BPC-AE - The STARS Alliance:

A Southeastern Partnership for Broadening Participation in Computing

FSU, FAMU, USF, Georgia Tech, Spelman, Auburn, USC, UTK, New Orleans, NC State, Meredith, UNC Charlotte, JCSU, UNCG, Virginia Tech, Landmark…and more!

1. Results from Prior NSF Support

The **S**tudents & **T**echnology in **A**cademia, **R**esearch, and **S**ervice (STARS) Alliance was formed in response to the 2005 NSF BPC solicitation. The alliance was funded for a three-year project, "*The STARS Alliance: A Southeastern Partnership for Diverse Participation in Computing*" ($2 million, March 2006 – Feb 2009)—henceforth referred to as "the STARS Initiation Project."

The **mission** of the STARS Alliance is to graduate a larger, more diverse cadre of professionals prepared to grow U.S. leadership in computing. We use the term "computing" to collectively refer to computer science, information systems, information technology, software engineering, computer engineering, and related disciplines and interdisciplinary areas.

The STARS Alliance has eleven academic members - the University of North Carolina at Charlotte (UNC Charlotte), Johnson C. Smith University (JCSU), North Carolina State University (NCSU), Meredith College, Georgia Institute of Technology (Ga Tech), Spelman College, Auburn University, Florida State University (FSU), Florida A & M University (FAMU), the University of South Florida Lakeland (USF Lakeland), and Landmark College.

The alliance is a national collaboration among regional partnerships. Figs. 1.1 and 1.2 illustrate the STARS Alliance Regional Partnership and Mentoring Models – the partnering of higher education, K-12 schools, industry, professional organizations, and community groups to strengthen local programs for recruitment and success in computing and to foster a computing community that extends from Kindergarten to the workforce.

Figure 1.1: The STARS Alliance Regional Partnership Model

STARS Alliance regional partnerships, also called *stars*, bring together leaders in higher education, K-12 schools, industry, professional organizations, and the community to strengthen local programs for student recruitment and success in computing.

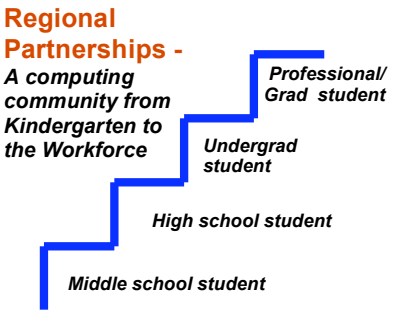


Figure 1.2: STARS Tiered Mentoring & Stair-step Role Models

Alliance members are organized onto seven regional partnerships, called "*stars*." Each star (Table 1.1) includes research, minority-serving and/or women's institutions (with computing enrollments shown in Table 1.2), as well as regional partners. Members and partners collaboratively implement, disseminate and institutionalize programs for recruiting, bridging, and graduating students from the underrepresented groups in computing. Activities build on existing programs within organizations, pooling expertise and resources, and providing a consistent, cohesive evaluation across multiple institutions and populations. Participants in the STARS Alliance project include faculty, staff and students from alliance member and partner institutions.

Year 1 highlights are listed below and detailed in [Dah07a].

Table 1.1: The STARS Alliance Initial Constellation

Stars	University & College *Members*	University, College, K-12, Industry, and Community *Partners*
Western North Carolina	**UNC Charlotte (Research)** • College of Computing and Informatics (Software & Information Systems, Computer Science, Bioinformatics); **Johnson C. Smith University (private HBCU)** • Dept of Computer Science & Engineering	UNC Charlotte Diversity in Information Technology Institute, Winthrop University, Charlotte-Mecklenburg Schools; ACM-W, TIAA-CREF, Girl Scouts Hornets Nest Council, Charlotte Chamber of Commerce, Black Data Processor Association, NC Technology Association Women in Science and Engineering;, Public Library of Charlotte & Mecklenburg County;
Eastern North Carolina	**N.C. State University (Research)** • Department of Computer Science **Meredith College (Women's College)** • Dept of Mathematics & Computer Science	Women and Math Mentoring; Wake County School System; SAS, IBM, ACM NCSU Chapter, SWE, WISE, Friday Institute, WICS, WMM, MCNC
Alabama/ Georgia	**Auburn University (Research)** • College of Computer Science & Software Engineering **Spelman College (private Women's HBCU)** • Computer Science	Alabama A&M University, South Carolina State University, Atlanta City Schools, Auburn University Engineering Administration, Auburn University Office of Outreach, Auburn City School System, University of Alabama
Georgia	**Georgia Institute of Technology (Research)** • College of Computing; Institute of Computing Education	Morehouse College Department of Computer Science, Girl Scouts of Atlanta, North Atlanta High School, Georgia Board of Education, Atlanta Women's Foundation;
Florida-Tallahassee	**Florida State University (Research)** • College of Information; College of Arts & Sciences (Computer Science); Career Center; Center for Academic Retention and Enhancement **Florida A & M University (HBCU)** • Computer Information Sciences	ACM FAMU Chapter, Tallahassee Big Bend Boys & Girls Clubs, FAMU High School, Apalachee Ridge Tech. Center, Fl./Ga.-Louis Stokes Alliance for Minority Participation, FAMU Trio Programs, Leon & Wakulla County School Boards, Leon Cty. Charter School of Arts & Sciences, FSU College of Business MIS Program, FSU National High Magnetic Field Lab, High School High Tech, FSU Disability Res Cntr
Florida-Polk County	**University of South Florida-Lakeland (Undergrad)** • Information Technology; Diversity Center	Polk Community College- Lakeland & Winter Haven IT Department, Polk Community College Collegiate High School, USF Lakeland Engineering Department, Polk County School District, Kathleen Senior High School, Family Fundamentals, Word Alive Ministries, Central Florida Business Diversity Council.
Alliance-wide	**Landmark College** (remote member - two-year college in Vermont for students with **learning disabilities)**	Landmark's participation in the STARS Leadership Corps provides a unique opportunity to understand how leadership training can prepare students with LD for entry into and success in four year computing programs.

Table 1.2: Existing Members: Computing enrollment– gender, underrepresented minority students

School	PhD Students			MS Students			Undergraduate students		
	Total	Female	Minority	Total	Female	Minority	Total	Female	Minority
Ga. Tech.	260	49 (19%)	12 (5%)	193	37 (19%)	20 (10%)	1,065	102(10%)	96 (9%)
NCSU	121	23 (19%)	4 (3%)	241	51(21%)	6 (2%)	689	75 (11%)	105 (15%)
UNCC	56	9 (16%)	2 (3%)	227	78 (34%)	30 (13%)	530	78 (15%)	91 (17%)
Auburn	45	19 (42%)	7 (16%)	140	26 (18%)	9 (6%)	459	33 (7%)	21 (5%)
FSU	37	9 (24%)	4 (11%)	93	24 (26%)	10 (8%)	523	101 (19%)	110 (21%)
FAMU	0	0	0	16	5 (31%)	8 (50%)	450	151 (34%)	440 (98%)
JCSU	0	0	0	0	0	0	177	60 (34%)	(100%)
USF-L	0	0	0	0	0	0	62	10 (16%)	21 (33%)
Spelman	0	0	0	0	0	0	210*	100%	100%
Meredith	0	0	0	0	0	0	20	18 (90%)	2(10%)
Landmark	Community College, 100% Learning Disabled or AD/HD						389*	108 (28%)	35 (9%)

*Includes non-computing students

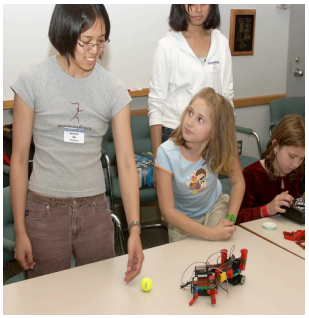
1.1 Development of the STARS Leadership Corps Model

The STARS Leadership Corps (SLC) is a repeatable one-year program that begins and ends with the STARS Celebration, a four-day conference in August for all alliance SLC students. The Celebration inducts students into the corps through training and activities built around the

STARS Central Values – values shown to be effective for recruiting and graduating under-represented students in computing. These are:

1. **Excellence** – developing students' technical excellence. Motivating and enabling students to become highly competent in computing, thereby increasing their confidence and interest in computing; Preparing for entry into workforce, grad school and the professoriate.
2. **Leadership** – developing students' soft skills, including leadership and professional development, team work, writing, speaking, time-management, and work/life balance.
3. **Civic Engagement** and **Service** – developing students' ability, desire, and sense of responsibility to use computing and technology in service to society. Helping students to see the social relevance of computing, both through the workforce and research.
4. **Community** – developing students' sense of belonging within a larger computing community; Training on STARS identity development, diversity, gender issues, persons with disabilities, and a tiered mentoring model (Fig. 1.2).

