Journal of Women and Minorities in Science and Engineering, vol. 14, pp. 119–140, 2008

COLLABORATION AS A MEANS TO BUILDING CAPACITY: RESULTS AND FUTURE DIRECTIONS OF THE NATIONAL GIRLS COLLABORATIVE PROJECT

Rose M. Marra,[1] Karen Peterson,[2] and Brenda Britsch[2]
[1]University of Missouri; [2]Puget Sound Center for Teaching, Learning and Technology

The purpose of the National Girls Collaborative Project is to extend the capacity, impact, and sustainability of existing and evolving girl-serving STEM projects and programs. This paper describes the underpinnings and design of the National Girls Collaborative Project (NGCP) and posits that the structured collaboration framework this organization foments may be a necessary component for our field to move beyond our current levels of representation of women in science, technology, engineering, and mathematics (STEM). Initial results from the projects are described and related to nationwide efforts to increase women in STEM.

INTRODUCTION/PROBLEM STATEMENT

It is commonly recognized that the representation of women in science, technology, engineering, and mathematics (STEM) fields is too low both from a perspective of equal opportunity (Gowan & Waller, 2002; Sadker & Sadker, 1994) and for meeting the projected need of STEM professionals (Chubin, May & Babco, 2005). Studies show that the low representation of women in STEM professions begins as early as eighth grade, when twice as many boys than girls show an interest in STEM careers (Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development, 2000), and continues in college, where women received only 21% of bachelor's degrees awarded in engineering, 27% in computer sciences, and 43% in physical sciences (National Science Board, 2006). Factors such as perceptions of careers, confidence, role models, and career advice have been noted in the literature as contributing to the lack of females in information technology (Bartol & Aspray, 2006). Women constitute 45% of the workforce in the United States but hold 25% of science and engineering jobs and 29% of computer and mathematical occupations (U.S. Census Bureau, 2000).

Many organizations and activities are designed with the sole purpose of addressing this problem. However, in spite of this investment, the nation has not experienced significant gains in the representation of women in several key STEM fields, e.g., computer science, engineering, and physics. This is particularly true in engineering where, overall, women represent about 20% of undergraduate engineering students; in computer science, women's representation has actually decreased (National Science Board; 2000; National Center for Women in Information Technology [NCWIT], 2007; see NCWIT for Numbers and citation). Many factors may contribute to the apparent inability of our efforts to increase the representation of women in these fields in order to reach

Correspondence concerning this article should be addressed to Rose M. Marra, University of Missouri; e-mail: Rmarra@missouri.edu.

ISSN 1072-8325/08/$35.00

the "tipping point," where women's representation will be equivalent to their numbers in the overall population. Collaboration, as an interactive process, enables professionals across projects and communities to generate and carry out creative solutions and strategies that maximize benefit beyond that which entity could accomplish. The National Girls Collaborative Project (NGCP) model includes a number of strategic activities that provide value and incentives to encourage organizations and individuals to work together and to use the leverage of a network of individual girl-serving STEM programs to help create gender equity in STEM.

How can collaboration help? Increasing collaboration between girl-serving organizations has the potential to reduce duplication of effort and organizational isolation, to increase efficiencies through sharing of resources (e.g., physical spaces, marketing materials), and to promote sustainability of recruitment and retention efforts. The National Science Foundation (NSF) has recognized the need for collaboration and recently funded several efforts to address this need (National Science Foundation, 2007a).The NGCP (http://www.ngcproject.org) is one such effort.

The purpose of the NGCP is to extend the capacity, impact, and sustainability of existing and evolving girl-serving STEM projects and programs. The NGCP is structured to bring organizations together to compare needs and resources, to share information, and to plan strategically to expand STEM–related opportunities for girls. This paper first examines the key elements of collaboration that provide the basis for NGCP, then describes how the NGCP model works; its results to date and how the lessons learned from NGCP can be applied to women in STEM organizations nationwide.

BACKGROUND LITERATURE

Since 1994, the NSF and the American Association of University Women (AAUW) have invested nearly $90 million to fund projects aimed at increasing gender equity in STEM fields (American Association of University Women Educational Foundation [AAUW], 2004). These are but two of many organizations that continue to invest in this effort; however, as we have previously argued, our efforts seemed to have stalled in their impact on the representation of women in STEM. We argue that this may be due in part to the isolation of STEM-focused girl-serving organizations. This isolation and lack of collaboration can lead to several problems including the following:

1. Too few resources distributed over too many programs, including the possibility that organizations may actually be inadvertently competing for the same girls when they receive solicitations for multiple activities that have not been coordinated.
2. Duplication of efforts—an indication of an overall lack of coordination.
3. Over taxation of the same or limited group of corporate donors being solicited for resources by individual organizations when coordinated requests could be more effective.
4. Increased motivation and sustainability problems. Isolation of individual girl-serving organizations can lead to burnout, lack of new ideas, and the furthering of ineffective practices.

5. Lack of capacity-building in STEM-focused girl-serving organizations. Low resourced organizations must spend the bulk of time and other resources implementing individual activities leaving little time for improving activities (evaluation and assessment), girl follow-up, or activities designed to create sustainable organizations (e.g., staff development).

The costs of these problems are exacerbated because many girl-serving organizations are not well resourced to begin with—limited staff, limited budget, limited time, limited expertise. Although organizations such as the NSF and AAUW followed a necessary path of funding STEM-focused girl-serving organizations over the past decade, the funding of so many individual activities may have contributed, in some ways, to the current situation.

A recent report also points to the issues that isolated funding and girl-serving efforts can produce. AAUW's *Under the Microscope* researched the STEM-focused girl-serving projects funded by AAUW and NSF and concludes that there has been an impressive collection of gender equity projects; however, they are discrete in nature, and the gender equity movement would benefit from more strategic approaches to addressing gender equity in STEM fields (AAUW, 2004).

Funding organizations are recognizing the need to focus their investments more systemically and their current requests for proposals (RFP) reflect this need. For instance, NSF's Program for Research on Gender in Science and Engineering (GSE) is not currently funding girl-serving activities but rather focusing on funding high quality research of STEM activity implementations as well as their ongoing funding of dissemination projects.

