A Mentoring Bridge Model for Students with Disabilities in Science, Technology, Engineering, and Mathematics

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Abstract

A recent analysis of the supply of workers in the Science, Technology, Engineering, and Mathematics (STEM) fields noted a persistent shortage of STEM workers (New American Economy Research Fund, 2017). Specifically, in 2016, for each unemployed worker there were 13 STEM jobs posted online, which translated into a shortage of approximately three million trained professionals. Students with disabilities have been identified as a possible untapped pool of future scientists (Committee on Equal Opportunities in Science and Engineering, 2006). Unfortunately, persistence in postsecondary education for students with disabilities is an issue (Sanford et al., 2011). The evaluation results of a comprehensive mentoring program designed to support students with disabilities in postsecondary STEM programs are reported. The mentoring program included elements related to both the academic and social environments of the students. It is part of a larger project designed to increase the number of students with disabilities pursuing and completing postsecondary STEM programs. The results of the study indicated that participants were highly satisfied with their mentoring experiences and perceived the mentoring experience positively.

Keywords: STEM, college students with disabilities, mentoring, postsecondary programs for students with disabilities

The United States has a "persistent and dramatic shortage of STEM workers" (New American Economy Research Fund, 2017, para. 4). The National Science Foundation has supported a number of initiatives to address this issue, such as the Louis Stokes Alliances for Minority Participation, Research in Disabilities (NSF, 2019). Its efforts at broadening participation focus on increasing the participation in STEM by underrepresented groups.

Although individuals with disabilities are considered an underrepresented group, the number of students with disabilities enrolling in postsecondary education has increased, and now about 19% of undergraduate students report having a disability (U.S. Department of Education, 2019). In addition, the percentage of students with disabilities enrolled in postsecondary science and engineering fields is similar to the general population (Thurston et al., 2017). For example, in 2016, 28% of undergraduate students with disabilities and 28% without disabilities were enrolled in the science and engineering fields (NSF, 2019). These figures are important because while not all STEM jobs require postsecondary education, approximately 65% do (Graf et al., 2018). However, fewer students with disabilities graduate in general in comparison to their peers. Findings from the National Longitudinal Transition Study-2 indicated that within six years of exiting high school, 63% of young adults with disabilities had ever attended any postsecondary education (Sanford et al., 2011). Of these students during this time period, only 38% had completed their programs. At the same time, 51% of similar age young adults without disabilities had completed their program.

Students with disabilities encounter a range of challenges in postsecondary education environments that could potentially contribute to their lack of success including inadequate academic preparation,

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limited access to and use of accommodations, discrimination, poor organizational and time management skills, and poor soft skills (Dowrick et al., 2005; Kochhar-Bryant et al., 2009; Mader & Butrymowicz, 2017; Winterowd et al., 1998). Researchers also have underscored the importance of the social environment, reporting the positive impact of faculty mentoring and peer support, integration into the academic community, and social networks with other students with disabilities in STEM (Brinckerhoff et al., 2002; Dowrick et al., 2005; Izzo et al., 2011; Jenson et al., 2011; Lightfoot et al., 2018). Thus, paying attention to both the academic and social environment of students is an important programmatic consideration for students with disabilities in postsecondary education settings.

One promising approach that has been endorsed for enhancing factors that contribute to success and reducing barriers for persons with disabilities in college and employment is mentoring (Burgstahler, 2003, 2006; Jenson et al., 2011; Stumbo et al., 2008). Mentoring programs can provide the social support and networks and academic support that seem to be an important factor in many students' postsecondary education success.

The general college mentoring literature highlights the positive impact of mentoring on students' (a) achievement, (b) persistence in college, and (c) preparation for success in professional careers (Coles, 2011; Colvin & Ashman, 2010; Crisp & Cruz, 2009; Kendricks et al., 2013; Seema & Sujatha, 2015; Wilson et al., 2010). An examination of the mentoring research suggests there are a set of common characteristics of mentoring, including (a) a learning partnership in which there is an experienced and less experienced partner; (b) a process that includes emotional functions, such as support and friendship; and (c) a process that includes instrumental functions, such as information and coaching (Coles, 2011). An additional commonly identified characteristic of mentoring is that the mentor serves as a role model and advocate (Coles 2011; Colvin & Ashman, 2010). Coles noted the relationship between mentor and mentee becomes "more impactful over time" (p. 2).

