

## **Building a Community of Practice Among STEM Graduate Students to Foster Academic and Professional Success**

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# **Building a Community of Practice Among STEM Graduate Students to Foster Academic and Professional Success**

## Introduction

STEM graduate students will enter a competitive and ever-changing workforce, in which networking and the need to build strong professional connections are mandatory for success. STEM graduate programs need to provide comprehensive career preparation, exposure to a wide range of career types, and networking opportunities. Our approach to professional development for graduate students incorporates the positive impact of communities of practice, as a mechanism of success. Through these communities, graduate students not only are exposed to larger bodies of knowledge and skills, but they also have opportunities to expand professional networks career options.

PROMISE, the state of Maryland's branch of the National Science Foundation's Alliance for Graduate Education and the Professoriate (AGEP) in collaboration with the Graduate School at the University of Maryland Baltimore County (UMBC) have implemented centralized professional development workshops to support graduate students' academic and professional success. We've developed specific workshops to address career options, in response to the 2012 report by the Council of Graduate Schools (CGS), "Pathways Through Graduate School and Into Careers." The CGS report and plans for our expanded graduate school sponsored career-focused activities, have been shared with graduate program directors, the Career Services Center, and the President's Council. We expose STEM graduate students to different kinds of careers, e.g., non-profit, government, and industry, and while maintaining a commitment to train future faculty for different kinds of academic institutions. Our signature career seminars for graduate students are roundtable networking sessions, in which participants have the opportunity to interact with diverse professionals with advanced degrees, from a variety of sectors. These roundtables have been held at the university for a broad audience of graduate students, and at the PROMISE AGEP's Summer Conferences. The PROMISE AGEP conferences, also known as the PROMISE Summer Success Institute (SSI), in particular, draw large audiences of underrepresented minority graduate students. Both the university-based sessions, and the AGEP sessions include several women and underrepresented minority (URM) professionals as "Roundtable Mentors."

This paper utilizes data from these roundtables to identify the impact that this community of practice has had on the success and professional development of graduate students in STEM fields, related to exposure to career options and networking. Several of the engineering graduate students who attended these programs were in their first and second years of their academic programs; therefore, the professional development workshops presented unique opportunities for exposure to career options and mentors at a critical time, early in their graduate studies.

Survey instruments have been used to assess the learning outcomes and reactions of participants to the information and content of each seminar or workshop. These survey instruments have also been designed to collect demographic information from participants – e.g. academic department, gender, racial/ethnic background, and citizenship status. Using a Likert scale measure with 4 options, participants have the opportunity to rank the impact and relevance of each seminar for

their professional and academic development. This paper utilizes assessments from roundtable session evaluations from 2012 and 2013, to show that graduate students in STEM fields can benefit from being part of a community of practice that prepares graduate students for careers, and fosters relationships with peers and professionals.

## Background

The Bureau of Labor Statistics (2012) projects that between the years of 2010 and 2020, there will be approximately 2.6 million job openings requiring advanced degrees.<sup>1</sup> The Commission on Graduate School and Into Careers noted that approximately 59% of graduate students noted that preparing for future jobs was their primary reason for attending graduate school.<sup>2</sup> Considering students' interests and job projections, it will be increasingly important for current and prospective graduate students to understand career options, and the ways in which their graduate studies will prepare them for the workforce. Stemming from their 2012 report, the Commission called for a more strategic approach to preparing graduate students for post-graduate careers. The Commission called on universities, policymakers, and employers to support academic programs in preparing graduate students for careers and strengthening career pathways.<sup>2</sup> Considering the ongoing calls for capable STEM professionals, there should be particular emphasis placed on this group of graduate students.

