder	M	BS	NSF-MII		no
Gilbert Castillo	M*	MS	Army		yes
Margarita Faudoa	F*	BS	NSF-MII		yes
Laura Jacquez	F*	BS	NSF-MII	C/T/P	yes
Michael Maxwell	M	BS	NSF-MII	C/P	yes
Ricardo Rodriguez	M*	BS	NSF-MII		yes

Table 6: Members of SAG May 1996 - May 1997.

2. Bernat, A., Gates, A., Teller, P., and Cabrera, S. "Affinity Groups for Student Success in Computing", *Proceedings of the 1997 ADMI Conference*, Washington, D.C., May 29 - 30, 1997, pp. 206-211.

3. Cabrera, S. and B. Usevitch, "The Signal Processing and Communication Affinity Group: An Integrated Environment for Student-Faculty Interaction," talk presented at the *1997 Mexican American Engineers and Scientists (MAES) International Engineering and Science Symposium and Career Fair*, January 1997.

4. Gates, A., Delgado, N.*, Bernat, A. and S. Cabrera, "Building Affinity Groups to Enable and Encourage Student Success in Computing", *Proceedings of the 1997 Joint National Conference WEPAN/NAMEPA Conference*, March 1997, pp. 233-238.

5. Gates, A., Teller, P., Bernat, A. and S. Cabrera, "An Orientation to the Affinity Research Group Model," talk presented to the *Eighth National Conference on College Teaching and Learning*, April 1997.

6. Gates, A., C. Della Piana and A. Bernat, "Affinity Groups: A Framework for Developing Workplace Skills," to appear in the *Proceedings of the Frontiers in Education Conference '97*, Nov. 1997.

7. Teller, P., "Experimental, Cooperative Labs in a First Course in Computer Architecture," to appear in the *Proceedings of the Frontiers in Education Conference '97*, Nov. 1997.

10 Technical Papers

Students are noted by an asterisk.

1. Arenas, J.E.*, Cabrera, S., Nunez, M.* and S. Bhakta*, "Evaluation of Lossy Compression Distortion on Digital Mammograms," *Proceedings of ELECTRO96*, pp. 514–529, Chihuahua, Mexico, Oct. 1996.

2. Auguston, M., Gates, A., and M. Lujan*, "Defining a Program Behavior Model for Dynamic Analyzers," to appear in *Proceedings International Conference on Software Engineering Knowledge Engineering*, Madrid, Spain, June 1997.

3. Bernat, A. "Lesson Learned from our II–MII Award", *Proceedings of the 1996 ADMI Symposium on Computing at Minority Institutions*, pp. 68–72, Mayaguez, Puerto Rico, July 24–28, 1996.

4. Bernat, A. P., "The Concurrent/Distributed Language Paradigm," invited book chapter for *The Computer Science and Engineering Handbook*, A. Tucker (ed.), pp. 2094–2110, 1997.

5. Carrillo, G.*, Cabrera, S.D., Portillo, A.* and A. Brito*, "Classification of Surface Mount Device Images Using Wavelet Domain Features," submitted to *Optical Engineering.*

6. Cooke, D. E., Gates, A., Demirors, O., Demirors, E., Tanik, M. and B. Kramer, "Languages for the Functional Specification of Software," *The Journal of Systems and Software*, **32**:269–308, March 1996.

7. Gates, A., and C. Kubo Della-Piana, “The Identification of Integrity Constraints in Requirements for Context Monitoring,” *Proceedings of the IEEE Conference and Workshop on Engineering of Computer Based Systems*, pp. 498–506, March 1997.

8. Gates, A., Fernandez, F.* and L. Romo*, “Building Systems with Integrity Constraints,” *Proceedings from the Second World Conference on Integrated Design and Process Technology* Vol. 1, pp. 437–444, December 1996.

9. Kreinovich, V., and Bernat, A. “Is the Solar System Stable? A Remark”, *Reliable Computing*, **3**, 149–154, 1997.

10. Rios, H., Bernat, A., and Engel, G. “Final Report: The Workshop on Mexico - U.S. Cooperation in Computer and Information Science and Engineering Education”, *Memoria V Congreso Iberoamericano de Educacion Superior en Computacion*, Ciudad de México, Facultad de Ciencias, UNAM, 19-21 Septiembre 1996, 25–34, 1996.