In their review of the literature of students with disabilities in postsecondary education settings, Brown et al. (2010) identified several themes related to mentoring including the benefits of technology, mentees becoming mentors, and long-term mentoring relationships. They also acknowledged that mentoring impacts many aspects of life including academics, career, and social skills. Though the authors noted the lack of evidence-based studies focusing specifically on mentoring for this group, they concluded that "students with disabilities are provided with the best opportunity for mentoring success when a flexible, multi-layered system of supports exists" (p. 108). Zaniewski and Reinholz (2016), in their study of a mentoring program for diverse students, also noted the importance of a program that provides holistic support, including psychosocial and academic support.

The literature discussed above indicates that mentoring programs provide the academic and social support and networks that seem to be an important factor in many students' postsecondary education success. The purpose of this paper is to describe a comprehensive mentoring program designed to support students with disabilities in STEM programs and then provide evidence related to participating students' perceptions of and satisfaction with the program. Specific research questions were:

1. What is the nature of mentoring that occurs (e.g., amount of time spent in mentoring activities, roles, type of mentoring)?
2. What are the students' perceptions of and satisfaction with mentoring?
3. What is the relationship between duration of mentoring and mentoring satisfaction and perceptions?
4. What is the relationship between type of mentoring and mentoring satisfaction and perceptions?

The Mentoring Bridge Model

The Mentoring Bridge Model for Students with Disabilities in Science, Technology, Engineering, and Mathematics (Bridge Model) was part of a project funded by the National Science Foundation (NSF) through the Research in Disabilities Education (RDE) program. The project's goals were to increase the quantity and quality of students with disabilities (e.g., academic performance, study skills, academic efficacy, intent to persist, self-advocacy) receiving associate, baccalaureate, and graduate degrees in science, technology, engineering, and mathematics (STEM) disciplines. The Bridge Model was comprised of colleges, universities, and local school systems in a southeastern state.

The Bridge Model program is an adaptation of a southeastern state's highly successful NSF Louis Stokes Alliance for Minority Participation (LSAMP) program, which is based on Tinto's (1975, 1987, 1993) interactionalist theory of student persistence in college. Tinto's theory contends that the greater the level of academic and social integration, the greater the student's chances of persisting until graduation.

Since its 1991 inception, LSAMP has substantially improved the number of underrepresented minorities participating and finding success in STEM disciplines. The program focuses on providing financial aid and requiring mandatory attendance at LSAMP Drop-In Centers, at which students have an opportunity to network (social integration) and receive or provide tutoring and/or mentoring services (academic integration).

The Bridge Model is an adaptation of the LSAMP Model. The model assumes that (1) students with disabilities admitted to STEM disciplines have an aptitude for basic sciences and mathematics, (2) students are committed to education and some science profession(s), and (3) the home institution is committed to diversity. The Bridge Model consists of (1) recruitment to participate in the Bridge program, (2) financial aid in terms of stipends/scholarships, (3) horizontal and vertical mentoring for both social and academic integration, and (4) continuous monitoring and assessment. The model includes both faculty mentors and peer mentors. For this study, faculty mentors were affiliated with the larger NSF project. The graduate mentors were program participants and received a $3,500 stipend per academic year, and undergraduate participants received a $2,000 stipend per academic year. Mentoring in the Bridge Model can occur across a wide range of settings depending on the type of mentoring transpiring. For example, individual peer mentoring could take place at the library or student center; whereas, large group Bridge meetings could occur in a classroom.

Horizontal Peer Mentoring

Horizontal peer mentoring occurs within three distinct groups in the Bridge Model. The *Bridge to Baccalaureate Peer-Mentoring Program* is for freshmen and sophomores who plan to obtain a bachelor's degree (or an associate degree) in STEM disciplines. The goal for students in this bridge is to move into the Bridge to Post-Baccalaureate Program. The *Bridge to Post-Baccalaureate Peer-Mentoring Program* is for juniors and seniors pursuing a bachelor's degree in STEM disciplines. The goal for students in this bridge is to move into the Graduate Bridge Program or join the STEM workforce. The *Graduate Bridge Peer-Mentoring Program* is for graduate students demonstrating a commitment to pursuing a PhD in STEM fields. The goal for students in this bridge is to attain a PhD in a STEM discipline and join the STEM workforce.

Each of the Bridges has a faculty mentor who facilitates Bridge meetings and provides additional individual mentoring to participants. Bridges meet separately during the second and fourth months of each semester. The faculty mentor facilitates these meetings, which are related to the needs of the students in that Bridge. For example, the Bridge to Baccalaureate meeting topics for Freshmen and Sophomores include time management, study skills, resources for academic assistance, advice on classes, and mentoring. The Bridge to Post Baccalaureate topics include co-op opportunities; research internships; and speakers from STEM disciplines, graduate school, industry, or government. Graduate Bridge topics include conference presentations, applying for postdocs, scientific grant writing, and future faculty preparation.