Professional Development seminars are one promising approach to this challenge. The AGEP and Council of Graduate Schools' Professional Development Seminars on our campus serve several critical functions. They foster a sense of community among graduate students and professionals, expose students to a range of career options, build graduate students' professional networks, and develop specific skills and competencies that will be useful in the workforce. Much of the research on graduate students' professional development in the United States has focused on grooming students for a particular career, rather than exposing them to a range of career options, building professional networks, and equipping them with more general skills.<sup>3,4,5,6,7,8</sup>

Many studies and articles related to career development for graduate students have conceptualized graduate programs as socialization for future careers, particularly careers in academia.<sup>3,4,5,6,7,8</sup> These studies often define socialization as learning and adjusting to the culture, values, and expectations of a particular discipline, department, or profession<sup>3</sup>, however in more recent years there has been more discussion of graduate student socialization as a dynamic, reciprocal process in which graduate students also influence their departments and organizations.<sup>3,9</sup> Despite the range of interpretations of socialization, many academic departments seem to continue to focus on preparation for careers in academia, rather than broader professional skills.<sup>2,10</sup>

Far fewer researchers and programs have emphasized the role of graduate programs in developing students' transferable skills and professional networks.<sup>11</sup> Bridgstock (2009) asserts that "...generic skill development is an inadequate answer to the question of graduate employability and that for enhanced graduate outcomes in the immediate term and on a sustained basis, universities should promote broader career management competence in students." Instead, Bridgstock and a number of other researchers have conceptualized career management as "... the

abilities required to proactively navigate the working world and successfully manage the career building process, based on attributes such as lifelong learning and adaptability”.<sup>11,12,13</sup> Several countries including the UK, Australia, and Canada have applied this broader approach to graduate student professional development. In these countries, public funding for postsecondary education is partially based on graduates’ preparation for the workforce.<sup>11</sup> Many universities in these countries have incorporated professional development into the curricula of their undergraduate and graduate programs. Despite this government and research emphasis, we have limited knowledge of students’ responses to these programs, and students’ specific professional development needs.

Graduate students will enter a workforce that is constantly changing; where they will be expected to develop new skills, adapt to new technologies, and adjust to an evolving labor market. Our concept of professional development must be broadened to include transferrable skills, as well as the development of professional networks that will serve as a resource to students long after they have completed their degree. Our AGEP and Campus professional development workshops were developed to support graduate students in this process.

## Methods

The lead institution for our state-wide AGEP has developed a full slate of professional development seminars to meet the needs of graduate students from all disciplines and all backgrounds. These seminars serve both the AGEP’s underrepresented minority STEM graduate student demographic as well as the general population of graduate students at the university. Preparation for careers is one of those critical needs that was identified. The AGEP director in collaboration with the campus’ Career Services Center began to offer an annual career-based seminar for graduate students in 2007. The annual spring-semester campus-based seminar, titled “Career Paths for Graduate Students,” initially featured roundtables with guests from academe, industry, and government who would talk about their work experiences within their respective sectors. The goal of these initial seminars was to expose the graduate students to a variety of different careers paths. Early evaluations showed that the student participants and the visiting corporate, government, and academic guests enjoyed the format of the program and found that the experience was a worthwhile endeavor.

In 2012, the Council of Graduate Schools (CGS) released a report stating that graduate programs needed to do more to assist their students with job preparation both within and outside of academe.<sup>2</sup> In response to the report, we moved our campus-based career seminar to a date that coincided with the campus-wide “Career week” and began to send special invitations to groups of students and faculty within sectors that were hiring. These additional efforts were particularly geared to students in STEM fields because several of the visiting speakers were interested in students in engineering and IT fields. In addition to expanding the marketing for the campus-based graduate student career seminar, the AGEP program for our state decided to offer a career seminar for the AGEP students since the campus-based model was developed at the AGEP’s lead institution. After studying the CGS’ report, the AGEP program office for our state decided that the current format of the campus-based career seminar was good, but had limitations. The current campus-based seminar provided graduate students with general exposure to people in positions that required advanced degrees, but it did not provide clear directions for fostering networks. We

discovered that we needed to have greater emphasis on job preparation, and our students needed better access to career opportunities. Therefore, we changed the focus of the “Career Paths” seminar by asking the visiting speakers to not only describe their experiences in their respective positions, but to also discuss how students should prepare for such positions. These topics included discussing needs for various certifications (above and beyond the M.S. or doctoral degree), external research or teaching experiences, security clearances, and other information that might not be shared by the academic department or faculty. We also asked the visiting speakers to discuss how the students could prepare for, access, and take advantage of the speakers’ presence at the seminar to have CVs previewed and reviewed for current openings and future hiring opportunities.