The NSF-funded Information Technology Experiences for Students and Teachers (ITEST) Learning Resource Center (http://www2.edc.org/itestlrc/) represents both this current funding direction as well as the need to reduce isolation of STEM recruitment activities. ITEST projects are designed to "provide opportunities for both school-age children and teachers to build the skills and knowledge needed to advance their study and to function and contribute in a technologically rich society" (ITEST, 2008). In particular, ITEST addresses the need to reinforce STEM discipline knowledge and career awareness beyond the classroom. ITEST addresses this need through a quality after-school and other out-of-school-time STEM experiences focused on purposeful involvement and community encouragement (including peers, family, and the community as a whole; Barton, Drake, Perez, St. Louis & George, 2004; College Board, 1999). When NSF developed the ITEST program in 2003, they included funding for a resource center in addition to funding for individual projects. The goal of the resource center was to assist the projects to achieve their full potential. The center was designed to create a community amongst projects, to help projects share resources and what they have learned to create new knowledge across the entire program, and to disseminate that knowledge to a wide education and policy-making audience to positively impact practice.

The resource center was designed to essentially address the same problems previously described that resulted from a lack of collaboration. NSF recognized this need and set of problems and funded the ITEST National Learning Resource Center to promote sharing and connection building between youth-based and ITEST projects in order to leverage and disseminate the lessons learned from individual programs to a wider au-

dience. In essence, the Learning Resource Center addresses issues of isolation across ITEST projects.

The ITEST project represents one example of how STEM recruitment and retention programs are seeking to collaborate in order to improve their effectiveness. While definitions vary, *collaboration* can be defined as an interactive process intended to enable professionals across projects and communities who share goals to generate and carry out creative solutions and strategies that maximize benefit beyond that which one project or community could accomplish. Collaborative models include a number of strategic activities—potentially including jointly developed structures and shared resources—that provide value and incentives to help organizations and individuals to maximize benefits beyond that which one project or community could accomplish (Mattessich, Murray-Close & Monsey, 2001; National Girls Collaborative Project, 2007).

Collaboration has the potential to provide for easier and coherent access to services and resources and the possibility of a greater and longer lasting impact on targeted systems; Loan-Clarke & Preston (2002, as cited in Caniglia, nd) describe several other diverse benefits of collaboration.

1. Collaboration can ensure more effective use of individual talents and resources. In general, collaboration offers the possibility of multiple entities coming together to work towards a common goal. It is often the case that no single organization possesses all the knowledge, skills, and techniques required to most effectively accomplish that common goal. The current representation of girls engaged in STEM activities may be an indicator that such a talent and/or resource deficit exists in individual STEM-focused girl-serving organizations. While it is possible that an organization might be able to learn or acquire all the techniques and resources needed to solve a particular problem, it seems both unlikely and also very costly in terms of time and other resources. In contrast, when organizations collaborate, it is more likely that when they combine their resources and skills, they will possess what is needed to effectively address the problem.
2. Collaboration may be a source of stimulation and creativity. When individuals and organizations with similar goals work together, there are natural opportunities for the discussion of ideas and for these ideas to cross fertilize and be adapted for improvement or for the spin-off of new ideas that grow from the old. Individual organizations may or may not be staffed sufficiently to promote this sort of creativity, yet combining multiple organizations may help to achieve this outcome.
3. Collaboration extends the individual organization's networks. An implicit outcome of the above is that by connecting previously unconnected organizations, all organizations have a broader network from which to draw upon for future needs. An individual organization may have contacts with 10 other like-minded organizations that can be contacted for information or advice. By collaborating with others, the network can be extended and further productivity enabled.
4. Collaboration enhances dissemination of results. With this extended network, the opportunities for disseminating results are increased. In the area of girls in

STEM, this is particularly important as the need to know both what activities are currently available and what is working is necessary if we are to further increase the representation of girls in STEM fields.

5. Collaboration can build organizational empowerment (Wolff, 2001). A last but very important potential benefit of collaboration is the possibility for individuals to be more empowered or more confident overall due to their increased connectivity with like-minded organizations. This sense of empowerment can improve the organization's ability to respond to new challenges and to new opportunities. (Wolff, 2001).

Many coalitions and collaborative projects have accomplished these types of outcomes when addressing complex societal issues (Jackson & Clark, 1996). Research suggests that coalition building assists in carrying out the educational plan: broadening the development of new audiences; reporting the results of member activities through media; and improving the educator's capacity for providing information to citizens, interest groups, and policy makers.

Mattessich et al. (2001) conducted a review of research on collaboration in order to identify factors commonly identified as being critical to the success of collaborative ventures. They grouped their findings into six categories and then subdivided each category further. Figure 1 shows the six categories and a sampling of the subcategories most often cited in their literature review.

Environment • History of collaboration or cooperation in the community • Collaborative group is seen as respected leader in community
Membership Characteristics • Mutual respect, understanding, and trust • Members see collaboration as in their self-interest
Purpose • Concrete and attainable goals and objectives • Shared vision amongst collaborating organizations.
Communications • Open and frequent communication • Established informal and formal communication links
Process/Structure • Members share investment in processes and outcomes • Multiple layers of decision making within the organizations • Flexibility and adaptability • Developing clear roles and policy guidelines
Resources • Sufficient funds • Skilled convener—individual who convenes has organizational and interpersonal skills to execute collaboration with fairness

Figure 1. Factors that influence success of collaborations (adapted from Mattessich et al., 2001).

Borden and Perkins' (1999) summary of common factors and characteristics influencing the collaborative process provides a similar set to those identified by Mattessich et al (2001). For instance, Borden and Perkins cite work from the National Network for Collaboration (Hogue et al., 1995) that identified factors such as leadership, communication, community development, and sustainability, and a study by Borden (1997) that identified four factors: internal communication, external communication, membership, and goal setting.

Agricultural extension is a U.S. institution that exemplifies many of the principles of collaboration that can be effective in addressing the needs of isolated STEM-focused girl-serving organizations. Agricultural extension services are rooted in the United State's land-grant institutions and strive to implement the meaning of the word extension—that is to "reach out," and along with teaching and research, "extend" college or university resources, solving public needs with resources through nonformal, noncredit programs. Like many of the organizations that work to attract girls into STEM, agricultural extension operates primarily through informal learning activities. The U.S. congress created the agricultural extension system in the early 1900's (Jackson & Clarke, 1996) to address the farming and agricultural issues of the 50% of the U.S. population that lived in rural areas and the 30% of the workforce that was engaged in farming (U.S. Department of Agriculture, 2007). Like some STEM-focused girl-serving organizations, the farmer was often isolated; the success and effectiveness of agricultural extension can be ascertained from the dramatic increases in farm productivity that coincided with the development and propagation of agricultural extension services and from the very fact that the program still exists today.