Vertical Peer Mentoring

For the Vertical Peer Mentoring, students are grouped into clusters of 10 or fewer students across the Bridges. Each cluster has a Graduate Bridge student mentor who facilitates the vertical peer mentoring for the cluster and serves as a mentor for the Bridge to Post-Baccalaureate students (i.e., juniors and seniors). The Bridge to Post-Baccalaureate students, in turn, mentor the Bridge to Baccalaureate students (i.e., freshmen and sophomores). In each cluster, graduate students mentor seniors, seniors mentor juniors, juniors mentor sophomores, and sophomores mentor freshmen. In this regard, a peer mentor serves as a resource, a helping hand, a sounding board, a role model, coach, friend, and advisor. The mentor provides support, encouragement, and information, including, but not limited to, academic matters.

Clusters meet once a week, without faculty mentors present, which provides opportunities for students to interact with their peers in an informal setting and discuss topics and issues that they may otherwise not be comfortable with or have time to discuss in a larger setting or with the faculty mentor present. Some activities at these meetings include students sharing papers they have written, discussing what they learned in recent weeks in class, and sharing fun things that happened outside the classroom. Mentors and mentees also connect throughout the week via individual meetings, text messaging, email, phone, Facebook, and video conference. Students are expected to spend a minimum of two hours per week in mentoring activities. They can decide on the nature of the mentoring (e.g., text, face-to-face).

The cascading mentoring design is unique in that students at every transition point have dual roles: they are mentors and mentees simultaneously. Much of the mentoring research focuses on the benefits to the mentee; however, mentoring also can impact the mentors in positive ways, such as being able to help others, expanding personal networks, and reinforcing concepts in their own lives (Colvin & Ashman, 2010). The design is also unique in the sense that the

scholarship recipients are required to participate in retention activities (integration of scholarship and retention).

This comprehensive mentoring program is flexible and provides a multilayered system of supports and experiences. Table 1 identifies and briefly explains some of the other mentoring components of the model. Students receive a stipend for participating in the program. Continued financial support is contingent upon maintaining the minimum GPA, participating in mentoring activities for a minimum of two hours per week, and participating in other required mentoring program activities such as the annual research conference.

Methods and Results

Participants

Participants were graduate and undergraduate students who were selected as Bridge scholars. Eligibility requirements for the program included:

a. Being enrolled at one of the partner institutions
b. Pursuing an associate, undergraduate, or graduate degree in STEM disciplines
c. Being a U.S. citizen or permanent resident with a documented qualifying condition (e.g., speech, visual, hearing, orthopedic, ADD/ADHD, autism/Aspergers, or other)
d. Having a cumulative 2.7 GPA.

Table 2 reports participant demographic information. These data are limited to those participating over a two-year period (2012-2014). Participants were from five different types of institutions with nearly half (46%) from a large public university setting. The typical participant was male (52.4%) and white (73%), and the most commonly disclosed disability was ADD/ADHD (31.7%).

Mentoring Survey

Between fall 2012 and spring 2014, mentees and mentors responded to an instrument that was used to gather information about their mentoring experience. This survey was adapted from the Georgia STEM Accessibility Alliance (GSAA), addressing the ways in which students were involved in mentoring during the past academic year and their satisfaction and general perceptions of the mentoring process. The instrument also included several subscales aimed at determining the extent to which mentees and mentors experienced interpersonal growth, level of support, fulfillment in the relationship between mentee and mentor, and the communication process. Scale descriptions and reliability estimates for the subscales from the spring 2014 administration are summarized in Table 3. Estimates ranged from .895 to .968 for the mentee subscales and from .898 to .976 for the mentor subscales (the full instrument is available for review upon request). The survey was distributed near the middle of each semester; students were asked to report their mentoring activities during the most recent week and month as well as their perceptions of and satisfaction with the mentoring.

A total of 126 different students responded to the survey over the two-year period. The number of students responding each semester varied and some responded each year. Fifty-nine responded in both academic years. Response rates over the four academic terms averaged 81.8% (ranging from 71.3% in spring 2014 to 95.7% in fall 2013).