11. Suriano, M.*, Abdel-Hafeez, S., Vega-Pineda, J.* and S. D. Cabrera, “Comparison of Two CAD Designs for a VLSI Image Multiresolution Transform for Lossy Compression,” talk presented to *1997 Mexican American Engineers and Scientists (MAES) International Engineering and Science Symposium and Career Fair*, El Paso, TX, January 1997.

11 Student Conference Papers

1. Acosta, J.*, “Pan-American Center for Earth and Environmental Studies: An Overview,” Second Student Conference on Computational Sciences, South Central Computational Sciences at Minority Institutions Consortium (SC-COSMIC), El Paso, TX, October 1996.

2. Acosta, J.* and L. Alvarado*, “Issues in Defining Software Architectures in a GIS Environment,” in *Proceedings of the NASA University Research Center's Technical Conference on Education, Aeronautics, Space, Autonomy, Earth and Environment*, pp. 13–18, Albuquerque, NM, February 1997.

3. Alvarado, L.* and J. Acosta*, “A Study of Data Issues in the GIS Environment,” to appear in *Proceedings of the National Conferences on Undergraduate Research-97 (NCUR)*, Austin, TX, April 1997.

4. Beltran, M.* and Y. Haris*, “Managing Data in a GIS Environment,” in *Proceedings of the NASA University Research Center's Technical Conference on Education, Aeronautics, Space, Autonomy, Earth and Environment*, pp. 109–114, Albuquerque, NM, February 1997.

5. Betancourt, C.*, Guillen, J.*, Richardson, I.* and B. Usevitch, “Systems Engineering Consortium for JPL Satellite Urania”, in *Proceedings of NASA University Research Centers Technical Advances in Education, Aeronautics, Space, Autonomy, Earth and Environment*, pp. 121–126, Albuquerque, NM, February 1997.

6. Caraveo, A.*, “Accuracy and Precision Issues in GIS Data Transfers,” *Proceedings of the 1997 ADMI Symposium on Computing at Minority Institutions*, Washington, D.C., May 29 - 30, 1997, pp. 106-111.

7. Delgado, N.*, "Monitoring Software Through Integrity Constraints," Second Student Conference on Computational Sciences, South Central Computational Sciences at Minority Institutions Consortium (SC-COSMIC), El Paso, TX, October 1996.

8. Delgado, N.* and T. Watson*, "An Approach to Building a Traceability Tool for Software Development," in *Proceedings of the NASA University Research Center's Technical Conference on Education, Aeronautics, Space, Autonomy, Earth and Environment*, pp. 197–202, Albuquerque, NM, February 1997.

9. Fernandez, F.*, "Fuzzy Implication can be Arbitrarily Complicated: A Theorem," Second Student Conference on Computational Sciences, South Central Computational Sciences at Minority Institutions Consortium (SC-COSMIC), El Paso, TX, October 1996.

10. Fernandez, F.*, "Integrity Constraint Monitoring in Software Development: Proposed Architectures," in *Proceedings of the NASA University Research Center's Technical Conference on Education, Aeronautics, Space, Autonomy, Earth and Environment*, pp. 243-248, Albuquerque, NM, February 1997.

11. Jacquez, L. E.*, "Synchronizing Readers and Writers by Passing the Baton, " *Proceedings of the 1997 ADMI Symposium on Computing at Minority Institutions*, Washington, D.C., May 29 - 30, 1997, pp. 6-11.

12. Lujan, M.*, "A Categorization of Dynamic Analyzers," in *Proceedings of the NASA University Research Center's Technical Conference on Education, Aeronautics, Space, Autonomy, Earth and Environment*, pp. 471–476, Albuquerque, NM, February 1997.

13. Maxwell, M.*, "Using VTune to Identify Potential Pentium Pro Performance Bottlenecks, " *Proceedings of the 1997 ADMI Symposium on Computing at Minority Institutions*, Washington, D.C., May 29 - 30, 1997, pp. 2-5.

14. Ordaz, M.A.*, "Minority University System Engineering: A Small Satellite Design Experience Held at the Jet Propulsion Laboratory During Summer of 1996," in *Proceedings of the NASA University Research Center's Technical Conference on Education, Aeronautics, Space, Autonomy, Earth and Environment*, Vol. 1, pp. 555-559, Albuquerque, NM, February 1997.