Jackson and Clark (1996) conducted a study of 58 extension sites to examine the relationship between selected situational factors and structural characteristics of collaborative organizations and perceived effectiveness of collaborations. Structural characteristics were aspects of the collaborative organizations that seemed to capture their "structural essence" (p. 2) such as resource flows, communication frequency, and communication quality. The situational factors used were the size of the collaborative organization, the type of organizations involved in the collaboration, the amount of resource dependency that existed between collaborative partners, and the degree of consensus among collaborative partners. The researchers found that the degree of consensus amongst collaborative partners followed by the formalization of agreements between partners, and the flow of resources between partners were the best predictors of the perceived effectiveness of the collaboration.

Although agricultural extension services have been in existence for nearly a century and played a critical role in popular programs such as World War I's Victory Gardens, many of us today are unaware of its existence—and may not be cognizant that the model of agricultural extension is itself being extended or propagated. In fact it is this very program that provides the roots for the recently developed extension services grants funded by NSF's GSE program. According to the NSF GSE call for proposals (National Science Foundation, 2007b), extension services grants are designed to "provide training and consulting services to educators and institutions, to enable them to adopt and embed proven gender-inclusive policies and practices in pedagogy, the design of curriculum materials, student support programs, educator and faculty development"

(p. 5). In general, these projects focus on building capacity and replicating programs that have been shown to be successful more broadly. The NGCP is an example of one such recently funded program.

NGCP—COLLABORATION AND EXTENSION IN ACTION

The NGCP exemplifies the essential elements of collaboration and the agricultural extension model and brings together organizations throughout the United States that are committed to informing and encouraging girls to pursue careers in STEM. The project focuses on three main goals:

1. Maximize access to shared resources within projects and with public and private sector organizations and institutions interested in expanding girls' participation in STEM.
2. Strengthen capacity of existing and evolving projects by sharing promising practice research and program models, outcomes, and products.
3. Use the leverage of a network or collaboration of individual STEM-focused girl-serving programs to create the tipping point for gender equity in STEM.

Project Origins

In 2002, the Puget Sound Center for Teaching, Learning and Technology (PSCTLT) implemented the Northwest Girls Collaborative Project (NWGCP) in Washington and Oregon. This regional collaborative organization was designed to promote institutional and resource collaboration to help STEM-focused girl-serving organizations more effectively address the complex issue of gender equity in STEM fields. As our results section below describes, the NWGCP was successful in its geographic area and resulted in a model of collaboration that could be applied more broadly.

In 2004, NSF funded the NGCP. The purpose of the NGCP is to increase the capacity, impact, and sustainability of existing and evolving girl-serving STEM projects and programs by replication of the NWGCP model in three states: California, Massachusetts, and Wisconsin. Recently, the NSF funded a process for extending and focusing the NGCP model across the United States and Puerto Rico. Implementation of the growing NGCP involves the creation of regional collaboratives across the United States that will assist existing and evolving girl-serving STEM projects to take advantage of shared idea and resources. Using the AAUW regional framework to organize oversight and support, this project implements and disseminates the strategies from the successful collaboration structure previously developed via the NWGCP and NGCP. The expanded NGCP utilizes the leadership and expertise of additional partners, Assessing Women and Men in Engineering (http://www.Aweonline.org) and the Educational Development Center (EDC), to disseminate research-based promising practices to further advance the work of existing and evolving girl-serving projects and also to provide a forum to share results among practitioners and researchers.

Key Elements of the Model

The NGCP model (as illustrated in Fig. 2) includes a number of key players, organizations, and design elements that exemplify collaboration and strive to reduce the previously stated problems associated with many relatively isolated organizations working to achieve the same goal. The key players operate as follows to achieve the project goals:

1. National leadership team: senior project team members with experience from previous replications of the model who can ensure model fidelity
2. National champions board: key individuals from higher education, national K-12 organizations, corporations, and professional organizations to advise and support the project throughout their various networks
3. AAUW regional liaisons: local AAUW members charged with supporting and promoting local regional collaborative organizations
4. Collaborative leadership teams: individuals from the two or three lead regional organizations managing local activities
5. Collaborative champions boards: key individuals from local companies, professional organization chapters, higher education, and local K-12 organizations to support and advise the regional implementation of the project
6. Participants (girl-serving organizations, education, business, professional organizations, e.g., Society of Women Engineers [SWE]): local girl-serving STEM organizations motivated to collaborate to extend and to enhance programming

The model implements the following design elements that bring the players together into a collaborative network.

1. Implementation of Collaborative Model: The National Leadership works to create the individual regional collaboratives by identifying organizations that demonstrate collaboration readiness. These organizations must have a history of local collaboration and be able to integrate participation in NGCP into existing organization activities and utilize existing organization staff. Typically, these organizations are seeking a leadership role in their communities and welcome the resources and tools the NGCP provides to further this goal. Once identified, the national leadership and the AAUW liaisons provide training and mentoring of these regional collaborative participants in how to create STEM-related collaborations and assist these collaborative networks in creating action plans, which utilize research-based promising practices in the areas of informal learning and evaluation and assessment. AAUW regional liaisons provide support to regional collaboratives through a connection to AAUW and other regional efforts to improve opportunities for girls in STEM. Currently, the project has 7 regional collaboratives operating and will add approximately three more in year 2 of the grant. By the end of the 5-year project, the project should support regional collaboratives that cover all states in the United States as well as Puerto Rico.
2. Dissemination and Outreach: In partnership with regional and professional organizations, the NGCP leadership team works to document and promote co-