Results

Table 4 reports the students' involvement in the mentoring process. Of the 126 students who completed surveys over the 2012-13 and 2013-14 academic years, 117 (92.1%) reported being involved in the mentoring process as either a mentee or a mentor. The percentage of students receiving mentoring was quite stable over the two-year period, with an average of 85% reporting being mentored by a peer and 48% being tutored by a faculty member. The percentage of students who provided mentoring for others increased over the two-year period, from 65.2% in 2012-13 to 74.6% in 2013-14. The percentage of students serving a dual role also increased from 58.3% in 2012-13 to 66.2% in 2013-14.

Students were expected to spend two hours per week in mentoring activities. The percentage of students reporting at least two hours per week increased from 68.7% in 2012-13 to 80.3% in 2013-14. The average number of hours engaged in mentoring also increased each year from an average of 2.74 hours per week in 2012-13 to 3.81 hours per week in 2013-14.

Types of Mentoring

Mentors and mentees were asked to indicate on a five-point scale, with 1=*not at all* and 5=*a great extent*, the extent to which they used different types of mentoring.The most frequently used method of mentoring during the 2012-13 and 2013-14 academic years was face-to-face meetings, averaging above 4 for mentees and mentors each year. Text messaging and email were also reported being used frequently by mentees and mentors, while the use of Facebook and video conferencing (e.g., Skype) were reported not being used with much frequency. These results

are summarized in Table 5.

Mentoring Perceptions and Satisfaction

Both mentees and mentors reported very positive perceptions and high levels of satisfaction with their mentoring experience during the 2012-2013 and 2013-14 academic years (see Tables 6-7). Using a 5-point response scale, average responses to each mentoring subscale were approximately 4 or higher. In addition, students reported more positive perceptions over the course of each academic year. In 2012-13, the greatest increases were revealed for students serving in a mentoring role, with nearly 60% or more reporting increased positive perceptions from the fall to spring semester. Statistically significant increases were found in terms of mentors' personal responsibility, fulfillment, communication, and overall mentoring perceptions. In contrast, those being mentored reported the greatest improvements over the 2013-14 academic year, with approximately 70% or more reporting more positive perceptions from fall to spring. Changes were statistically significant for five of the six mentoring scales.

Using a matched sample, further comparisons were made to determine changes over the two academic years. A total of 28 mentees and 21 mentors were matched. While the small sample size limited statistical significance, over 67% of mentees reported positive changes on all scales. Over 70% reported positive changes in personal fulfillment, support seeking, and communication. For mentors, over 60% reported positive changes in all areas, with 70% in personal fulfillment, support seeking, and overall satisfaction (see Table 8).

Relationships Between Duration and Types of Mentoring with Mentoring Perceptions

Relationships between time spent in the mentoring process per month and overall mentoring perceptions and satisfaction were examined using Pearson correlations, while multiple regression was used to examine which types of mentoring best predicted participants' overall perceptions and satisfaction. All analyses used the overall sample from 2012-2014. Overall, students reporting being more involved in the mentoring process, as a mentee or a mentor, reported more positive perceptions and greater satisfaction with mentoring (see Table 9). For mentees, these correlations ranged from .229 to .315, with a median of .269. For mentors, these correlations ranged from .234 to .323 with a median of .286. All correlations were statistically significant. The types of mentoring approaches used also were found to be related to overall mentee and mentor perceptions and satisfaction.

Mentee Perceptions and Satisfaction

In terms of overall perceptions, a backwards elimination regression approach resulted in a final model with a medium effect size (R^2 = .168). This model was restricted to three approaches (face-to-face, text, and video conference). Mentees reporting greater use of face-to-face, text messaging, and video conferencing during mentoring also reported more positive perceptions of the overall mentoring process. In terms of overall satisfaction, the final model (R^2 = .111) also resulted in a medium effect size. This model was restricted to two approaches (face-to-face and text messaging) and supported the conclusion that greater use of these two approaches was associated with greater overall mentoring satisfaction.

Mentor Perceptions and Satisfaction

For mentors, models examining the relationships between mentoring approaches with overall perceptions (R^2 of .324) and satisfaction (R^2 of .271) both resulted in large effect sizes. Both models were restricted to the same three mentoring approaches (face-to-face, text messaging, and video conferencing). Therefore, when mentors reported greater use of these three approaches, they also reported more positive overall perceptions and greater satisfaction with the mentoring process.

Discussion

The college mentoring literature highlights the potential benefits of mentoring programs. The results of this study add to this literature by describing and evaluating an innovative mentoring program that provides a flexible and multilayered system of supports. In the Bridge Model, social and academic integration were accomplished through both horizontal and vertical mentoring. General program data and mentoring feedback data indicated that both mentees and mentors were highly satisfied with the program. Although the majority of the mentoring data was collected from students' perceptions, this kind of information is extremely valuable. Students' perceptions are their realities, and it is their reality that plays a major role in how connected and supported they feel and their persistence in programs (Dunn et al., 2004; Habel et al., 1999).