The cornerstone activity was development and implementation of **The STARS Leadership Corps**, a program that catalyzes regional partnerships to combine K-12 recruitment with college retention and workforce development.



During the Celebration, students are called to action to help fill the national need for a larger, more diverse computing workforce. Students respond by undertaking leadership projects to *recruit*, *develop* and *become* the next generation of computing professionals. Leadership projects are broadly classified as: Outreach to pre-college students to inform and excite kids about computing; Peer outreach to other college students to mentor slightly younger students; Community service to work with nonprofits to serve society with computing; and Research Experiences and Internships to serve by improving one's own expertise in computing. (E.g., see Table 3.1.) At the Celebration, experienced SLC students guide new SLC students' plans for new leadership projects. Student teams carry out projects during the academic year at their home schools.

Leadership Projects are existing programs shown to be effective for BPC; The SLC puts a common "wrapper" around these to support an extended community and cohesive evaluation across programs & organizations

The STARS Leadership Corps is **a national call to action**…"*to recruit, develop and become the next generation of computing professionals*"

Figure 1.3:The STARS Leadership Corps Model

STARS training continues through monthly seminars and a tiered mentoring program (Fig. 1.2) at home institutions. Corps projects are enhanced through written reflection, presentation to peers, and outreach to younger students. Student success is showcased at the next Celebration.

1.2 Implementation of the STARS Leadership Corps

The first STARS Celebration was held in August 2006 in Atlanta [STARS-Celebration]. Faculty joined in ASC meetings and evaluation training for conducting student interviews. The primary objectives for the student participants were to inform them about diversity **workforce needs** in computing, connect them with **a "like" community** of under-represented colleagues, and introduce and connect them with **SLC projects**. The structure of the Celebration consisted of workshops for students on a variety of topics designed to **inform and prepare students** for careers and graduate programs in computing. Industry partners and faculty presented both small-group workshops, as well as guest speaker presentations to the whole conference during meals. Topics included: diversity awareness, the demand for computing professionals, demonstrations of robotic technology, lab tours and social activities. The conference concluded with student presentations to the alliance about planned Leadership Projects in the upcoming academic year.

STARS Celebration - Evaluation

- Participants felt that the STARS Celebration:
- Provided **community building** opportunities (97%).
- Emphasized how computing and IT professionals can help **improve quality of life** (83%).

The inaugural **STARS Celebration** was hosted by Georgia Tech and aimed to instill STARS core values of excellence, leadership, civic engagement, service, and community – values intended to foster student success in computing.

107 college students participated in the SLC 2006-2007, providing outreach to hundreds of K-12 teachers, guidance counselors and students (e.g., see Table 3.1). 56% of the participants were female; 29% Caucasian females, 20% African American females, and 7% Asian or Pacific Island females; 23% of SLC students were African American males, and 19% Caucasian males.

STARS Leadership Corps – Evaluation

- SLC Participants reported that the SLC:
- **Increased commitment to computing** majors(88%) and helped form **meaningful relationships** with faculty & peers (95%)- supporting retention.
- **Increased interest in graduate school** (83%) & helped others understand the value of computing (90%) – supporting recruitment (>15 SLC graduating seniors enrolled in grad school for Fall 2007!)
- **Developed computing skills** and knowledge (83%) – supporting bridging
- Provided opportunities to work with people like themselves (88%), supporting the goal of creating **a "like" community**

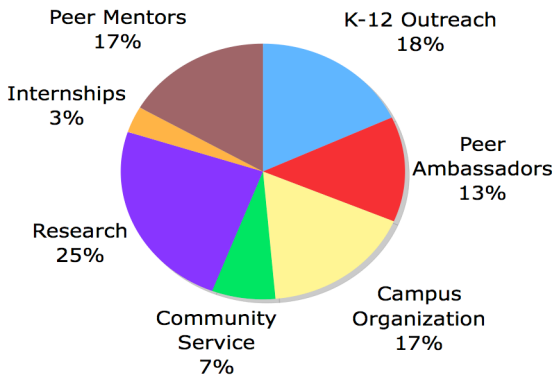


Figure 1.4: Leadership Projects Undertaken by the 107 SLC Participants in Year 1

1.3 Alliance Exchange

Year 1 Alliance Exchange Activities

- Initial Planning Meeting of Alliance Steering Committee (ASC) and Evaluation Team (ET), Jan. 2006, Charlotte.
- Monthly ASC & ET Teleconferences
- ASC meeting, Aug 2006, Atlanta, STARS Celebration
- ASC meeting, Oct 2006, San Diego, Grace Hopper Cel.
- ASC training events - Jan 2007, Tampa – Pair Programming, STARS Mentor Training
- Institutionalizing BPC Task Force – Jan 2007, Tampa
- ET meeting, April 2007, Greensboro, NC
- ASC meeting – May 2007, Boulder, CO

Alliance Exchange – Evaluation

- **Collaborations** are beneficial to both students and faculty.
- Participation facilitates faculty and student **career development.**
- Alliance **goals are being achieved** and represent meaningful impact to the computing field.
- **Training, dissemination, and sustainability** goals are being met.

The **Alliance Exchange** facilitated a variety of committees and task forces for the exchange of information and pooling of resources among the Alliance Steering Committee – a diverse group of 18 researchers, including nine female and six African-American faculty, ranging from assistant to full professors, in computing, education, social sciences, and educational psychology.

1.4 STARS Demonstration Projects

The STARS Alliance serves as an incubator for new demonstration projects and the scaling and replicating of best practices among the diverse Alliance institutions.

Alliance-wide dissemination of **Pair Programming** was implemented to increase student retention and success in gate-keeper computing courses.

A **tiered mentoring model** was developed for implementation into the STARS Leadership Corps program.

An exploratory project, **Teaching Math to the Visually Impaired**, was begun for middle school math teachers to prepare visually impaired students for college.

STARS students participated in the **African American Researchers in Computer Science** demonstration project for recruitment into computing doctoral programs

A new demonstration project using **Culturally Situated Design Tools** was begun to foster learning among African American, Latino, and Native American children.

1.5 STARS Alliance Dissemination

The **STARS Alliance web portal** was developed to support a Marketing and Careers Campaign aimed towards K-12 students.
The Alliance has established listserves for students and faculty members. Partnerships and localized student chapters have been established at STARS institutions with CRA-W, IEEE, ACM, and Women in Computing. STARS presentations have been made at the **Grace Hopper Celebration** [Bar06c] and to computing high school teachers at **ACM SIGCSE06** (sponsored by Microsoft), and will be made at the **IEEE Frontiers in Education** conference [Dah07b]. STARS panels and Birds of a Feather have been proposed at GHC and **Tapia** 2007 [Dah07c, Bar07a, Bar07b]. Partnerships have been formed with the professional org of ACM, IEEE, and Women in Computing.

1.6 STARS Alliance Evaluation and Dissemination

The **STARS Alliance Evaluation** Team developed tools for a consistent, cohesive evaluation of STARS programs and is sharing best practices. The ET has found that the Alliance is achieving its goals of computing student recruitment (undergraduate and graduate), retention, and bridging, while also working towards institutionalization, sustainability, and supporting computing faculty careers. A major contribution of the Alliance is the development and refinement of evaluation methods that allow for the comparison of diverse, multi-institutional BPC programs.

2. Goals and Outcomes for the STARS Extension Project

We propose to extend the size and scope of the STARS Alliance to demonstrate the STARS Southeastern "constellation" as a sustainable network of regional partnerships, for broadening participation in computing, that can be replicated in other geographical regions.

STARS **target populations** include females, under-represented minorities and persons with disabilities – in middle school through graduate school. We propose to extend our population to include elementary school students, as well as support for assistant professors who are role models for under-represented student populations in computing.

Our project **goals and expected outcomes** remain the same, with one addition:

Goal 1 is **Recruiting** of under-represented populations, with the outcomes of a) increasing student enrollment in post-secondary computing programs, and b) increasing student awareness about computing disciplines and careers. Goal 2 is **Bridging** for under-represented populations, with the outcomes of a) Increasing student readiness to enter computing programs, and b) Increasing the number of undergraduates (in computing or non-computing disciplines) who enter computing graduate school or workforce. Goal 3 is **Retention** of under-represented populations, with the outcomes of a) Increasing the graduation rates in computing disciplines, b) increasing the year-to-year persistence and the declaration of majors in computing disciplines, and c) Increasing college adjustment and GPA. Goal 4 (new goal) is **Advancement** of assistant professors who are role models for under-represented student populations in computing, with the outcomes of a) increasing faculty scholarship in computing research and b) supporting faculty tenure and promotion. Goal 5 is **Sustainability**, with the outcomes of a) Sustaining effective BPC practices at Alliance institutions, and b) Institutionalizing Alliance partnerships. Goal 6 is **Dissemination**, with the outcomes of a) Increasing national awareness of effective practices, b) Serving as a model and repository for effective practices for BPC, and c) Promoting Alliance implementation and evaluation methodology.