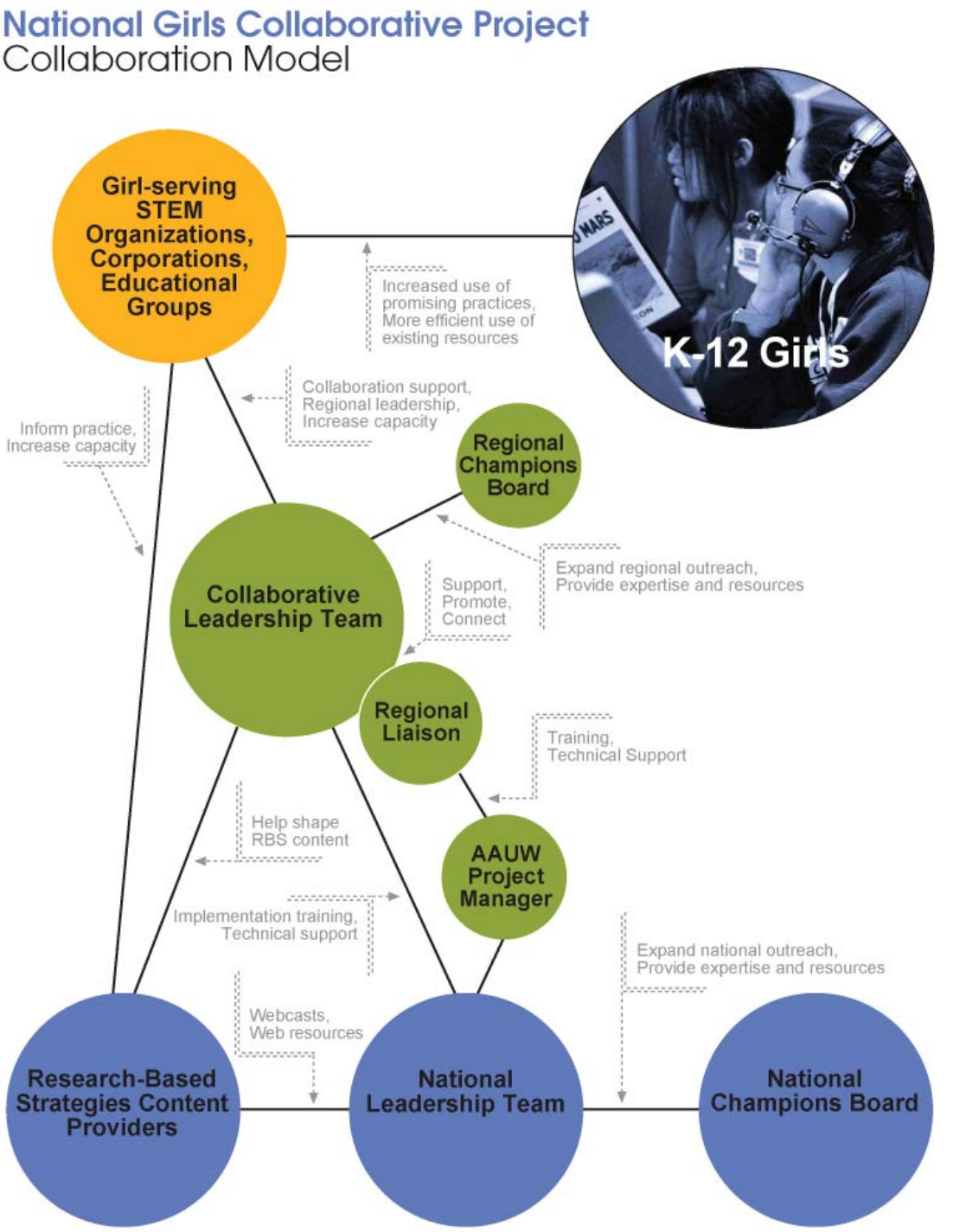

Figure 2. National Girls Collaborative Project Model.

ordination and collaboration among girl-serving STEM programs throughout the United States and Puerto Rico by implementing an ongoing communication system linking these organizations. There are several tools used to promote this communication including webinars and the NGCP newsletter; however, a key tool for this activity is the NGCP Program Directory. The program directory lists organizations and programs that focus on motivating girls to pursue careers in STEM and is designed to help organizations and individuals network, share resources, and collaborate on STEM-related projects for girls.

3. Collaboration Support: Regional collaboratives offer minigrants of $1,000 or less to girl-serving STEM-focused programs as an incentive to collaborate and to assist in informal STEM-focused learning projects as well as assessment and evaluation activities.
4. Research Evaluation: Conduct evaluation of the NGCP to determine effectiveness of collaboration and the impact of collaboration and implementation of STEM research-based promising practices at national, regional, and local levels.

The combination of these key players and design elements produces a model that addresses the need to reduce isolation and to increase collaboration by bringing people together in person and online, by providing professional development and incentives (minigrants) for collaboration, by providing and creating an online community for those doing this work, and by connecting girl-serving organizations with each other, educa-

Mattessich, et al. (2001) Factors	NGCP Design Elements That Address Factor
Environment	Determine that potential regional collaborative organizations are "collaboration" ready.
Membership Characteristics	Regional collaboratives must "propose" their membership and plan for working with the NGCP model and express how collaboration will benefit them.
Purpose	Works with organizations with like goals (e.g., organizations that work in some way with K-12 girl to promote STEM).
Communications	Frequent communication via multiple methods: AAUW liaisons, newsletters, List servs, conference calls.
Process/Structure	Implementation guide establishes a clear process to guide regional collaborative.
Resources	Resources made available both to regional collaboratives plus to girl-serving organizations through minigrants.

Figure 3. Key collaboration factors as implemented in NGCP.

tion, and business to have a greater impact on services and possibly policy ("a bigger voice"). We also note that the NGCP model is in alignment with the factors that influence collaboration identified by Mattessich et al. (2001). Figure 3 shows how the NGCP model aligns with these factors.

NGCP as Extension

Another way to understand NGCP and how it addresses issues of isolation of girl-serving STEM organizations is to map its functionality to the elements of traditional agricultural extension. Figure 4 shows this mapping. The similarities begin with both programs serving a participant that is relatively isolated, in need of resources and information that can promote information and resource collaboration or sharing. In agricultural extension, this participant is generally the farmer; in NGCP, it is the STEM girl-serving organization.