The Nature of Mentoring and Its Relationship to Mentoring Satisfaction and Perceptions

The Mentoring Bridge Model provided a structured approach for mentoring, while at the same time allowing for individual differences, preferences, and

need. For example, there was an expectation that students would participate in mentoring activities for a minimum of two hours per week. Students were required to attend formal, mandatory mentoring meetings in their different bridges that were facilitated by faculty members and focused on issues relevant for their bridge. They were also required to attend the less formal, cluster mentoring meetings once a week, which were facilitated by a graduate student. Within clusters, students were assigned a mentor or served as peer mentor or both. How the mentoring pairs met outside of the large group sessions to meet the minimum time requirement was up to them. The fact that the average time spent in mentoring was well above the two hours per week minimum and increased over the years suggests that students found these activities worthwhile (2.74 hours per week in 2012-13 and 3.81 hours per week in 2013-14). The most frequently used method of communication was face-to-face and text messaging, with those using these methods reporting greater overall satisfaction with the process. This combination of structured and unstructured mentoring activities covering a range of activities and additional supports (e.g., tutoring by faculty) is consistent with Brown et al.'s (2010) recommendation that effective mentoring programs provide layers of supports and are flexible.

Students' Perceptions of and Satisfaction with Mentoring

The results of the mentoring survey indicated that the students were highly satisfied with their mentoring experiences and perceived it positively. Not only did students find the mentoring personally fulfilling and contributing to their interpersonal development, but they also reported very positive perceptions about the level of academic and personal support they received. Previous research has highlighted the importance of academic and social support to program completion. Zaniewski and Reinholz (2016), in their study of a mentoring program for diverse students, noted the importance of a program that provides holistic support, including psychosocial and academic support. Lack of such support has been found to prevent some capable students with disabilities from completing college before completion (Dowrick et al., 2005; Nelson et al., 1993).

The Relationship Between Duration of Mentoring and Satisfaction and Perceptions

As noted previously, over the two-year period there was an increase in the amount of time students reported participating in mentoring activities. If mentoring relationships and activities are successful, it is expected that there would be an increase in the amount of time students spent in mentoring activities. Furthermore, students' overall perceptions and satisfaction also improved each academic year, with the largest increases for mentors in the first year and mentees in year two. As well, more time involved in the mentoring process each month was moderately associated with more positive perceptions and greater satisfaction.

Several researchers have noted the developmental nature of the mentee-mentor relationship (e.g., Coles, 2010; Colvin & Ashman, 2010). The results in this study suggested that the positive impact of mentoring increases over time, which is consistent with Coles' description of the mentoring process. The data examining changes in mentor and mentees perceptions and satisfaction from year one to year two indicated the majority reported positive changes for the mentoring scales. In fact, over 70% of both mentors and mentees increased their personal fulfillment as a result of participation in the mentoring activities. Additionally, over the two years there was an increase in the number of students actively serving in a mentoring role and those serving as both a mentor and mentee. The most frequently reported method used was face-to-face meetings. Overall, students reporting being more involved in the mentoring process, as a mentee or a mentor, also reported more positive perceptions and greater satisfaction.

Mentoring Perspectives from Site-Visits

The program evaluation plan included site visits at each of the participating institutions. Results of the site visit evaluations provide strong support for the inclusion of mentoring. Students noted a range of benefits from having a support system they could rely on to helping them feel more at ease in class, which increased performance. These reflections are consistent with the results of Izzo et al.'s (2011) study that examined the effectiveness of student learning communities for recruiting and retaining students with disabilities in STEM careers. Students in their study highlighted the importance of a "social and professional network that reinforces interest and achievement in STEM pursuits" (p. 314), which could potentially increase the number of students with disabilities successfully completing STEM programs.

Limitations

Several limitations should be considered when interpreting the results. The response rate was not 100% for the self-reported measures (surveys) as compared to other data (GPA, attendance records, etc.) where

all students were accounted for. The response rate averaged 81.8%, with a range from 71.3% in spring 2014 to 95.7% in fall 2013. Related, although all participants were expected to participate in mentoring activities, approximately 10% of the students in the program reported they did not participate in mentoring activities. Another potential limitation is the nature of surveys. All of the data were self-reported, and participants' responses could have been influenced by the fact they received a stipend for participating in the program. Finally, although there was a general structure for the mentoring component of the program, there were slight variations in implementation across the different institutions due to contextual variables (e.g., no graduate program, small number of students participating in the program).