Our **motivation for forming the Alliance** derives from the substantial results published to inform effective practices for recruiting, bridging, and graduating under-represented persons in computing. Since many BPC interventions are implemented as tangential to the core research, teaching and service mission of academia, even successful programs can end when the faculty champion leaves or funding ends. Evaluating BPC implementations at an inter-institutional level provides a pool of resources and expertise, while offering stronger evidence and incentive for institutionalizing effective practices. Furthermore, research shows that higher student retention rates and satisfaction, particularly among minority students, result from the existence of a community of "like" students to support the development of a student's identity [Coh05, Blu05, Tho05, Sel98]. However, the representation of some demographic populations is so small within an institution, it is difficult to foster communities of "like" students. Community-building efforts must extend beyond a single academic institution and beyond academia as well.

Our **motivation for extending the Alliance** is threefold: 1) Size - Year 1 activities have been very successful, resulting in a close community for research collaborations and an extended support network for faculty and students. We want to mentor new members wishing to join this community; 2) Time - Additional time is needed to institutionalize STARS outcomes and to develop the STARS Southeastern constellation as a model for replication in other geographic regions; and 3) Impact - The Alliance provides a unique opportunity to extend the tiered mentoring and community, developed for SLC students, to include faculty, particularly those who are BPC role-models. We see a need to integrate the BPC and Computing research communities, and better support faculty through their career advancement. We aim to demonstrate that participation in BPC activities such as the STARS Alliance can be leveraged to strengthen, not diminish, computing faculty records for promotion and tenure.

Table 2.1 provides an overview of activities undertaken in the STARS Initiation Project and highlights the additional key activities to be undertaken with the proposed STARS Extension Project. The details for these activities are given in Section 3.

Table 2.1: Highlights of STARS Extension Activities

Activity or Component	STARS Initiation Project	STARS Extension Project
Members & Partners	The Alliance includes 11 members and over 50 regional partner organizations	The Alliance will grow to include at least 15 members and over 80 regional partners, along with national affiliations.
STARS Leadership Corps (SLC)	SLC participation by 250 college students, over 3 years- half participating for 2 years and half for 1 year.	SLC participation by >600 students, over 5 years- half participating for 2 years and half for 1 year; including about 125 grad students; 375 undergrads; And, about 100 from community colleges and high schools;
SLC Leadership Projects	Leadership projects include 7^{th}–12^{th} grade and peer outreach, community service, research exp, and internships, in Fall/Spring	Leadership projects will also include K-6^{th} grade outreach, as well as a summer component to serve in summer camps for K-12 students, teachers, and guidance counselors.
STARS Leaders	STARS Leaders are college students who serve in the SLC	SLC "wrapper" model to be applied to existing summer camps to develop K-12 students, teachers & counselors as STARS Leaders at their home schools.
REU	REU supplements support in-depth research exp. for SLC undergraduates	The Alliance will form a cohort of undergraduate SLC students undertaking research experiences within a student exchange program.
BPC Faculty Role Models	STARS women and minority junior faculty are passionate about BPC, with no support for their computing research.	Foster a community to support career advancement of BPC faculty role models, whose success is crucial for retention of under-represented students. E.g., writing circles, coaching, peer mentoring, RA support, faculty exchanges;
Broadening Participation in Research (BPR)	For most faculty conducting BPC programs, their computing research & BPC communities are separate	Host "BPR sessions or workshops" at professional computing research conferences to inform and engage the broader computing research community in BPC efforts.
STARS Celebration	The 4-day workshop trains students to join the SLC and hosts an ASC meeting	Evolve to a conference format for: preparing SLC cohorts; training for BPC demonstration projects; supporting BPC role models; disseminating effective BPC evaluation and institutionalization;
Web & Marketing	Portal supports K-12 Careers Marketing	Extend to disseminate Alliance activities, repository for BPC in-classroom and extracurricular activities.
Mentoring	Dr. Nate Thomas conducts training on a STARS mentoring model.	Formalize Thomas' efforts as a demonstration project to implement and disseminate STARS mentoring model. Include stipends to encourage participation.
Pair Programming	Dr. Laurie Williams conducts training for pair programming adoption.	Additional training sessions, support, and participation stipends for faculty who implement and evaluate pair programming (PP). Form cohort of PP implementers.
Alliance Exchange	Alliance collaboration is supported by regional partnerships, committees and task forces.	Add STARS advisory boards to guide regional partnerships; Develop sponsorship model for national and regional fund raising; Visit computing departments to leverage internal resources (e.g., career centers, student support services).
Sustainability	Alliance structure and activities intended to evolve to be sustainable through flexibility, but common themes for sustainability are still being discovered.	Scale by adding new regional stars and serve as a model for other STARS-like constellations; Create an ACM SIGBPC; Engage students and faculty with non-monetary benefits and rewards; Establish BPC efforts as part of day-to-day operations (e.g. through adding for-credit BPC courses, adding BPC as an integral part of courses, TA/RA duties, REUs, honors and internship programs, and service-learning requirements);
Evaluation Team	Alliance evaluation modeled on the CIPP model to ensure collection of all relevant data. Measures impact of Alliance on enrollments and SLC student retention and compares to national performance.	Extend to include SLC Evaluation Projects and REUs and recruit social scientists to mentor these projects to explore STARS impact on computing culture at each institution; Develop or purchase comprehensive tools for collaboration, communication, data collection, and dissemination that will serve as a reliable, efficient data source for reporting and examining the effects of the STARS Alliance. Extend to measure impacts of BPC on careers of STARS faculty.

From 1992-2002, UNC Charlotte, NC State, Georgia Tech, Florida State, and Florida A&M participated in the NSF-funded Southeastern University and College Coalition for Engineering Education [SUCCEED]. Designed to make dramatic improvements, SUCCEED resulted in the development, and institutionalization of a fundamentally new, experimental undergraduate engineering curriculum model. These same schools, along with the rest of the STARS Alliance are making a dramatic impact in the culture and practice in computing disciplines.

Preliminary results indicate that the Alliance will bring about a dramatic breakthrough in the culture and practice of computing, through weaving effective BPC recruiting, bridging and retention practices into the fabric of STARS Alliance institutions and serving as a nationwide model for inclusion of BPC efforts in day-to-day operations.

Intellectual merit: The STARS Alliance will identify effective practices and demonstrate their applicability for BPC across a variety of Southeastern institutions. We will collect and contribute to the knowledge and assessment base for BPC efforts at institutional, regional, and national levels. We will determine the most important factors in building lasting relationships and infrastructures that support and sustain BPC practices, and we will provide opportunities to evaluate and disseminate recommendations that affect BPC.

Broader impact: The principal outcome of this project is expected to be an increase in the enrollment in, and retention and graduation of, under-represented populations from post secondary computing programs. The effort is expected to have a long-term impact through the establishment of a sustainable, replicable network of regional partnerships for BPC, and through catalyzing change in the culture of computing.

3. Implementation Plan

3.1 Aligning with Similar Programs

Table 3.1: Example Pre-College & Post-Secondary Programs Aligned with STARS

Community Service	SLC students: host girl scout visits on Girls are IT! Tech Bus www.GirlsAreIT.org; Provide Internet Safety training for girl scout's "IT Badge"(UNCC, JCSU); Conduct Girl Scouts Workshops (Meredith); and Mentor at Boys and Girls Clubs (FAMU)
High School Tutors and Mentors	SLC students serve in tutoring/mentoring programs: High School Tutor (Ga Tech); Tutoring Gifted Students (FSU); CS 101 High School Workshop Series (FAMU)
On-campus events for K-12 students, parents, counselors	SLC students assist and serve as role-models for K-12 events: Freshman Orientation (UNCC, FAMU); CoolComputing@Tech for HS students, parents, (Ga Tech); Computing Careers Night (FSU); Fall/Spring Outreach, World Usability Day (www.WorldUsabilityAtAuburn.org), E-Day, Alice3D Competition (Auburn, Spelman); Sonia Kovalevsky Math Day (Meredith);
Computing Roadshows for Middle and High school outreach	SLC student presentations to inform/excite kids about computing and advice on applying to college: IMC@T and Women@CC (Ga Tech); Minority Outreach, High School Outreach, and Middle School Outreach Teams (JCSU, FSU, FAMU, USF Lakeland, UNCC);
Outreach with Industry and Professional Organizations	SLC students provide "stair-step" role models (as per Fig. 1.2) by K-12 outreach with industry: Black Data Processors Association (BDPA) High School Academy (UNCC, JCSU); Women and Math Mentoring Org (Meredith); Community Neighborhood Partnership (FSU)
Student Organizations	SLC students strengthen existing student organizations: Women in Computer Science (NCSU FSU); and are starting new orgs or student chapters: ACM-W, Gamer's Alliance, Black Data Processors Association (UNCC); IEEE (JCSU);
Mentoring Programs	Existing mentoring programs inform the STARS Mentoring Model: Ga Tech Big/Little Sisters mentoring pairs upper level undergrads with Freshman; Peer & Group Mentoring (UNCC, FSU, FAMU); USF Lakeland Identity-based mentoring employs tiered peer mentoring for minority students [Tho05; Sey98]; Peer Tutoring Lab (FSU);
Louis Stokes Alliances for Minority Participation	STARS Alliance structure and organization are informed by existing LSAMP and other Alliances: Florida/Georgia and North Carolina (FAMU, UNC Charlotte);
Research Experiences for Undergraduates (REU) programs	SLC students enroll in REU programs: REU Sites (Auburn, UNCC, JCSU); Intel Scholars (Ga Tech); McNair Scholars (UNCC); Scholars of the Future (Auburn). Students host lab demonstrations and Roadshows to bring research to K-12.
Website Development	SLC students develop websites: [STARS, STARS-Celebration, STARS-Charlotte, STARS-Landmark, STARS-FAMU, STARS-NCSU]