Continuing the mapping to the agricultural extension model, the NGCP model provides extension "agents" in the field, located geographically in the same area as the participants from STEM girl-serving organizations. The extension agents include the regional collaborative host organizations/leadership teams, AAUW regional liaisons, and content experts in areas such as assessment and evaluation (Assessing Women and Men in Engineering [AWE]), or in the case of informal learning, EDC and Techbridge (http://www.techbridgegirls.org). These individuals provide support and expertise to the participating girl-serving organizations, educational organizations, and businesses. The purpose is to provide support and expertise regionally so it is more accessible to local organizations than if it were housed at the national level. The national leadership

Agricultural Extension—NGCP Focused Organization Mapping

Agricultural Extension Participants	Characteristics in Common	NGCP Participants
Farmer	Isolated, in need of expert knowledge, resources and economy of scales; can profit from informal learning opportunities.	Girl-serving STEM organizations
Land Grant Institution extension agents	Has regional expertise and resources, and tools to promote collaboration to provide to "isolated" participants	AAUW liaisons, Regional Collaborative Leadership teams; content experts (e.g., AWE, EDC, Techbridge)
United States Department of Agriculture	Develops systems to help collaboration and sharing occur between "agents" and "isolated" participants	NGCP Leadership, Regional Collaborative Leadership

Figure 4. Mapping between Agricultural Extension and NGCP.

of NGCP is analogous to the agriculture extension's U.S. Department of Agriculture. NGCP leadership supports the organizations and individuals who operate as agents, but it acknowledges that regional support and expertise is often most valuable. The AAUW liaisons, in particular, have expertise on the NGCP model but are located within the region they serve, which makes them better equipped to support the regional collaboratives and the participating organizations. The regional collaborative host organizations and leadership provide training and mentoring and resources to the organizations in their regions in the form of in-person events, online resources, and minigrants. They are also experts on the model (with the help of AAUW liaisons and training provided by the national team) but are in touch with their region in a way the national team is not able to accomplish.

RESULTS, LESSONS LEARNED, AND IMPLICATIONS

The NGCP extension project has just completed year 1 of 5 at this writing; however, evidence of the effectiveness of the collaborative model can be garnered from the precursors of the NGCP (e.g., NWGCP and the South Central Girls Collaborative project [SCGCP], an NSF-funded regional replication of the NGCP). These results are germane to the current extension project (and provide evidence of our current projects' potential impact) as these prior collaborative instantiations had the same essential objectives as the current project. That is, they are designated to increase collaboration among STEM-focused girl-serving organizations. Lastly, we also present initial results from year 1 of the NGCP extension services project. The reader will note that even though our broader goals are concerned with increasing the representation of girls in STEM, all of the NGCP projects are focused on collaboration building among organizations that either directly serve or provide resources to these girl-serving organizations. Thus, all results are discussed in terms of collaboration capacity building.

Metrics from the combined projects also provide evidence of the models ability and accomplishments in reaching a significant number of not only girl-serving STEM organizations but also their potential and actual collaborative partners. Table 1 summarizes these metrics.

Minigrant Collaboration Results

Currently, we are systematically gathering outcomes results data for all new minigrantees for the NGCP extension services grant; however, results from grants funded in the earlier instantiations of NGCP—namely the NWGCP and the SCGCP—provide evidence of their impact on collaboration. The NWGCP awarded 25 minigrants of a maximum of $1,000 each to organizations that collaborated on a project serving girls in STEM. The minigrant projects varied in size and scope, including a summer Lego Robotics camp for underserved girls, an inquiry-based science class for underachieving high school girls, a trip for rural girls to visit Boeing and the Museum of Flight, and an after-school program for middle school girls focused on marine science.

Ten grant recipients completed a pre-report and thirteen recipients completed the postreport. The presurvey was completed before projects began and asked minigrant-

Table 1. Metrics from Combined NGCP Projects

Accomplishment	Description
Minigrantees	156 minigrants awarded since 2004.[1]
Replicated collaborative projects	Two additional projects funded by NSF that followed the NGCP model; the SCGCP and the Midwest Rural Urban Girls Collaborative Project (MRU). Both projects are completed and will be Texas Girls Collaborative Project and Midwest Girls Collaborative Project in current NGCP extension project.
Regional collaborative established	Six regional collaboratives have been established since the beginning of the NWGCP. All of these are still operating.
Monthly newsletter subscriptions	NGCP sends a monthly newsletter to a list of 4,500 individuals highlighting not only the current news from each regional collaborative The newsletter serves as a portal to announcements from related projects such as funding opportunities, updates to resources such as the Assessing Women and Men in Engineering project (AWE), and conference and workshop announcements of value for STEM-related programs.
NGCP online program directory	This directory is fundamental to the success of regional collaborative and individual minigrants' ability to find collaborative partners and sustain them. It lists organizations and programs that focus on motivating girls to pursue STEM careers. In 2001, it began with approximately 185 entries; it has grown both in functionality and size with over 500 girl serving entries and increased administrative functions. See Table 2 for details on directory entries.
Webcasts	NGCP offers monthly webcasts focusing on the research-based strategy components or information about collaboration and other resources for programs. These webcasts are recorded and archived on the NGCP site for ongoing access and use.

[1]Includes minigrants from all collaborative projects beginning with the NWGCP.

ees about their collaborations and project goals. The postsurvey asked minigrantees about the projects, their experiences with the collaborations and the projects, and project outcomes. Our results summary here focuses on the minigrant recipients' reports of impact on collaboration.

Table 2. Program Directory Listing Details

Type of Organization	Number in Program Directory (5/1/2008)
National professional organizations (e.g., SWE)	7
Science programs at museums (Girls At the Museum Exploring Science [GAMES])	5
Corporate diversity programs	22
After-school robotics programs (FIRST Lego League)	14
General STEM after-school programs (Girls, Inc.)	392
Girl Scout Councils	82
Programs with mentoring/and or role model components	219
Expanding Your Horizons conferences	18
Zoo programs	4

1. Many minigrantees started a new collaboration because of their funding from NWGCP. For those who did not previously know each other, the NWGCP provided the opportunity to meet each other and the guidance to develop a minigrant application and project.
2. As evidenced by the following quotation, for collaborators who already knew each other, the NWGCP minigrant provided the momentum to develop a specific project together: "The NWGCP got me moving forward on the project and collaborating with others. Without the grant my project wouldn't have gone past the idea stage and I wouldn't have thought about collaborating."
3. Minigrants exemplified the benefit of shared collaborative resources. Grantees reported consistently that they were able to provide more and/or higher quality programming or services as a result of the collaboration. Many mentioned the benefits of two organizations with different skills and resources working together.
4. The sustainability of the collaborations varied. Nine minigrantees reported that their collaborations would continue, and five of these stated that the collaboration would be expanding. For example, one program developed a working relationship with a female engineer at Boeing that will continue in the future. Three recipients were hopeful that their collaboration would continue but were not sure, and one recipient stated that the collaboration would not really continue, but the relationship would.
5. The minigrantees recognized the value of the collaborations. Minigrantees expressed that the minigrant really motivated them to collaborate in a new way or with a new organization. The minigrants also motivated organiza-

tions to put into action an idea that they had not acted on previously. Minigrantees also stated that the grants provided support (both financial and other) to carry out the project. An additional benefit for some organizations was that the minigrantees motivated and allowed them to leverage resources for a larger project.