Practical Implications

A wide range of individuals could be involved in the development and implementation of mentoring programs; these programs could be housed within an office of disability support services, a specific STEM department, a college, or even across several colleges. The results of this study highlight several important considerations for individuals who engage in developing and implementing mentoring programs. Specific recommendations for these program developers and implementers include the following:

1. Attending to social integration: social and professional networks have the potential to strengthen achievement and interest in STEM endeavors (Izzo et al., 2011).
2. Providing a range of mentoring activities from individual meetings to large group activities that include both peer and faculty mentors: a range of activities helps individualize the process to meet individual student needs and offers a multi-layered system of support (Brown et al., 2010).
3. Providing a comprehensive, multicomponent mentoring program: a comprehensive program supplements mentoring with experiences and opportunities that help build career and technical skills.

The results of this study provide some valuable information about the Bridge Mentoring Model and students' perspectives of and participation in the mentoring. Students indicated high levels of engagement and satisfaction in the program. Future research needs to expand on these findings to consider the relationship between participation in the mentoring activities and quality program outcomes. For example, how does program participation relate to GPA and student participation in research activities? Related to the shortage of STEM workers, although assumed, does program participation actually increase the number of students graduating in the STEM fields and ultimately obtaining jobs in STEM fields? It would be informative, too, to compare students with disabilities in STEM programs not participating in a mentoring program with those who are participating in a mentoring program. Additionally, it would be helpful to determine which aspects of the mentoring program (e.g., large group formal, large group informal) are most influential. Finally, examining students' perceptions and satisfaction by disability classification could provide useful information for adapting programs to meet individual student needs.

In closing, the mentoring program examined in this study is a component of a larger NSF project designed to increase the quantity and success of students with disabilities completing STEM programs and eventually securing employment in STEM fields. The results of this study indicated that participants were highly satisfied with their mentoring experiences, perceived the mentoring experience positively, and reported improvement over the two-year period examined in this study. Furthermore, greater engagement in the mentoring process was related to greater satisfaction and more positive perceptions of the mentoring process. Previous research has demonstrated the importance of social connections and support to postsecondary education completion. Finding effective ways to support students with disabilities in postsecondary education programs has the potential to increase the number of students with disabilities successfully completing these programs.

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Table 1

Mentoring Program Components

Component	Description

Horizontal Mentoring	• Bridge to Baccalaureate Peer Mentoring (Freshmen and Sophomores)
	  • Meeting topics include time management, study skills, academic assistance resources, class registration advice, etc.
	  • Goal is to move to Bridge to Post-Baccalaureate Program
	• Bridge to Post-Baccalaureate Peer Mentoring (Juniors and Seniors)
	  • Meeting topics include co-op opportunities and research internships; class registration; and speakers from STEM disciplines, graduate school, industries, and government
	  • Goal is to move to Graduate Peer-Mentoring Program or join the STEM workforce
	• Graduate Bridge Peer Mentoring (Graduate students demonstrating a commitment to pursuing doctorate in STEM fields)
	  • Meeting topics include conference presentations, applying for post-doc opportunities, grant writing, and future faculty preparation
	  • Goal is to obtain a doctorate in a STEM discipline and join STEM workforce
	• Faculty mentor facilitates Bridge meetings and provides additional individual mentoring

Vertical Mentoring	• Occurs with clusters of ten or fewer students across Bridges • Each cluster has a Graduate Bridge mentor who facilitates the vertical peer mentoring and serves as a mentor for the Bridge to Post-Baccalaureate students • Bridge to Post-Baccalaureate students serve as mentors to the Bridge to Baccalaureate students • Peer mentors provide support, encouragement and information to their mentees • Clusters meet once a week in informal settings
Recruitment	• Varies from institution to institution, but includes letters to parents of all entering freshmen and dissemination of applications through offices of disability services
Financial Assistance	• Students receive a stipend for program participation, dependent on active participation and maintaining a minimum required GPA • $2000/academic year for undergraduate students • $3500/academic year for graduate students
Research Internships	• Competitive eight-week research internships available in summer • Students receive $3,500 stipend
Student Advocacy Group	• Open to all students, faculty, and staff and is not exclusive to individuals with disabilities
Research Presentations	• Students supported in efforts to conduct research and present findings at conferences
Special Seminars	• Occurred throughout the year and based on student interest and needs