Assessments from our other campus-based professional development seminars showed trends where women and underrepresented minority graduate students received the greatest benefit from the information that was being offered. Often, participants from these groups did not previously know about the topic being offered, and felt that learning about the topic would contribute to their successful graduation. Some of these topics included preparation for graduate-level research, understanding faculty expectations, and factors involved with dissertation completion. Combining anecdotal observations and assessments from these other campus-based seminars with the mission of the CGS report, and adding them to the mission of the AGEP (to prepare graduate students for faculty positions, either immediately following graduation, or later in the career), we decided to offer the new AGEP-focused “Career Roundtable” session during the annual PROMISE AGEP Summer Success Institute in August 2012.

The Career Roundtable format for both the campus-based seminar and the AGEP-focused seminar is advertised as a “speed-dating-styled” career seminar. The format borrows elements from several tried and true event types:

- traditional job fairs where students walk through rows of employers at rectangular tables,
- panel front table with 2-3 speakers,
- information sessions that feature one key employer (e.g., An IBM Seminar, An MIT Lincoln Laboratories Seminar), and
- networking lunches at conferences.

The Career Roundtable sessions fill a room with round tables. There isn’t a panel table, and there are no “career fair” rows. The employer’s name and organization is on a placard, and the tables are numbered. Students receive a reference guide in advance of the program so that they can plan their visitations accordingly. The seminar includes three rotations between tables so that students can connect with more than one employer.

The logistics for each of the workshops are as follows:

- Students are contacted via email to invite them to attend the seminar. A list of the speakers’ organizations is provided to the students in advance of the program.
- Each speaker “hosts” a table. The speaker sits at a designated round table, and graduate students peruse the room and the list of speakers and sit at tables of their choice.

- The session moderator opens the seminar by welcoming the audience and gives each speaker an opportunity to introduce her/himself and the organization that they are representing to the larger audience.
- Students stay at their current table for the first 20 minutes. Speakers re-introduce themselves to the participants at their table and talk about their “Pathways to Success.” Speakers are asked to share tips with the students. The conversation is 50% motivation and sharing stories, and 50% information about how to pursue a position within the speaker’s organization.
- The moderator prompts students to "switch" tables after 20 minutes. There are three rotations, but the speakers stay in place. This process allows the students to focus on their choices.
- Speakers are asked to remain for at least 30 minutes following the seminar to facilitate additional conversations, and allow students to meet additional speakers with whom they were not able to meet during the rotations.

The campus-based seminars were open to the entire graduate student population. Similarly, the sessions at the PROMISE AGEP Summer Success Institute were also open to a wide range of graduate students, although additional targeted marketing efforts were geared toward underrepresented graduate students in STEM fields.

This paper reviews results from evaluations that were collected at the end of the PROMISE AGEP Summer Success Institute seminar in August 2012, the campus-based seminar in March 2013, and at the PROMISE AGEP Summer Success Institute seminar in August 2013. Participants were asked to complete demographic information, answer 10 questions with a Likert scale (Disagree, Somewhat Agree, Mostly Agree, Completely Agree), and options for open-ended comments. Each participant was given a paper-based evaluation at the beginning of the seminar. The evaluations were collected as participants left the event.

## Data

The three seminars in this study included different sets of employers from a variety of sectors. The following section lists the organizations that were represented, and a subset of the demographics of the events’ evaluation respondents. It is important to note that the number of evaluation respondents does not equal the number of event participants.

The organizations at the PROMISE AGEP Summer Success Institute Career Sessions 2012 included: Institute for Higher Education Policy, National Institutes of Health (NIH), The Aerospace Corporation, The RAND Corporation, Lockheed Martin, and Prince George’s Community College (Evaluation Respondents: N= 42, STEM: 62%, N/A: 19%, URM: 78%, Female: 67%.) The Campus Career Session 2013 included speakers from the following organizations: Assured Information Security, Inc.; National Security Agency; SAIC-Frederick, Inc.; The Hilltop Institute; The Johns Hopkins University Applied Physics Laboratories; Transamerica Agency Network; Urban Teacher Center; NIH National Cancer Institute; and Delmock Technologies, Inc. (Evaluation Respondents: N= 61, STEM: 56%, N/A: 24%, URM: 37%, Female: 54%). The most recent event, the PROMISE AGEP Summer Success Institute (SSI) Career seminar 2013, included speakers from the following organizations: Boeing Cyber

Solutions, MIT Lincoln Labs, Purdue University, Los Alamos National Laboratories, North Carolina State University, Creative Growth Solutions For You!, Lockheed Martin, Beysix Consulting, NASA, Harvard University, and NIH (Evaluation Respondents: N= 42, STEM: 59%, N/A: 36%, URM: 80%, Female: 28%).