15. Saenz, F.* and T. Watson*, "A Traceability Tool: Linking Knowledge and Programs," to appear in *Proceedings of the National Conferences on Undergraduate Research-97 (NCUR)*, Austin, TX, April 1997.

12 Long-range Results

Degree of success.

The first year goals were targeted at setting up the labs and developing the model. The second year goals were aimed at developing an orientation, refining and documenting the model, and starting model dissemination. Papers and awards indicate student research success, and model dissemination and refinement. Recognition by outside groups such as Lucent Technology and the Southern Association of Colleges and Schools (SACS) indicate the effectiveness and success of the groups. The award of a NASA technical grant based on a cooperative effort that cross-fertilizes two distinct research areas demonstrates the power of the model (brainstorming and extended discussions of research problems). A pending DOE grant proposes to disseminate the model to other minority institutions and to provide funding for documentation.

A summary of the funding efforts for the reporting year follows:

- Patricia Teller, *PerfOrmancE Modeling System (POEMS) Consortium*, DARPA award in conjunction with UT Austin, UCLA, Rice University, Purdue University, University of Wisconsin, Los Alamos National Laboratory, $300,000 awarded over 3 years.

- Patricia Teller and Ann Q. Gates, *Verification of NASA Mission-Critical Software Without Sacrificing Performance,* NASA FY 1997 Partnership Awards with Minority Institutions, 7/1997 - 8/1999, $199,887 awarded over two years.

- B. Usevitch, *Low-Complexity, Reconfigurable Circuits for Data Compression,* NASA Faculty Awards for Research, 9/1997 - 8/2000, $296,933 awarded over three years.

- Ann Q. Gates, *Install, Configure and Migrate Data for Integrated Training Area Management,* U.S. Army Corps of Engineers, June/1997 - June 1998, $40,716 awarded over 1 year.

- Andrew Bernat and Vladik Kreinovich, University of Texas at El Paso, in conjunction with Jorge E. Gonzalez-Cruz, Ramon Vasquez, Jorge Capella, Amos Winter and Nazario Ramirez, University Puerto Rico - Mayaguez; Charles F. Kell, Los Alamos National Laboratory, *The Caribbean Climate Dynamics Initiative,* Research and Education in Science and Engineering (HiCREST), Department of Energy and Office of Energy Research, 07/1997 - 06/2000, $1,067,024 requested for funding the three groups.

- Ann Q. Gates and Connie Kubo Della-Piana, University of Texas at El Paso, in conjunction with Ed Hensel, New Mexico State University and Dr. Jose L. Zayas-Castro, Dr. David Serrano *et al.*, University of Puerto Rico - Mayaguez, *Coordinating Workplace and Educational Restructuring: The Transfer of the Affinity Group Experience to the Workplace; The Learning Factory, A Non-Traditional Experience: Advancing Hispanics in Engineering and Science*, Hispanic Collaborative for Research and Education in Science and Engineering (HiCREST), Department of Energy and Office of Energy Research, 07/1997 - 06/20000, $120,000 requested for funding the UTEP group over 3 years.

- P. Nava, G. Gibson, V. Singh and S. Cabrera, *Tools for Fast Design of Efficient Special-Purpose Processors,* Ballistic Missile Defense Organization (BMDO), 9/1997 - 8/1999, $299,962 requested over two years.

Unmet goals. The documentation of the model is proceeding slower than expected. Some of this can be attributed to the teaching load of the investigators. Also, we have not been successful at securing funds to satisfactorily furnish the labs. A few students that had intended to continue to graduate school took industry jobs. Because students are well-trained, recruiters are offering high salaries that students are finding too attractive to refuse.

Outcome. The model is producing better qualified students, and students who are enthusiastic about learning outside the classroom. In spite of the pull from industry, there appears to be an increase in students who are continuing to graduate school. We believe this is due to their involvement in the affinity groups. Numerous students have received fellowships and have been selected for internship and co-op programs. A new course was developed as a result of the grant. The model develops students with strong team and leadership skills who will become productive workers in industry.

Impact. There is considerable documented evidence that mentoring is the most effective means of encouraging students to pursue careers in science and engineering. Unfortunately, mentoring does not scale–there is a limit to the number of students that a faculty member can "touch." Naturally, the selected students will be those who have proven their abilities. Lost will be those students with promise, but without demonstrated success. By building group models in which these students are welcomed, encouraged, and supported to achieve success, we are creating a new and enhanced mentoring scheme.