Table 2

Bridge Model Participant Demographics

Participant Characteristic	Number	Percentage
Site/Institution:		
Large Public University	58	46.0
Small Private HBCU	30	23.8
Public HBCU	18	14.3
Medium Public University	16	12.7
Small State Community College	4	3.2
Gender:		
Male	66	52.4
Female	60	47.6
Race/Ethnicity:		
White	92	73.0
Black or African-American	18	14.3
Hispanic	8	6.3
Asian or Pacific Islander	6	4.8
American Indian/Alaska Native	1	0.8
Not Reported	1	0.8
Condition:		
Attention deficit disorder (ADD)/attention deficit hyperactivity disorder (ADHD)	40	31.7
Physical impairment/orthopedic/mobility impairment	17	13.5
Systemic health/medical condition	17	13.5
Deaf or hard-of-hearing (D/HoH)	11	8.7
Learning disorder	11	8.7
Psychological/psychiatric condition	5	4.0
Asperger's syndrome/autism spectrum disorder	4	3.2
Speech impairment	4	3.2
Blind or visual impairment	3	2.4
Acquired/traumatic brain injury	2	1.6
Other condition	12	9.5

Table 3

Mentoring Scales Reliability

Mentoring Scales[a]	Items	Reliability Spring 2014		Description
		Mentee	Mentor	
Personal Responsibility	6	.929	.939	How much mentoring has enabled interpersonal growth
Personal Fulfillment	5	.900	.898	Sense of fulfillment in the relationship between mentors and mentees
Support Seeking	5	.895	.923	How much mentoring provides academic and personal support
Communication	6	.933	.907	How satisfied mentors and mentees are with the frequency, duration, and quality of their communication
Mentoring Total Scale	22	.968	.976	Mentee and mentor perceptions of the overall mentoring experience
Mentoring Satisfaction Scale	6	.948	.950	How satisfied mentors and mentees are with the mentoring process

Note. [a] 5-point scale.

Table 4

Involvement in the Mentoring Process

	2012-13 (*N*=115)	2013-14 (*N*=71)	2012-2014 (*N*=126)
Involvement	*N*(%)	*N*(%)	*N*(%)
Received mentoring	105 (91.3)	65 (91.5)	117 (92.1)
Received mentoring from peer	95 (82.6)	59 (83.1)	108 (85.0)
Received mentoring from faculty	51 (44.3)	29 (40.8)	61 (48.0)
Provided mentoring for peer	75 (65.2)	53 (74.6)	94 (74.0)
Served dual role as mentor			
Mentee	67 (58.3)	47 (66.2)	86 (67.7)
Participated at least 2 hours per week	79 (68.7)	57 (80.3)	90 (70.9)
	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
Hours per week	2.74 (2.5)	3.81 (4.4)	3.45 (3.7)
Hours per month	11.88 (8.8)	12.54 (10.5)	12.65 (8.5)

Table 5

Types of Mentoring

Mentoring Methods[a]	Mentees 2012-13	2013-14	Overall 2012-14	Mentors 2012-13	2013-14	Overall 2012-14
Face-to-face	4.14 (1.3)	4.38 (.97)	4.21 (1.0)	4.26 (1.1)	4.68 (.73)	4.14 (1.3)
Text Messaging	3.13 (1.6)	3.06 (1.6)	3.01 (1.3)	3.32 (1.5)	3.30 (1.6)	2.88 (1.5)
Email	3.08 (1.5)	2.85 (1.5)	3.01 (1.3)	2.93 (1.5)	2.77 (1.5)	2.53 (1.4)
Phone	2.27 (1.4)	2.25 (1.4)	2.23 (1.3)	2.27 (1.4)	2.26 (1.6)	2.07 (1.3)
Facebook	1.84 (1.3)	1.55 (1.1)	1.57 (1.0)	1.85 (1.2)	1.72 (1.3)	1.63 (1.1)
Video Conference	1.58 (1.3)	1.47 (1.1)	1.49 (1.0)	1.36 (0.9)	1.45 (1.1)	1.51 (1.2)

Note. [a] 5-point scale (1=not at all, 5=a great extent).