The evaluations asked a series of questions and asked the participants to rate their satisfaction on a 4 point Likert Scale. Table 1 provides summaries of the combination of answers that were either “Mostly Agree” or “Completely Agree.” The “Somewhat Agree” and “Disagree” responses are not recorded in the table.

Table 1: Questions administered to participants at the end of each career session, and combined responses of “Mostly Agree” and “Completely Agree.”

	PROMISE AGEP SSI 2012	Campus- based Seminar 2013	PROMISE AGEP SSI 2013
1. <i>This session gave me useful information about future career options and plans</i>	98%	64%	90%
2. <i>This session gave me new ideas about networking</i>	96%	67%	83%
3. <i>This session gave me relevant information about job search</i>	83%	88%	84%
4. <i>This workshop helped me identify my strengths as a graduate student</i>	79%	62%	55%
5. <i>This session gave me orientation in my academic/professional career</i>	79%	48%	78%
6. <i>This session helped me meet potential professional mentors</i>	N/A*	46%	89%
7. <i>This session helped me feel more confident about my professional future</i>	91%	57%	86%
8. <i>The format of this session was useful for facilitating conversations about job options</i>	N/A*	63%	88%
9. <i>This workshop should be recommended to other graduate students</i>	91%	81%	93%
10. <i>Coming to this seminar was a good use of my time</i>	98%	47%	90%

\*Questions 6 and 8, as described here, were not administered on the survey in 2012.

## Discussion

In nearly every category, at least half of the respondents were either completely or mostly satisfied with their experience at the seminars. The evaluation results from the PROMISE AGEP Summer Success Institute’s respondents show higher levels of satisfaction than those who attended the campus-based career seminar. Assessments from previous years (not included in this paper) showed that both participants and guest speakers liked the “speed-dating,” three-rounds-of-rotation style of the seminar, therefore, we did not evaluate structure in this study.

We found that many participants do not answer all of the questions, for example the question to identify academic department, and several of the demographic questions are left blank. In future surveys, we will consider providing boxed options that can be answered with a check mark. This method has been used for some of our other events, and participants tend to answer those questions with more frequency. With the demographic information that we received, the major pattern showed that more than 50% of the STEM students had high satisfaction, and female students responded with the highest levels of satisfaction for the PROMISE AGEP Summer Success Institute career seminars.

While the general structure of the logistics within the seminars was identical, we noticed some differences between the seminars which could contribute to the wide ranges of satisfaction. We noticed that the AGEP seminars had a stronger emphasis on mentoring that was conveyed to both the visiting speakers and the participants. There were distinct differences in the titles of the seminars and differences in references to the activity. For example, the title for the campus-based event was “Career Paths for Graduate Students,” and the title for the PROMISE AGEP Summer Success Institute sessions was “Mentoring for Career Advancement.” We also noted that the campus-based “Career Roundtables” were called “Mentoring Pods” at the PROMISE AGEP Summer Success Institute. Given these initial differences, we examined the events more closely, and discovered other notable differences. These differences in logistics are compared in Table 2.

Table 2: Comparison of the event styles of the campus-based seminar versus the PROMISE AGEP Summer Success Institute seminar, independent of the seminar’s content.