Table 3.1 lists examples of ongoing programs that are aligned with the STARS Alliance. Prior to STARS, each program in Table 3.1 was largely an island of activity with little interaction among participants from different programs or among evaluation teams for each program. These programs are now linked, primarily through the Leadership Projects of STARS SLC students. The impact of these programs is enhanced a great deal: students participate in multiple programs; a consistent, cohesive evaluation is being applied across multiple programs and institutions; and the inclusion of college students in Industry-based K-12 outreach fosters a computing community that extends from kindergarten to the workforce (Fig. 1.2).

3.2 Creative & Strategic Actions

3.2.1 Alliance Members & Partners

Table 3.2: Extending the Southeastern STARS Alliance Constellation

Stars	**University & College *Members***	**University, College, K-12, Industry, and Community *Partners***
Virginia	**Virginia Tech (VT) (Research)** • Department of Computer Science	Hollins University, University of Virginia's College at Wise, Blacksburg-Montgomery school system, Beeks Community Center, ACM-W, Computer Science Community Service Org
Virginia – Hampton Roads	**Hampton University (HBCU)** • Computer Science • Computer Information Sciences • Mathematics (Computational)	ACM HU Chapter; Cooperating Hampton Roads Organization for Minorities in Engineering; High Schools – Phoebus, Bethel, Kecoughtan, Norcom, Hampton, and Heritage; Elizabeth City State Univ, Virginia State Univ, Virginia Union Univ
South Carolina	**University of South Carolina Columbia (USC) (Undergraduate)** • Department of Computer Science and Engineering **South Carolina State University (HBCU)** • Department of Computer Science	Benedict College, Midlands Technical College, other community colleges; Governor's School- Science & Math, S.C. State Dept of Education, Richland County and Lexington County Public Schools; Blackbaud, Collexis, Interactive Data Visualization Inc; Assoc. for Women in Science, BDPA, Junior Achievement, SC Alliance for Minority Participation
Tennessee	**University of Tennessee- Knoxville (UTK) (Research)** • Department of Computer Science & ECE	UTK ACM Chapter, Tennessee Louis Stokes Alliance for Minority Participation (TLSAMP), Knox County School System, Knoxville College, UTK Office of Engineering Diversity Prog.
New Orleans	**University of New Orleans (UNO) (Research)** • Department of Computer Science	Greater New Orleans Universities: Tulane, Loyola, Dillard, Xavier, SUNO; Northrop Grumman; GNO REU Site; GNO K-12 School system and Pierre A. Capdau Charter School.
Central Georgia	**Georgia Southern University (GSU) (Undergraduate)** • College of Information Technology	Swainsboro Tech College, East Georgia College, Ogeechee Tech College, Charter Conservatory for Liberal Arts & Technology, Bulloch Academy, ACM chapter, SWE chapter, Savannah State Univ:; School Districts of surrounding counties; Morris Multimedia, National Cash Register (NCR)
Joining the Eastern NC Star	**Saint Augustine's College (HBCU)** • Department of Computer Science **Shaw University (HBCU)** • Dept of Computer Information Sciences	Louisburg College, Cisco, Halifax County High Schools, Upward Bound Programs; Forsyth Technical Community College; Wake County Public Schools;
Joining the FL-Polk County Star	**Polk Community College (PCC) (Community College)** • Computer Network Engineering Technology	Polk County School Board, PCC High School, Polk Community College High School, Lakeland HS, Publix Supermarkets, Florida Regional Medical Center, FedEx National, AITP Chaptr, Polk Works Workforce 2020, Polk County Schools. FL High Tech Corridor

Table 3.3: New Members: Computing enrollment– gender, underrepresented minority students

School	**PhD Students**			**MS Students**			**Undergraduate students**		
	Total	**Female**	**Minority**	**Total**	**Female**	**Minority**	**Total**	**Female**	**Minority**
VT	115	20 (17%)	15 (13%)	85	12 (14%)	10 (12%)	325	18 (6%)	23 (7%)
UTK	53	7 (13%)	2 (4%)	55	6 (11%)	2 (4%)	210	18 (9%)	16 (8%)
USC	50	13 (26%)	4 (8%)	47	7 (15%)	2 (4%)	230	30(13%)	49 (21%)
UNO	18	4 (22%)	6 (33%)	60	**	38(63%)	287	47 (16%)	144 (50%)
Hampton	0	0	0	10	5 (50%)	5(50%)	170	85 (50%)	162 (95%)
GSU	0	0	0	0	0	0	495	61(12%)	175 (35%)
Shaw	0	0	0	0	0	0	120	37 (31%)	114(95%)
St August.	0	0	0	0	0	0	60	12 (20%)	60(100%)
PCC	0	0	0	0	0	0	36	6 (17%)	8 (22%)

We will grow the STARS Alliance by adding 3-6 members who demonstrate institutional support, synergistic programs, and targeted student populations. Tables 3.2 and 3.3 list schools

who have submitted to us: a Letter of Intent to Apply for STARS Alliance Membership; a partnership plan; and a CV for their Academic Liaison. (See attachments.) We will provide a support stipend to an existing member to serve as an *institutional mentor* to each new member, for focused support to further develop their regional partnerships, institutional support, implementation of the STARS Leadership Corps, and participation in other Alliance activities.

3.2.2 STARS Advisory Boards

An advisory board will be formed for each regional partnership, comprised of representatives from academia, school districts, industry and community groups, to: identify SLC Leadership Projects, reach target populations (e.g., immigrant families not familiar with academia), provide student internship opportunities, assist with dissemination, and seek local funding for STARS activities. Nominal stipends will be provided to support participation.

3.2.3 Sponsorship Model

We will develop a sponsorship model that will enable potential industry and private donors to engage in supporting Alliance efforts at several levels. As we move beyond NSF funding, this model will help ensure that Alliance programs are of value to both students and industry.

3.2.4 Alliance Exchange

We refer to Alliance-wide interaction as the Alliance Exchange. It includes an Alliance Steering Committee (ASC), an Evaluation Team, and multiple Task Force Dialogues (TFD).

The ASC includes academic liaisons, project director, web manager, and the evaluation team (Table 4.1). We monitor institutional demographic data and guide development and implementation of programs and evaluation. TFDs are committees leading focused multi-institutional dialogues on challenging issues, such as: **First Generation Students**: preparing our institutions for the Hispanic immigrant population whose children will soon reach college age; **Combining Research & Outreach**: strategies for leveraging Alliance infrastructure to engage computing researchers in broadening the impact of their research (see sections 3.2.9 and 3.2.10); **Institutional Change**: incorporating successful interventions into the core academic mission. We kicked-off this latter TFD with industry and community reps in Florida's Polk County IT Corridor, Jan 2007 [STARS-Train07]. A second meeting was sponsored by the N.C. Technology Association, May 2007, with a third to take place during the STARS Celebration, Aug 2007.

We are efficiently combining dissemination with Alliance meetings at synergistic venues, such as the Grace Hopper Celebration and SIGCSE, but additional travel support is needed. In particular, we want to support an Alliance team to meet with STARS computing department chairs. Our goal is to help departments explore creative ways to leverage their institutional resources to support the STARS efforts. Suggestions include: a) integrating the SLC into for-credit courses, Teaching and Research Assistant responsibilities, Honors Program, or Service Learning requirements; b) Leveraging on-campus career center, office of disabilities, volunteer services, and multicultural centers to support SLC and partnership development.