A recent report from SCGCP also provides support for the effectiveness of minigrants in supporting and growing collaboration (Peet, 2007). Although the SCGCP minigrantees reported some challenges due to the distance between collaborative partners, almost all of the minigrant participants that reported evaluation data indicated that the collaboration between the minigrant partners would continue in some form, whether it was with the same minigrant project or the start of something new.

Organizational Collaboration

NGCP gathered data on the effectiveness of the project in promoting collaboration through the use of a "collaboration rubric." Figure 5 shows an excerpt from this rubric (Borden & Perkins, 1999; Frey, 2006; Hogue, 1993). Respondents from each of the regional collaboratives were asked to rate the extent of their collaboration with the STEM organizations listed. The five levels of collaboration (see Fig. 5) are as follows:

1. networking
2. cooperation
3. coordination
4. coalition
5. collaboration

At the low end, *networking* means there is an awareness of another organization but no defined roles or established communication, and at the high end *collaboration* indicates the members of each organization operate as if belonging to one system, there is frequent communication, and consensus is reached on all decisions.

To measure NGCP's impact on collaborative relationships, representatives from individual STEM-focused girl-serving organizations, corporations, and professional organizations in each regional collaborative completed the rubric at the beginning and again at the end of the project. The national leadership team collected these results for 3 of the 4 collaborative regions. Results showed an increase in collaboration with all organization types. Increases were significant in 2 categories: collaboration with STEM professionals and with higher education STEM programs.

The Wisconsin organizations showed the most positive changes in collaboration as measured by this rubric. Overall pre- and postdata indicating the degree to which the reporting organization collaborated with a certain type of group indicated an average of 1.72 (pre: $N = 32$) and 2.58 (post: $N = 17$). A t-test showed this difference to be significant at the .05 level. In addition to Wisconsin, the mean level of collaboration across all individual organizations surveyed increased significantly ($p < .01$) from 1.84 to 2.81.The California organizations' collaborative data also showed positive change in level of collaboration with each type of organization as well as an increased overall

Five Levels of Collaboration and their Characteristics

	Networking (1)	Cooperation (2)	Coordination (3)	Coalition (4)	Collaboration (5)
Relationship Characteristics	• Aware of organization • Loosely defined roles • Little communication • All decisions are made independently	• Provide information to each other • Somewhat defined roles • Formal communication • All decisions are made independently	• Share information • Share resources • Defined roles • Frequent communication • Some shared decision making	• Share ideas • Share resources • Frequent and prioritized communication • All members have a vote in decision making	• Members belong to one system • Frequent communication characterized by mutual trust • Consensus is reached on all decisions

STEM Organizations	No Interaction	Networking	Cooperation	Coordination	Coalition	Collaboration
K-12 teachers	0	1	2	3	4	5
K-12 counselors	0	1	2	3	4	5
Higher ed STEM faculty	0	1	2	3	4	5
Higher ed academic counselors	0	1	2	3	4	5
Higher ed STEM program	0	1	2	3	4	5

Figure 5. Collaboration Rubric Excerpt (scale adapted from the work of Hogue, 1993; Borden and Perkins, 1998, 1999; Frey, 2004.

mean level of collaboration of each organization; however, no changes were significant at the $p < .05$ data.

Pre- and postproject collaboration rubric data from the SCGCP also provide some support for the effectiveness of the model. Results showed a slight increase in the mean amount of collaboration between respondents and other organizations from the beginning of the project to the end. The level of collaboration increased in 6 out of 11 organization types; however, none of the changes were statistically significant. Results also showed that the highest levels of collaboration were with K-12 teachers, corporate partners, and professional organizations. Lowest levels of collaboration were with higher education STEM programs and academic counselors.

NGCP Extension Services Evaluation—Early Results and Plans

Specific data on project outcomes is being gathered via the NGCP extension services grant evaluation to examine project implementation at regional and national levels in order to understand the impact of the project and guide project improvement efforts. Even as we complete year 1, we are working to answer the following evaluation questions regarding the effectiveness of the collaboration: a) How much (and how) does the NGCP model impact collaboration between STEM programs and/or other organizations? b) How are the STEM-focused girl-serving programs affected by access to shared resources of the NGCP (e.g., are their programs more effective)?

The NGCP national team works with the regional collaborative leaders to simultaneously build capacity to conduct the assessment and evaluation activities necessary to answer these questions and to pass these skills and tools on to the STEM-focused girl-serving organizations in each collaborative. Standardized evaluation and assessment tools are providing the basis for both valid and reliable data and include the collaboration rubric, the tested and validated AWE surveys for assessing the impact of minigrant activities, formative evaluation tools for all collaborative events, online database for collecting participant data, and in-depth evaluation forms for each minigrant activity. Additionally, as the project progresses, we will be able to do longitudinal tracking of impact of participation in NGCP of the STEM-focused girl serving organizations. We expect the latter data source to yield valuable information on NGCP's impact on recruitment and retention of girls in STEM.

The following year 1 results regarding collaboration for both the regional collaborative organizations and the AAUW liaisons and their impact on STEM-focused girl-serving organizations show some early signs of effectiveness and also are being used to inform project revisions.

1. All regional collaborative leadership representatives reported communicating at least once with their AAUW liaison during each reported quarter (ranging from 2 to more than 10 times); however, the degree to which AAUW liaisons and regional collaborative leadership communicated each quarter varied from region to region.
2. AAUW liaisons reported being most active in making contacts with organizations associated with promoting girls in STEM (e.g., university personnel, K-12 school personnel, informal education personnel, government personnel) in

order to promote NGCP. One liaison reported making "100s" of new contacts during one quarter. We see this networking result as being critical to goals of NGCP; such contacts increase NGCP visibility and provide important potential resources for regional collaboratives to create champions boards and to find collaborative partners for their regional programs.