	Campus-based Event 2013	PROMISE AGEP SSI Events, 2012 and 2013
<i>Name of event</i>	“Career Paths for Graduate Students”	“Mentoring for Career Advancement”
<i>Reference to the Representative/Speaker</i>	“The employer”	“The Mentor-in-Residence”
<i>Orientation for the Representative/Speaker</i>	Letter of invitation from the Career Services Center, and email prior to event describing the schedule for the program	Orientation dinner the night prior for all speakers at the SSI.
<i>Activity of the representative, 8 hours prior to activity</i>	Work. The campus-based representatives are local and come to the university to	Hotel. The PROMISE AGEP SSI representatives are external, arrive the night prior



	participate in the seminar after their regular work-day.	to the session, and stay at the hotel. Several participate in the morning plenary session of the SSI prior to their session.
<i>Demographics</i>	All graduate fields, graduate students from all disciplines, without particular emphasis on race or gender.	All graduate fields with an emphasis on STEM disciplines, and emphasis on inviting URM participants
<i>Reach</i>	Graduate students on one campus	Graduate students, postdoctoral fellows, and alumni from several universities in the state.
<i>Direct Competition</i>	Classes, research, job	Two other concurrent workshops
<i>Venue</i>	University Seminar Room	Hotel and conference center ballroom
<i>Food</i>	Available in the room before, during, and after event	Lunch served immediately after event
<i>Positioning of event</i>	Within the university's "Career Week" which is largely geared toward undergraduates. Our event is the only program during Career Week that specifically targets graduate students.	Within the PROMISE AGEP SSI, a 2-day event that specifically targets graduate students, and focuses on preparing URM STEM students for success.
<i>History</i>	Campus-based career seminars for graduate students begin in 2007.	The PROMISE AGEP Summer Success Institute began in 2003. The career seminar at the SSI began in 2012.
<i>Timing</i>	Wednesday in March, following Spring Break, 4:30 PM – 6:00 PM	Saturday in August, one week prior to the start of Fall semester, 11:00 AM – 12:30 PM
<i>Opportunities for immediate follow-up</i>	30 minutes, immediately following the seminar	Immediately following the seminar, and at the subsequent 1:00 PM SSI closing luncheon.

Some additional differences between the seminars include eligibility for opportunities, and preparation of the speaker. There are a number of international students in the STEM disciplines on our campus, and their comments in the assessments at the campus-based sessions expressed disappointment at the numbers of employers that had positions that required U.S. citizenship. Conversely, the demographic for the sessions at the PROMISE AGEP SSI included more U.S. citizens. The PROMISE AGEP SSI session also deliberately included "mentors" in high-level positions at the respective institutions who were either URM or verbally expressed that they were interested in actively facilitating the advancement of URM graduate students and postdoctoral fellows. Both of these situations, eligibility to be considered for positions, and "mentors" who

provided strong encouragement to pursue positions, may have contributed to higher levels of satisfaction for the participants.

Given our AGEP's emphasis on building community-based connections, having students learn together, and celebrating successes as a group, the students who participated in the PROMISE AGEP session may have been more invested in their seminar. We also noted that we provided the mentors with a similar sense of community and connection, prior to the event. The mentors for the entire PROMISE AGEP SSI program (which included those who were presenting the Career seminar) received personal invitations to participate from the PROMISE AGEP director, follow-up emails, phone calls from the PROMISE AGEP staff, detailed website information, and an orientation dinner session. The atmosphere of "community" may have contributed to AGEP students' satisfaction with the SSI seminar. In addition, the moderators for the AGEP sessions voluntarily took on the additional role of mentoring by discussing the benefits of networking, sharing personal stories, and making sure that students were involved and engaged during the table sessions. Further, the PROMISE AGEP session featured photos, biographical information, and links to contact information for all of the speakers on the PROMISE AGEP's website in advance of the program, and within the conference program. In contrast, the campus-based seminar provided speakers' names and organizations on the website, and a program with a synopsis of the organization.

#### Conclusion and Future Work

Since 2003, our multi-campus PROMISE: Maryland's AGEP program has piloted seminars and workshops for the URM STEM demographic that have later been provided for graduate students from all backgrounds. While the campus-based career seminar pre-dates the PROMISE AGEP SSI career seminar, we will look toward incorporating some of the PROMISE AGEP-inspired, "community-based" approaches into the campus-based seminar. Plans for seminars in 2014 are under development, and include variations of the activities described here. However, to stimulate a community of practice on the campus, we will use this study as a basis for developing a more "community-infused" approach for the campus-based seminar. For both the campus-based career seminar, and the PROMISE AGEP career seminars, we will now purposefully include orientation for the mentors. In addition to continuing to involve alumni, we will look toward sharing the speakers' stories on the website, provide examples of successes of both the mentors and past participants, offer more information about the speakers and encourage interaction prior to the seminar, facilitate networking, and encourage follow-up.