3.2.5 National Affiliations

The STARS Alliance is served by the Industry Experts Advisory Panel, subject matter experts who work in the computing and IT industry. The board works with Alliance personnel and students to provide advice, guidance, and mentoring for SLC students. In the STARS Extension project, this Panel will expand to foster Alliance-wide partnerships and opportunities for STARS students. For example, national partnerships are being formed with the Black Data Processors Association (student opportunities to network with and participate in K-12 outreach with IT professionals) and with INROADS (internships for minority students).

We will continue our collaboration with other BPC Alliances. In particular, we collaborate with the Computing Alliance for Hispanic Serving Institutions, by attending each other's annual meetings. We are active members of the AccessComputing Alliance - they are funding our Assistive Technology Workshop, Aug. 2007. We are deepening our collaboration with the National Center for Women and Information Technology (NCWIT) – leveraging their national

platform to support replication of STARS Constellations. See support letters from Wayne Hicks, BDPA National, and Lucy Sanders, NCWIT CEO.

3.2.6 Alliance Web Portals and Marketing & Careers Campaign

The Alliance Web Portal [STARS] has been implemented as part of a Marketing & Careers Campaign to inform and excite K-12 students about Computing college programs and IT careers. We have also branded the STARS Alliance project via a suite of marketing materials (tee-shirts, bags, etc.) with the STARS Leadership Corps theme of "*recruit, develop, become the next generation of computing professionals*." A guidance counselors' kit has been developed comprising materials and a script for SLC students to visit counselors to encourage them to bring their students to the website. Regional websites have also been developed [STARS-Auburn, STARS-Charlotte, STARS-FAMU, STARS-Landmark, & STARS-NCSU].

Additional support is needed to extend the web portal to serve as a central repository and communication tool for Alliance members and people interested in BPC issues. The portal will highlight STARS demonstration projects and will include a **"**Socially Relevant Projects Repository**"** of assignments with social value, building on the work of NCSU PI Laurie Williams [Lay07] and similar to the "Nifty Assignments" [NIFTY]. This will serve as a resource for instructors to create material that will be more appealing to women and minorities, whom often value work that has social value [Far02,Cha02,NSF96].

3.2.7 The STARS Leadership Corps (SLC)

The SLC (formerly called the *Student* Leadership Corps) is a multi-year experience providing students with multiple touch-points to find information and support throughout their academic journey [Pin99,Cle92]. The SLC fosters an extended student community among academia, industry and the community through *civic engagement, mentoring, professional development and research experiences*. Our program is informed by best practices such as those disseminated by the Learning through Evaluation, Adaptation, and Dissemination Center [LEAD], including Richard Tapia's Spend a Summer with a Scientist program [Ale98], the National Center for Women in Technology [NCWIT], and the programs highlighted in Table 3.1, and includes the mentoring model described below. The SLC model is described in Section 1.1. Below we describe how we will extend the SLC with support from the STARS Extension Project.

- **STARS Leaders**

We will double the number of college students in the SLC (from 250 to 500, with half participating for 1 year and half for 2 years). We will extend SLC participation (>100 students) to community colleges, as well as to high school students taking college credits (e.g., USFL's university partner PCC collegiate HS Program). We will also develop K-12 students, teachers and guidance counselors as "K-12 Computing Ambassadors" (described below).

- **STARS Celebration**

As described in Section 1.1, the STARS Celebration is a single-track 4 day conference to induct students into the SLC with emphasis on the STARS central values of Technical Excellence, Leadership, Community, and Civic Engagement & Service, and to showcase prior-year SLC accomplishments. We will open the Celebration to participation by non-STARS members and extend the content to a multi-theme conference, as follows:

1) Add a BPC Track for faculty to share effective practices for developing regional partnerships, gaining institutional support, program evaluation and implementing the SLC.

2) Add a BPC Career Mentoring Track to support junior faculty who are role-models for BPC, as per our new goal of Advancement of BPC assistant professors (details below).

The STARS Celebration complements, but does not duplicate, the Grace Hopper Celebration of Women and Computing, the Tapia Celebration of Diversity and Computing and the NCWIT meetings. The STARS Celebration will remain focused on training cohorts of SLC students and providing support for people who lead efforts to implement and sustain SLC programs. This will enable other schools to independently establish their own SLC programs, and other geographic regions to implement new STARS constellations.

- **SLC Monthly Seminar Series**

During the academic year, monthly seminars reinforce the STARS central values training begun at the STARS Celebration. With the extension, each Alliance member will contribute to a repository of web-based seminars to be made publicly available.

- **SLC Leadership Projects**

SLC students work on Leadership Projects in small teams (with industry and community volunteers). Example projects are described in section 1.1-1.2, Fig. 1.4 and Table 3.1. Most projects take an average of 5 hours/week, except when combined with for-credit courses, summer REUs, or Internship programs. We will extend leadership projects to include K-6 outreach programs and summer camps for K-12 students, teachers, and guidance counselors.

For the latter, we will develop a version of the "SLC Wrapper", shown in Fig. 1.3, to apply to our existing summer camps. While assisting with a summer camp, SLC students and faculty will interweave training on 1) the national need for a larger, more diverse IT workforce; 2) Exciting IT careers and research; and 3) Preparing for entry into a computing college program. Camp participants will be asked to identify specific action plans to take back to their home schools, where they will serve as *K-12 Computing Ambassadors*, with ongoing support from the SLC. E.g., at UNC Charlotte we held the DITI Teachers & Counselors (Summer) Workshop for three years to interweave diversity training with technology skills training for teams of middle school technology teachers and guidance counselors [DITI] – using a format inspired by Carnegie Mellon's high school teachers' workshop [Mar02]. The teachers and counselors shared their summer experience back at their home schools by holding career fairs, computing clubs, and in-service presentations to other school staff. Auburn and Spelman hold many summer camps for kids, including Camp KEMET (computer literacy for disadvantaged kids) and skills training in WebPage and Game Creation Software (Squeak, Alice3D, 3DGameStudio, and HalfLife2), in camps ranging from 1 day to 12 weeks. SLC students guide campers during the camps. With the extension, campers will receive guidance in developing and delivering presentations to talk about their creations and their new knowledge about IT careers at their home schools. Having SLC students continue to work with K-12 Computing Ambassadors can be an effective mechanism for year-round reinforcement of summer camp themes.

- **SLC Stipends**

Most STARS members will continue to provide stipends to SLC undergraduates of $500 per semester. We will reduce the graduate student stipend from $1,000 to $500/semester, and offer $250/semester stipends to high school students. Nominal stipends will be provided the teachers and counselors serving as K-12 Computing Ambassadors, depending on the level of service articulated. With the extension project, FSU will not offer SLC stipends. Rather, they will support student attendance at the STARS Celebration as an incentive and reward for SLC participation. UNC Charlotte will begin offering the SLC as a 1-credit seminar course that can be repeated up to 3 times, for elective credit. JCSU will experiment with integrating the SLC into their service-learning curriculum. The extra time provided by the STARS Extension project will allow us to explore various options for maintaining the SLC, without the long-term need for student stipends. Time is needed, however, to experiment with various options, assess the impact on motivating student participation, and work through our departmental policies.

3.2.8 Research Experiences for Undergraduates (REU) and Teachers (RET)

With the extension, we will implement an REU exchange program within the Alliance. Each year, we will request several REU supplements (e.g., we have received 8) to support an SLC cohort undertaking in-depth summer research experiences. STARS faculty will advertise research projects, and SLC students will apply for projects at schools other than their own. REU assignments will be awarded competitively by the Alliance Steering Committee.

We will also request Research Experiences for Teachers supplements, to provide in-depth experiences for K-12 Teachers who will then serve as K-12 Computing Ambassadors.

3.2.9 BPC Role Models – Faculty Advancement

Women and minority faculty often carry higher than normal service loads, due to their status as being part of under-represented populations [Par96, Dub97]. Since service carries minimal weight in the research, teaching and service trio for reappointment, promotion and tenure (RPT), new assistant professors are often advised to stay away from activities related to outreach and student development and to focus on building a funded research program.

However, consider the research cited in section 3.3, showing the need for building a community among students and demonstrating the effectiveness of reaching out to a younger student as an effective mechanism for retaining the older student. Assistant professors, who have just emerged from being students themselves, have the same need for community and can benefit from participation in a computing community that extends from Kindergarten to the workforce and professoriate. Furthermore, under-represented students need role models who look like them. A critical mass of "BPC role models" simply does not exist among senior faculty ranks. Lastly, sustainability of BPC goals can only be realized if faculty contributions to BPC "count" towards RPT.