3. An important part of collaboration building is providing appropriate resources (Mattessich et al., 2001). Both AAUW liaisons and regional collaborative leaderships report that they frequently use the resources provided by the NGCP leadership team. The NGCP Web site is the most commonly used tool by both groups; print materials (brochures, etc.) were also frequently used, along with the guide documenting the collaboration implementation model and, in the case of the regional collaborative leadership, the AAUW liaisons.
4. Lastly, data from the regional collaborative leadership team indicates that each region is making varying progress towards required outcomes for fully participating as a collaborative. For instance, as of October 2007, only one collaborative had hosted a kickoff conference; however, most collaboratives had hosted a champions' board meeting (which is to occur before the project kickoff). The data indicate overall that all collaboratives are making progress on their required activities but at different rates.
5. Overall these results indicate that the current degree of collaboration is varying between each regional collaborative. This argues for the need for collecting further data—perhaps interview data—to ascertain how the implementation of each collaborative varies and how those differences are related to the collaboration metric results.

Sustaining Collaboration

Another important result aspect of NGCP project effectiveness is the degree to which collaborations are sustained beyond the term of a minigrant, for instance. Although the project can claim successes in establishing new collaborative relationships, sustainability of collaboration continues to be a challenge in the NGCP. For instance, the SWGCP reported that one of the most daunting challenges for the project was to create tools and resources that can be utilized beyond the project funding. Providing tools that will help to engage participating programs, organizations, and Champions Board members in conversations around strategies to better serve girls in STEM can help to ensure that collaborative efforts will continue beyond the funding cycle of SCGCP. Although the formal funding of the SCGCP has ended, the online tools the project created, such as the program directory, Listserv and Web site, will remain as resources available to programs.

Lessons Learned and Implications

A key aspect of any long-term project such as NGCP is continually reflecting on project directions, activities, and results with the intention of continuous improvement. The model pictured in Figure 2 was not the first model NGCP used; it has evolved as the result of lessons learned and the need to make the model work at a national level. For instance, the inclusion of AAUW liaisons in the current project, the increased focus on

identifying partners with collaboration readiness characteristics, and the increased expectations of collaborative partners (e.g., do assessment and evaluation from the beginning) are all examples of how the project has evolved. From these reflections and changes, we feel there are important lessons that we have learned. The following summarizes these lessons and how they may apply to girl-serving STEM organizations.

Set expectations clearly and from the outset. A key strength of NGCP is the collaboration implementation model. This model defines the elements, steps, and required activities of participating as a regional collaborative. Even though somewhat prescriptive, the model itself allows for a great deal of variation in implementation details, so individual organizations can operate effectively in many different ways and still be following the collaborative model. Any problems that have occurred have largely stemmed from straying from the implementation model. We have learned that early reference and ongoing reinforcement of the model is the most effective way to implement successful collaborations. The lesson that can be applied beyond NGCP is that setting expectations clearly up front for the pending collaboration can reduce confusion, help identify collaborative partners that are able to participate fully, and ultimately enable a successful collaboration.

Use the project resources as intended right from the beginning. This lesson is related to the prior one. In the case of NGCP, we have experiences in both doing this well and ones where we could do better. The use of the program directory is a positive example from NGCP. At the onset of the NGCP extension grant, all collaboratives were required to complete their program directory entries. Further, completion of program directory entries is also required for all minigrant applicants. This use of the program directory both served to familiarize participants with its use and value as well as helped to more fully populate the directory, making it more useful to all.

Our incorporation of the AAUW liaisons is an example where we have improved during the last year. Recall that the AAUW liaisons provide regional support to the regional collaboratives to support their implementations, to provide training, and to answer questions about the implementation model. Having these liaisons is a critical part in keeping the collaborations local.

Both of these lessons point to the need to be well prepared to execute and support collaborative relationships before one begins to solicit and build these collaborations. This again points to the need to both be ready to collaborate and implement a proven NGCP model but also to identify organizations that are collaboration ready. This may sound obvious, but it is easy to be anxious to begin and perhaps do so before all the resources and tools are fully ready to support the identified collaborations. By using these resources from the get-go, you get the most from your investment and have the greatest likelihood of sustainability in the long run.

Look for collaboration readiness from the onset. In our experience, collaboration readiness in an organization is indicated when the organization has a history of local collaboration, has already established potential partners for networking during the project, and can integrate participation in NGCP into existing organization activities and utilize existing organization staff. For instance (as a nonexample), an organization of strictly volunteers may not provide a stable and ongoing network to sustain the project as volunteers come and go. Thus, collaboration readiness requires that the organization have a strong organizational structure with some permanence; so even if individuals transi-

tion, there is enough of a core organization and staff remaining to carry on with organizational commitments. Such organizations may take varying forms; for instance, NGCP has found that strong Girl Scout councils as well as university-based diversity outreach organizations (e.g., Women in Science or Engineering programs) may have the characteristics needed to successfully implement the NGCP model. We note that these aspects of collaboration readiness are supported by their similarity to Mattessich et al. list of key factors for collaboration (2001). One of those factors is shared purpose; our experience support this in that we see collaboration readiness as requiring that the mission of the potential collaborator must have some match with NGCP's mission, but interestingly enough that match does not have to be discipline specific. For instance, an organization having a mission of collaboration or informal education (as with many Girl Scout Councils) may be sufficient; they don't necessarily have to be STEM focused.

CONCLUSIONS

When explaining the NGCP to prospective collaborative partners, author Peterson is known to say "the National Girls Collaborative Project doesn't work directly with girls." Now this may seem counter intuitive and somewhat ironic, but the NGCP is not alone in understanding that supporting and increasing capacity for successful girl-serving organizations as well as providing access to resources via collaboration does ultimately impact our overall ability to attract and retain more girls in STEM disciplines

To be more effective in our overall goal of achieving gender equity in STEM disciplines, we may need to—what appears to be—distance ourselves from actual girl-serving activities and concentrate on reforms and organizations that can build capacity and ultimately make the girl-serving organizations more effective.

The NGCP represents a new model for creating sustainable collaborative partnerships between STEM-promoting girl-serving organizations and the organizations that work with them to provide resources, ideas, and access to future girls and women in STEM. This paper has described how the NGCP model works and how, by building collaborative relationships, it can address the relative isolation of these organizations and the resulting duplication of efforts.