In 2014, as part of the PROMISE AGEP: Maryland Transformation (AGEP-T) program, we will host a one-day PROMISE AGEP STEM-based academic career preparation conference that is separate from the PROMISE AGEP Summer Success Institute. It will include morning research presentations and afternoon professional development seminars that cover public speaking, and strategies that will help graduate students to think ahead and plan for tenure.. This conference will supplement the session that will take place at the PROMISE AGEP SSI. We will expand the campus-based "Career Pathways for Graduate Students" to include both the round tables and a new concurrent session with a panel that will showcase international opportunities. Finally, the 2014 Mentoring Pods for the PROMISE AGEP SSI will focus on academic institutions from a variety of Carnegie classifications, but will include some pods from national and international

organizations that can provide career building experiences and foster collaborations, such as Fulbright, the United Nations Environment Programme (UNEP), and the U.S. Department of State. To encourage consistency, develop a career-focused community, and establish opportunities for participants to develop networking relationships with organizations over time, we will ask organizations to consider participating in both the campus-based event and the PROMISE AGEPSI. We believe that these updates to our current programming will improve the levels of satisfaction for the graduate student participants, and will above all lead to job offers that will contribute to fruitful STEM careers.

The career-based seminars are part of a larger suite of professional development workshops for graduate students that are co-sponsored by the PROMISE AGEPSI and the Graduate School at UMBC. The Fall 2013/Spring 2014 professional development curriculum is being updated to now include a “Financial Literacy” segment (sponsored by the Council of Graduate Schools and TIAA-CREF) that includes strategies for transitioning from a graduate student stipend to a professional salary, investing, managing credit scores, and long-term retirement planning. In Spring 2014, two new initiatives are being launched to bring more career-focused information to graduate students. For the first 2014 initiative, a subset of the Leadership Team of The Graduate School at UMBC (e.g. Dean, Associate Dean, Sr. Assistant Dean, Associate Vice Provost, Executive Director of the Graduate Student Association) are having continuous meetings with the director of UMBC’s Career Services Center (CSC) and the Assistant Vice President for Careers and Corporate Partnerships to review the Council of Graduate Schools’ 2012 report on “Pathways Through Graduate School and into Careers.”<sup>2</sup> Ties are also being strengthened through participation of the graduate school’s Leadership Team, and groups of graduate students, in the CSC’s Spring 2014 focus groups that include topics that pertain to improving services for graduate students. The Graduate Student Development Unit of The Graduate School is also working with the CSC to bring representatives from the corporate membership of the National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM) to campus. UMBC is a university member of the GEM Consortium, and prior to 2014, the connection to GEM’s corporate membership had been underutilized. The second initiative of 2014 involves The Graduate School at UMBC’s spring launch of “Mini-grants” to academic departments. The academic department will form teams of faculty and graduate students, which include the department’s Graduate Program Director and either a departmental Graduate Student Association Senator or president of an active departmental graduate student organization (e.g., the UMBC Institute for Electrical and Electronics Engineers (IEEE) Student Branch, UMBC Women in Science and Engineering (WISE Grads)). The teams will review recommendations from the Council of Graduate Schools’ 2012 “Pathways” report, and implement a career-based activity that will have direct ties to the academic discipline. Awardees of the Mini-grants will be required to evaluate their activities and submit a report at the end of 2014. Outcomes from all of these efforts will be disseminated to graduate students through PROMISE AGEPSI workshops, and Graduate Student Associate senate meetings. These topics will be slated as specific agenda items at upcoming meetings. These new 2014 initiatives along with the continuing “Career Pathways” workshop in partnership with the Career Services Center, and the PROMISE AGEPSI’s efforts to mentor and connect large numbers of STEM graduate students to opportunities that will prepare them for the professoriate, can become part of a comprehensive suite of internal and external activities that will include graduate students from all backgrounds, and improve their transitions to careers.

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