The Alliance steering committee currently includes five assistant professors who are devoted champions for STARS activities and who are BPC role-models (Barnes, Cheng, Seals, Lustria and Black). Year 1 evaluation of the Alliance exchange indicates that participation in the STARS Alliance greatly contributes to faculty social psychological support networks. Our challenge is to leverage this network to support faculty research and teaching. With the STARS Extension project, we propose the following:

- Using supplements, we will support a *Summer Exchange for Research* within the Alliance: 1) Faculty from undergraduate schools will visit and work in labs with faculty from research universities; 2) Graduate research assistants from research schools will visit and work with faculty from schools that do not have graduate students.
- The STARS Alliance activities provide a rich resource for interdisciplinary social science and computing research. We will form *Writing Circles* to identify hypothesis that can be proven using stars data and support faculty to publish work based on STARS activities.
- STARS junior faculty have found common research and teaching interests, including gaming curriculum, gaming research, and assistive technology research. We will form *Teaching Circles* and *Research Circles* to foster these collaborations through retreats.
- Faculty need support for managing their service activities (e.g., when to say "no") and developing their portfolios for RPT. STARS faculty will leverage existing career mentoring workshops (e.g., those by CRA-W and NSF ADVANCE programs). We will supplement existing workshops with the *BPC Career Mentoring Track* in the STARS Celebration.
- As previously described, we will focus our *Institutionalizing BPC Task Force Dialogue* on working with department chairs to support BPC efforts, without overloading junior faculty (e.g., course reductions, graduate assistants, counting SLC as teaching load).

3.2.10 Broadening Participation in Research (BPR) – Faculty Advancement

For most STARS faculty, our "BPC community" and our "Computing Research Community" are separate, producing a tension in professional obligations, and a feeling of "singing to the choir" at BPC events. To encourage BPC awareness and participation among the broader computing research community, we will provide support stipends, and content support, to faculty willing to propose and host BPC-related sessions at IEEE and ACM conferences that do not normally address BPC. For example, a session on game development geared towards engaging girls could be held at a gaming research conference; a session on developing hands-on lab demos to excite kids about sensor networks research could be held at one of the many workshops on experimental testbeds for networking research. Sessions could be single-presenter tutorial, panel, or a collection of related papers. The intent is to encourage a greater commitment to the "broader impact" of research by demonstrating ways to integrate BPC into a research agenda.

3.2.11 STARS Mentoring Model – A New STARS Demonstration Project

USF Lakeland PI, Dr. Nate Thomas, developed a tiered peer mentoring program to support underrepresented students in computing. Utilizing principles from his Ethnic-based Mentoring Model, upper-class students mentor first year students. To promote recruitment, leadership development through service learning, and retention, first year mentees mentor high school students. An ecological approach is used to support mentors' and mentees' college adjustment, GPA, retention, graduation and Career preparation [Tho05,Sey98,Cha00].

A STARS Alliance "Train the Trainer" Mentoring workshop was held by Thomas in Jan. 2007 [STARS-Train07]. Eight Alliance members attended and indicate interest in implementing the mentoring model as part of the SLC. Support for this was not included in the STARS Initiation Project. With the extension project, Identity-based Mentoring Principles (IMTP) will be undertaken as a demonstration project to help increase recruitment, bridging, retention, academic success and graduation of underrepresented students in computing.

Implementation includes three steps. **Step one** includes training for mentoring program implementors. Training will be provided annually in January with technical assistance during spring and summer as schools develop their organizational structures and recruit mentors. Primary training and technical assistance topics are: **1) Program Development**- starting and sustaining a formal mentoring program: a) What is mentoring; b) Understanding mentoring approaches and the use of Identity-based Mentoring; c) Determining financial and human resources to sustain your program; d) Staffing your mentoring program – professionals and student staff; e) Communicating expectations and responsibilities to staff, mentors, and mentees; and f) Understanding mentoring program organizational structures; **2) Program Implementation & Evaluation** – Managing a formal mentoring program: a) Recruitment of mentors and mentees; b) Curriculum Development for mentoring (Implementing the Thomas Principles: *Identity Development, Social and Psychological Support, Academic Support, Sense of Belonging, and Leadership Development*); c) Quantitative and Qualitative Evaluation (Mentor Logs and measurement scales for Thomas Principles).

Step two will include training for the mentors on IMTP and promoting strong mentoring relationships. Mentor training will be conducted during the annual STARS Celebration in August. Mentor training concepts will be reinforced through school-based mentoring program activities. **Step three** will include a mentor implementor support workshop at the STARS Celebration. At this workshop implementors can share positive and negative experiences, challenges, success stories, formulate strategies around success to promote best practices, and most importantly develop and nurture informal support networks and partnerships.

The **evaluation** for implementing IMTP Alliance wide includes four levels of examination: 1) Mentoring program effectiveness - Alliance wide and school-based; 2) Program effectiveness to transfer IMTP from mentors to mentees; 3) Assessment of the mentor-mentee relationships; and 4) Programs overall ability to improve Thomas Principles, recruitment, retention, academic success and graduation based on pre-post test examination. Nominal **participation stipends** will be given to faculty who implement and evaluate the mentoring program for at least one year.

3.2.12 Pair Programming – Extending a STARS Demonstration Project

NC State is leading the Alliance efforts to replicate pair programming, one of the few practices proven to be effective for increasing student success, particularly for women, in gate-keeper programming classes. Extensive studies of student pair programmers have been conducted at [Nag03,Wil02a,Wil02b] and the University of California – Santa Cruz (UCSC) [Bev02,McD02]. Those studies consistently report, to varying degrees, the following observations relative to the use of pair programming in introductory computer science classes. An equal or higher percentage of pair programming students completed an introductory programming class with a grade of C or better when compared with solo programmers. Student participation in pair programming leads to at least similar exam performance on average when compared with solo

programming students. Students that use pair programming on programming projects produce better projects than solo programming students. If pair programming is required only for a closed lab, there is no discernable impact on programming projects produced outside of the closed lab. Students in paired labs have a positive attitude toward collaborative programming settings. Students who use pair programming in an introductory computer science course are not hampered in future solo programming courses. Students who use pair programming in an introductory programming course are significantly more likely than solo-programming students to pursue Computer Science related majors one year later.

During Year 1, Pair Programming (PP) training was conducted at UNC Charlotte, FAMU and for eight Alliance members in Tampa. However, additional support in needed to introduce pair programming to the faculty who teach and make curriculum decisions regarding programming classes at member institutions. The extension project will support the following:

Introductory pair programming workshops Twice annually, an introductory workshop will be conducted (January and August) that is geared toward educators who have not used pair programming in their classes. PP will be introduced, research results overviewed, an interactive exercise will be conducted, and participants will brainstorm concrete plans for instituting PP.

Conduct pair programming cohort meetings Twice annually, a PP cohort meeting will be held, the day after the introductory workshop, geared towards educators who have just completed the workshop and those who have already instituted PP in their classes. The cohort meetings will foster peer support for classroom management strategies and sharing of results.

Stipends for use and evaluation of pair programming in the classroom Educators who attend an "introduction to pair programming" workshop and transition to the use of pair programming with their classes will be awarded a $1,500 stipend, and those who complete a data collection kit and present their experiences to the cohort will be awarded a $500 stipend.

3.2.13 Continuation of Other STARS Demonstration Projects

We will continue our examination of **Computing Education for Students with Learning Disabilities** through Alliance remote member, Landmark College. Landmark is a two-year college that prepares students with learning disabilities (LD) and/or AD/HD for entry or re-entry into four-year college programs. Through their experimentation with the SLC, and other Alliance programs, Landmark enables us to better understand our students with LD, in a way that cannot be studied in schools where LD students cannot be identified. Landmark's Steve Fadden actively participates in the BPC community serving persons with disabilities that has been created by the AccessComputing Alliance (another BPC Alliance). Dr. Fadden will hold an Assistive Technology Workshop, funded by AcessComputing, at the 2007 STARS Celebration.

We will continue our participation in Dr. Juan Gilbert's **African American Researchers in Computer Science** BPC demonstration project at Auburn, as well as our sponsorship of Dr. Art Karshmer's experimentation at USFL, **Teaching Math to the Visually Impaired** - software to enable middle school teachers to boost success of students in math courses. In Year 2 we begin our sponsorship of Dr. Tiffany Barnes' BPC Demonstration Project, **Culturally Situated Design Tools**, with SLC students using a cultural-based approach (e.g., cornrow braids, beadwork) that allow kids to explore African, Hip hop, Latino, and Native American cultural practices while also learning about their inherent mathematical properties.

3.3 Motivation and Research Base

Information technology (IT) is one of the fastest-growing areas of job growth. However, the Department of Labor projects that IT degree production will not keep up with demand for IT jobs in the current decade [Zwe05-07, BLS07]. To meet the need for IT jobs and remain competitive, we must increase the number of students, and particularly those from historically underrepresented groups, receiving undergraduate and graduate degrees in the computing disciplines. The inclusion of these groups in computing can provide increased opportunities for individuals and an infusion of talent, creativity, and diverse perspectives that can shape the

future of technology. Researchers and newspapers alike tout the need for broader participation in technology, and address some of the reasons for unequal representation [Zwe07, Was06, Rip05, Jas05, Mul05, Lew05, Lew03, Pos91, Pow90].