Although results are preliminary and are limited by the initial small sample size of evaluation data from such targeted organizations as the minigrantees, our early data suggests that such collaboration and cooperation has the possibility to become vehicles for sustainable outcomes by affecting the tipping point—the point at which small, targeted strategies or activities that happen unsystematically become widespread, causing a cultural shift that drives systemic and inherent change (Gladwell, 2000). The key is to know how to apply the appropriate leverage and influence to make a bigger difference. The same analysis can be applied to gender equity in STEM. Although there have been hundreds of girl-serving STEM projects and targeted strategies to close the gender gap in STEM, we may have not yet reached the tipping point that transforms these individual efforts into systemic change, resulting in our relative plateauing of approximately 20% representation of women studying engineering at the undergraduate level (Engineering Workforce Commission, 2005). NGCP strives to use the leverage of a collaboration of girl-serving STEM programs to create the tipping point for gender equity in STEM.

Although we are still refining it, the NGCP collaborative model has shown its effectiveness through increased collaboration and minigrant projects with sustained results. As we have described, the success to date of the NGCP in developing collaborations has been demonstrated via data from the collaboration rubric, mini-grant reports, and metrics that show how collaborative activities have increased over the duration of the NGCP projects. As NGCP expands over the next few years to provide regional collaboratives across the entire United States and Puerto Rico, we will continue our assessment of its impact and hope to be able to report its influence on building capacity to attract and retain girls in STEM.

ACKNOWLEDGEMENTS

The NGCP is partially funded via a grant from the NSF, Human Resource Development, and Research on Gender in Science and Engineering. National Girls Collaborative Project: Advancing the Agenda in Gender Equity for Science, Technology, Engineering and Mathematics, Grant No. HRD-0631789.

REFERENCES

American Association of University Women Educational Foundation (2004). *Under the Microscope: A Decade of Gender Equity Projects in the Science*. Washington, DC: S.K. Dyer.

Bartol, K. M., & Aspray, W. (2006). The transition from the academic world to the IT workplace. In J. McGrath Cohoon & William Aspray (Eds.), *Women and information technology: Research on underrepresentation* (pp. 377–419). Cambridge, MA: MIT Press.

Barton, A. C., Drake, C., Perez, J. G., St. Louis, K., & George, M. (2004). Ecologies of parental engagement in urban education. *Educational Researcher, 33*(4), 3–12.

Borden, L. (1997). *Community collaboration: When the whole is greater than the sum of parts*. Unpublished doctoral dissertation, University of Illinois, Urbana-Champaign, IL.

Borden, L. M., & Perkins, D. F. (1999). Assessing your collaboration: A self-evaluation tool. *Journal of Extension*, *37*(2), 67–72.

Chubin, D., May G., & Babco, E. (2005). Diversifying the engineering workforce. *Journal of Engineering Education, 95*(1), 73–86.

College Board. (1999). *National task force on minority high achievement: reaching the top.* New York: Author.

Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development. (2000). Land of plenty: Diversity as America's competitive edge in science, engineering and technology. Arlington, VA: National Science Foundation. Retrieved on October 1, 2007, from http://www.nsf.gov/pubs/2000/cawmset0409/cawmset_0409.pdf.

Engineering Workforce Commission (2005). *Engineering and technology enrollments*. American Washington, DC: Association of Engineering Societies.

Frey, B., Lohmeier, J. L., S. & Tollefson, N. (2006). Measuring collaboration among grant partners. *American Journal of Evaluation, 27*, 383–392.

Gladwell (2000). *The Tipping point: how little things can make a big difference.* New York, NY: Little Brown and Company.

Gowen, S. G., & Waller, A. A. (2002). Gender equity and engineering: a review of education policy and research since 1964. Proceedings of the America Society for Engineering Education & Exposition.

Hogue, T. (1993). *Community-based collaboration: Community wellness multiplied. Oregon Center for Community Leadership, Oregon State University*. Retrieved January 24, 2001 from http://crs.uvm.edu/nnco/collab/wellness.html.

Hogue, T., Perkins, D., Clark, R., Bergstrum, A., Slinski, M., et al. (1995). *Collaboration framework: Addressing community capacity*. Columbus, OH: National Network for Collaboration.

ITest (2008). About ITest. Retrieved August 5, 2008, from http://www2.edc.org/ITESTLRC/about/default.asp.

Jackson, D. G., & Clark, R. W. (1996). Predictors of effectiveness of collaborative relationships of the USDA Youth At Risk coalitions. *Journal of Extension*, *36*(6). Retrieved May 15, 2008, from http://www.joe.org/joe/1996december/rb3.html.

Loan-Clarke, J., & Preston, D. (2002). Tensions and benefits in collaborative research involving a university and another organization. *Studies in Higher Education 27*(2),169–185.

Mattessich, P., Murray-Close, M., & Monsey, B. (2001). *Collaboration: What makes it work: A review of research literature on factors influencing successful collaborations* (Vol. 2). Saint Paul, MN: Wilder Research Center.

National Center for Women in Information Technology. (2007). *By the numbers.* Retrieved October 30, 2007, from http://www.ncwit.org/pdf/Stat_sheet_2007.pdf.

National Girls Collaborative Project. (2007). NGCP Web site. Retrieved October 30, 2007, from http://www.ngcproject.org.

National Science Board. (2000). *Science & engineering indicators* (Appendix 4–33). Retrieved August 5, 2008,, from http://www.nsf.gov/statistics/seind06/.

National Science Foundation. (2007a). *Research on Gender in Science and Engineering recent awards*. Retrieved August 31, 2007, from http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5475&org=NSF&sel_org=NSF&from=fund.

National Science Foundation. (2007b). *Program solicitation: Research on gender in science and engineering FY2008 (GSE)*. Retrieved October 1, 2007, from http://www.nsf.gov/pubs/2007/nsf07578/nsf07578.pdf.

Peet, M. (2007). Annual report to the National Science Foundation for NSF Grant No. HRD-0507881. Denton, TX: Texas Center for Educational Technology, University of North Texas.

Sadker, M., & Sadker, D. (1994). Failing at fairness: How America's schools cheat girls. New York: Charles Scribner's Sons.

United States Census Bureau. (2000). Employed bachelor's or higher degree recipients, by occupation, sex, race/ethnicity, country of birth, and disability status: 2000. Retrieved on October 11, 2005, from http://www.nsf.gov/statistics/wmpd/tables/tabh-1.xls.

United States Department of Agriculture. (2007). *Extension*. Retrieved September 4, 2007, from Cooperative State Research, Education, and Extension Service Web site: http://www.csrees.usda.gov/qlinks/extension.html.

Wolff, T. (2001). Community coalition building—Contemporary practice and research: introduction. *American Journal of Community Psychology*, *29*(2), 165–172.