The formation of the STARS Alliance was inspired and informed by pre-existing collaborative efforts between multiple organizations to support underrepresented minorities [SUCCEED, LEAD, NCWIT, MNSCU, GEAR UP, NACME, NSF-PI, CDC, Asp00, TAP, Gan05]. Many of these programs incorporate the efforts of educational institutions with industry, K-12 schools, and community and professional organizations, and engage the interests and efforts of undergraduate and graduate students in mentoring, research, and/or service. The SLC program is built as a framework to "wrap" successful programs such as these with community building and development opportunities for students, in a way that is flexible enough to implement diverse but united programs at multiple institutions.

Research evidence is central to the choice and design of STARS activities. Here we review literature that reports success and retention factors for undergraduate and graduate students in Science, Technology, Engineering, and Math (STEM) programs. Most of these studies report general findings for all students, while some focus on a particular underrepresented group. However, we believe that while some populations may need a specialized approach, particularly when building a community of like students, most of the factors are applicable to all students.

Persistence and Retention: Student engagement, or level of involvement in academics and campus activities, has been recently shown through the 2006 National Survey of Student Engagement, to have a positive effect on student grades and retention, particularly for underrepresented minorities [Was06]. The SLC involves students in collaboration with their peers, which was shown to help students overcome previous educational disadvantages [Was06]. Factors that contribute to persistence in STEM disciplines for all students include ensuring adequate preparation, lab participation, hands-on research opportunities with faculty, and positive peer interactions and influences [Ast92]. Nathan Thomas defines strategies for retention, including: Identity, Social Support, Psychological Support, Academic Support, Sense of Belonging, and Leadership Development [Tho05]. High academic achievement prior to college and interest in SME majors upon college entrance are also positively associated with SME retention [Bon00]. For example, Post, Stewart, and Smith [Pos91] found that confidence regarding educational requirements was a significant predictor of math and science careers. Financial support, study groups, a supportive program community, specialized advising, setting high expectations for students, and peer solidarity have also been found to provide an environment highly supportive of strong academic performance [Hra95]. Relationships between peers offer the best support to underrepresented students [Coh05, Was06]. Retention of underrepresented groups will have the effect of increasing the overall number of students in a group that are in a major, that has an effect in making the major attractive to and survivable for students in that group. [Coho05,Blu05].

The persistence of doctoral students in mathematics, and the quality of experience in graduate school, has been linked to how well integrated students are in the academic communities of their department and discipline [Tin93,Rog95,Her04]. In addition, doctoral students who persist in mathematics are more likely to have family members who are involved in mathematics, to have participated in research experiences as undergraduates, and have been committed to mathematics from a very young age [Her02].

Civic Engagement, Recruiting and Bridging: Numerous programs have introduced students to service learning and outreach as ambassadors or recruiters with great success [TAP,Hor04,Fla04], Civic engagement projects, such as Girls are IT! [Dah03] and ChicTech [Kam04] provide students with opportunities to be leaders and role models for younger students, providing both recruitment and retention benefits. Women students are more likely than men to participate in volunteer activities [Was06], but do less tutoring and collaboration on class-work with peers, so enticing women to outreach that leverages computing skills may be one way to

engage them in collaboration that is beneficial to their academic performance. Participation of students in real projects that impact other people and offer experience that will be useful in future careers will have a positive effect on student retention. Educational research shows that grounding teaching in familiar, concrete, and relevant examples improves learning [Bra99]. The participation in BPC efforts by industry and professional organizations will help computing programs stay connected to the job market. This connection has been shown to have a positive effect on gendered attrition [Coh05]. Connecting computing to real applications that help others may also encourage retention of women and minorities [Coh05, Far02, Cha02, NSF96].

Research experiences: Similarly to the benefits of civic engagement, the participation of students in actual research has tremendous benefits for retention, as evidenced by the GA Tech/Intel Opportunity program, the Tapia Spend a Summer with a Scientist program [Ale98], and reported in [Asp00] and [Rus07].

Collaborative learning: Research has shown that African-American success rates in science courses can be dramatically improved by shifting the learning paradigm from individual study to one that capitalizes on group processes, such as student work groups and student-student tutoring [Nel96,Tre92] while others suggest such collaborative learning would improve retention of women [Coh05] and underrepresented minorities [Was06] in computing.

Advancement: Faculty women are more likely than men to experience inequities in salary [AAUP06, Fog03], other rewards [McE92], power [Str05], and voice [Den93] in many American universities. Women are more likely to find a chilly climate [MIT99], lack mentoring, and to face challenges in balancing work/family obligations [Ols98, Per02, Spa04]. Mentors and networks are crucial for successful academic careers, but men are more likely to be mentored than are women, and minority women receive less mentoring than do whites [Moo90], while the networks that women form do not result in the career advantages from those of men [Mar97]. Men and women often have different work assignments. Women's underrepresented status, especially for women of color, means they are in demand for committee work. Compared to men, women teach more, perform more service, and consequently, may publish less [Du97]. Research productivity is related to laboratory space, teaching and service loads, initial startup packages, access to mentors, and informal networks. Studies find that women have less access to these resources and, consequently, show less scholarly productivity than male peers—other factors being equal [Spa00]. However, there is a need for faculty role models for both women and underrepresented minorities [Pea90], and for existing faculty to advance in their careers.

These findings and our experiences in intervention programs inform the design of Alliance programs. The SLC program incorporates the development of community and peer interactions with hands-on research and service that are so important for persistence and strong academic performance. Pair programming brings some of these advantages to the classroom, with the result of improved student aptitudes and attitudes in computing [Nag03]. MathGenie brings math education to the visually impaired [MathGenie], while Landmark's learning disabilities work informs us about teaching diverse students. The Alliance Exchange and continued examination of other best practice resources will ensure the continued applicability of STARS programs.

3.4 Dissemination

Anthony Chow of UNCG will coordinate Alliance dissemination. The Alliance Web Portal will be a key point for dissemination - with the Marketing & Careers campaign, the STARS Advisory Board meetings, the Industry Experts Panel, and the SLC STARS Leaders and K-12 Computing Ambassadors employed to draw a larger audience to the Web Portal. With the Extension Project, we will open the STARS Celebration to competitive submissions nationwide. The Alliance as a whole and individual stars will seek Public Service Announcements, Presentations at education conferences (e.g., SIGCSE, ASEE, FIE) and related events (e.g., Grace Hopper, Tapia, Anita Borg Women in Technology Institute), and journal publications (Computer Science Education, IEEE Transactions on Education, the Journal of Engineering Education).

4. Partnership Plan & Sustainability

Table 4.1 Alliance Roles & Responsibilities

Role(s)	Description
Alliance Evaluation Team	Tiffany Barnes, Kim Buch & Audrey Rorrer, UNC Charlotte; Sarah Berenson, NC State; Anthony Chow, UNCG; Nathan Thomas, USFL; Several student assistants; This team will handle tools development, data collection and analysis for evaluating Alliance infrastructure, STARS Leadership Corps program and outreach, and demonstration projects;
Project Management	Teresa Dahlberg, Director of the Diversity in Information Technology Institute and Associate professor of Computer Science, UNC Charlotte, will Chair the Alliance Steering Committee, coordinate Alliance Exchange and report to the NSF.
Web Portal & Marketing	Anthony Chow, UNCG, with student support, will lead the development of the web portal and the collateral materials to be used for the marketing & careers campaign.
Demonstration Project Coordinators	Nathan Thomas, USFL: Mentoring; Teaching Math to the Visually Impaired. Laurie Williams, NC State: Pair Programming implementation Steve Fadden, Landmark College: Students with Learning Disabilities. Juan Gilbert, Auburn University: African American Researchers in Computing. Tiffany Barnes, UNC Charlotte: Culturally Situated Design Tools
Industry & Community Liaison	Steve Fadden, Landmark College, manage alliance-wide Industry Experts Advisory Panel, development of Sponsorship model, national partnerships.
Lead Academic Liaisons	A faculty member from each academic partner will serve as an Academic Liaison to serve on the Alliance Steering Committee, oversee implementation of SLC and other activities and interface with their institutions to address policy and curriculum changes; These are: Teresa Dahlberg, UNCC; Magdy Attia, JCSU; Mladen Vouk, NCSU; Kristin Watkins, Meredith; Cheryl Seals, Auburn; Andrea Lawrence, Spelman; Maureen Biggers, Georgia Tech; Lois Hawkes & Mia Lustria, FSU; Jason Black, FAMU; Nate Thomas, USFL, and Steve Fadden, Landmark College.
Dissemination	Anthony Chow, UNCG, manage Alliance dissemination through the Web Portal and print media.

Table 4.1 lists key personnel. STARS Alliance partnerships will continue to be guided by the Alliance Steering Committee (ASC). Each star will form its own advisory board to guide regional partnerships, and to coordinate implementation of the SLC and other alliance initiatives at the local level. Each newly accepted Alliance member institution has identified a faculty to serve on the ASC as their Academic Liaison (AL). Letters of Intent to Apply for STARS Membership and CVs for the AL are included in the attachments. To facilitate start-up, one faculty member from the current ASC will be supported to as an *Institutional Mentor* to the new member. Beginning with the STARS Extension Project, the STARS Celebration will be organized by a Conference Organizing Committee, following standard conference format.

The Alliance Extension Project will provide the additional time and resources needed to demonstrate the Alliance as a replicable network of regional partnerships that can be implemented in other geographic regions. Other activities geared towards **sustainability** include creating an ACM SIGBPC and exploring mechanisms to engage students and faculty in STARS Activities with non-monetary rewards by establishing BPC efforts as part of day-to-day operations (e.g. through adding for-credit BPC courses, adding BPC as an integral part of courses, TA/RA duties, REUs, honors and internship programs, and service-learning requirements). Many of us leading the Alliance efforts have existing institutional roles related to BPC. The Extension grant will enable us to dramatically enhance the impact of our efforts by pooling resources and expertise across an even greater number of diverse institutions. Beyond the timeframe of this grant, we expect to continue serving these institutional roles, but as part of a larger, cohesive effort, rather than as isolated entities. We expect the improvement in our own institutional demographics and the support received from industry and community partners to encourage our administrations to provide the support needed to continue the Alliance Exchange and Faculty Liaison activities.

We already have strong institutional support, as evidenced by the Letters of Support from our Deans and Provosts citing the important impact of the STARS Initiation Project and pledging their support for the Extension Project (see attachments).

5. Evaluation Plan

The Alliance offers a unique opportunity to build an outstanding evaluation team and to design and refine evaluation instruments for multi-institutional, diverse BPC programs. The STARS Alliance evaluation team includes Tiffany Barnes, Kim Buch, Sarah Berenson, Audrey Rorrer, Anthony Chow, and Nathan Thomas. Kim Buch, an organizational psychologist and evaluator for the ADVANCE 2006 grant at UNC Charlotte, offers a psychology perspective for designing and evaluating the Alliance structure and intervention programs. Sarah Berenson, Director of the Center for Research in Science and Math Education at NC State, provides the educational research design perspective, along with experience from ITWF-funded research projects designed to affect and understand the participation of women in IT. In 2005, she received the 2005 Holladay Medal for Excellence, NCSU's highest faculty award. Nathan Thomas, Director of Diversity at the USF-Lakeland, serves as the content expert for evaluating the SLC based on his "ecological model" [Tho05] for retention of computing students. Tiffany Barnes, co-PI of the STARS Alliance and Assistant Professor of Computer Science at UNC Charlotte, serves as Evaluation Manager. Anthony Chow, Assistant Professor of Information Science at UNCG, serves as the marketing evaluator. This outstanding team collaborates to design, refine, and evaluate the effectiveness of the Alliance and its activities and disseminate STARS results.

Evaluation is a critical component of the STARS Alliance, to assess program efficacy and to inform the academic community of which interventions can be successfully applied within the respective communities. Daniel Stufflebeam's Context, Input, Process, Product (**CIPP**) model [Mad83,Stu71] is being used to assess the demonstration projects including the STARS Leadership Corps, and the STARS Alliance structure overall. This model is well-recognized and broadly used to assess projects in K-16 educational settings, and provides valuable formative and summative evaluation measures. Using this model, evaluators record and assess:

- **Context** – the larger setting of the project
- **Input** – all crucial project staff, materials, and resources
- **Process** – project strategies, activities, and procedures. This formative evaluation is used to determine modifications and adjustments needed to improve project operation.
- **Product** – the ultimate result obtained that can be attributed to project interventions. This summative evaluation is used to determine the overall success of the project.

The evaluation will include both quantitative and qualitative components. The quantitative component will examine readily quantified factors, such as number of computing faculty, students, and professionals involved; hours contributed by the students and faculty; and number of participants in outreach events. The qualitative component will involve electronic journaling by all SLC students and select interviewing or focus groups of key STARS mentors, faculty, and students. Qualitative data will be solicited from all these individuals and compared using triangulation. Electronic journal entries and open-ended survey data will be analyzed using Content Analysis techniques. These results should provide insight into the impact of STARS programs, and should reflect affective, behavioral and cognitive (ABC) change in participants. **Affective changes** reflect changes in attitude or perception, such as expressing an increased interest in majoring in computing**. Behavioral changes** reflect actual change in participant behavior, such as enrolling in a computing degree program. **Cognitive changes** reflect change in knowledge, such as becoming aware of previously unknown programs or scholarships for computing students [Ajz01, Pet97]. Survey instruments will be designed to capture change relative to computing in all three of these areas.

For any interventions implemented through the Alliance, including the SLC, BPC Role Models, BPR, and Pair Programming, all participants will take pre- and post-tests to measure changes in these (ABC) areas. We view the Alliance as an experimental testbed, where ideas for BPC can be incorporated and studied on a multi-institutional scale. Therefore, we design

our analysis as an exploratory study to determine the variables that contribute to observed outcomes. We plan to seek additional funding to augment and explore our project findings.

Our evaluation plan works in the following way: Alliance activities are developed to align with research evidence that shows that such activities will impact the overall goals of the Alliance. Evaluation of each activity is tailored to measure the particular factors that contribute to BPC goals. Overall assessment of Alliance success will be determined through a careful comparison of baseline data, disaggregated by race, ethnicity, gender, and physical ability for each institution and observing gains or losses in each of the specific outcomes identified. A summary of assessment objectives, example measures and data collection associated with each of the project activities is given in the following table.

Table 5.1: Summary of Assessment Objectives, Activities, Measures and Data Collection

Goals & Desired Outcomes	Activities	Example Measures	Data
Goal 1: Recruitment Increased computing enrollments & awareness	-Alliance Exchange -SLC program -Pair programming	- Faculty, professional, student, & K-12 participation computing attitu - # STARS publications, presentations	-Pre-post test -Interviews -Participation
Goal 2: Bridging Increased student readiness, graduate stud. & workforce	-Website, Marketing & Careers Campaign -SLC program	- # people affected - Computing attitude scale - # student job applications; interviews	-Applications -Enrollment
Goal 3: Retention Increased computing retention, majors, graduation	-Alliance Exchange -SLC program -Pair Programming	- Identity development scale; GPA - Social, academic, & psych support scale; College Adjustment scale	-Pre-post test -Enrollment -Longitudinal
Goal 4: Advancement Increased computing faculty research & support for faculty tenure & promotion	- Writing, teaching, research circles - Tiered mentoring - Research exchanges	- # faculty & student participants - # faculty retained, # promoted - # faculty computing publications - Career satisfaction scale for faculty	-Pre-post test -Faculty retention & demographics
Goal 5: Sustainability Sustained Alliance efficacy & partnership building	-Advisory Board -Pair Programming -Task Force Dialogues	- # participating institutions & orgs. - # policies adopted - Organizational Efficacy scale	-Annual Alliance Report
Goal 6: Dissemination Increased awareness & adoption of effective STARS/BPC practices	-Task Force Dialogues -Website & Exchange -SLC program -STARS Celebration	- Student participation & attendance - # policies adopted; people affected by service, dissemination activities; - Measures to asses Alliance efficacy	-Marketing report -Exchange report

As new members are added to the STARS Alliance, the evaluation team will be augmented to ensure that STARS evaluation is conducted at each member institution. All STARS evaluation materials will be made public and shared with newly forming STARS Constellations. As the Alliance works to institutionalize the SLC and other projects as part of the culture of participating institutions, the evaluation team will work carefully to design metrics and measures to determine the extent to which each institution is incorporating STARS initiatives into its standard practices. Examples of quantitative measures include: participation rates in SLC-like courses, number of BPC-like activities adopted at an institution, number of faculty, staff, and students participating in department-level outreach, number of new BPC-related positions created, and the number of new student organizations, honors programs, and service learning requirements in participating departments. Qualitative measures of the success of institutionalization will include computing department climate surveys, focus groups, and interviews. We plan to implement Evaluator Assistant projects, where we will recruit computing students and social science students and faculty to carry out these projects as extended SLC or REU projects at each member school.

In all cases, where available, STARS data will be compared with national and regional data to determine the relative impact of STARS programs on its goals to broaden participation in computing.