Table 6

Mentoring Perceptions and Satisfaction of Mentees

		Fall 2012	Spring 2013		
Scale	*N*	Mean (*SD*)	Mean (*SD*)	% Improving	*t*
Mentoring Scales[a] Personal Responsibility	61	4.05 (.63)	4.08 (.68)	54.1	.287
Personal Fulfillment	61	4.11 (.62)	4.19 (.68)	65.6	.770
Support seeking	61	3.98 (.67)	4.06 (.73)	59.0	.737
Communication	62	4.17 (.72)	4.28 (.66)	66.1	.965
TOTAL SCALE	61	4.07 (.58)	4.11 (.62)	49.2	.531
Overall Satisfaction[b]	62	4.13 (.77)	4.24 (.68)	66.1	1.01
		Fall 2013	Spring 2014		
Scale	*N*	Mean (*SD*)	Mean (*SD*)	% Improving	*t*
Mentoring Scales[a] Personal Responsibility	51	4.04 (.65)	4.21 (.71)	78.4	2.85**
Personal Fulfillment	51	4.10 (.71)	4.33 (.69)	72.5	2.73**
Support seeking	51	3.95 (.63)	4.25 (.71)	78.4	3.26**
Communication	51	4.22 (.57)	4.33 (.62)	68.6	2.45*
TOTAL SCALE	51	4.03 (.56)	4.24 (.64)	70.6	3.25**
Overall Satisfaction[b]	50	4.25 (.62)	4.28 (.63)	74.0	0.325

Note. [a] 5-point agreement scale (1=SD, 2=D, 3=N,4=A, 5=SA). [b] 5-point satisfaction scale (=not satisfied, 2=somewhat satisfied, 3=neutral, 4=satisfied, 5=very satisfied). *p<.05, **p<.01.

Table 7

Mentoring Perceptions and Satisfaction of Mentors

		Fall 2012	Spring 2013		
Scale	*N*	Mean (*SD*)	Mean (*SD*)	% Improving	*t*
Mentoring Scales[a] Personal Responsibility	37	3.90 (.58)	4.24 (.65)	75.7	2.96**
Personal Fulfillment	37	3.98 (.58)	4.26 (.67)	72.9	2.55*
Support seeking	37	3.94 (.66)	4.07 (.71)	59.5	1.07
Communication	37	4.00 (.59)	4.29 (.65)	81.1	2.68*
TOTAL SCALE	37	3.92 (.58)	4.16 (.62)	64.9	2.22*
Overall Satisfaction[b]	37	4.10 (.69)	4.32 (.69)	75.7	1.78

		Fall 2013	Spring 2014		
Scale	*N*	Mean (*SD*)	Mean (*SD*)	% Improving	*t*
Mentoring Scales[a] Personal Responsibility	34	4.04 (.75)	4.05 (.71)	58.8	.314
Personal Fulfillment	34	4.11 (.61)	4.12 (.66)	70.6	.271
Support seeking	34	4.05 (.63)	4.09 (.63)	73.5	.141
Communication	34	4.19 (.60)	4.22 (.64)	64.7	.249
TOTAL SCALE	34	4.06 (.59)	4.09 (.65)	61.8	.220
Overall Satisfaction[b]	32	4.22 (.66)	4.18 (.67)	71.9	-.332

Note. [a] 5-point agreement scale (1=SD, 2=D, 3=N,4=A, 5=SA). [b] 5-point satisfaction scale (=not satisfied, 2=somewhat satisfied, 3=neutral, 4=satisfied, 5=very satisfied). *p<.05, **p<.01.

Table 8

Changes from Fall 2012 to Spring 2014

	Pre (F12) Mean (*SD*)	Post (SP14) Mean (*SD*)	*t*	Percent of Students who Improved *N* (%)
Mentees (*n*=28)				
Mentoring Total Scale	3.91 (.64)	4.17 (.71)	1.76	67.9
Personal Responsibility	3.86 (.66)	4.10 (.77)	1.57	67.9
Personal Fulfillment	4.02 (.69)	4.26 (.72)	1.58	71.4
Support seeking	3.87 (.71)	4.16 (.81)	1.84	78.6
Communication	3.97 (.84)	4.29 (.69)	1.61	78.6
Mentoring Satisfaction	3.97 (.86)	4.18 (.71)	1.13	67.9
Mentors (*n*=21)				
Mentoring Total Scale	3.81 (.62)	4.13 (.72)	1.48	61.9
Personal Responsibility	3.79 (.67)	4.11 (.77)	1.49	67.0
Personal Fulfillment	3.86 (.60)	4.15 (.73)	1.39	71.4
Support seeking	3.78 (.62)	4.12 (.67)	1.65	76.2
Communication	3.93 (.64)	4.26 (.66)	1.61	67.0
Mentoring Satisfaction	4.04 (.76)	4.27 (.69)	1.02	71.4

Table 9

Relationships Between Participation in Mentoring and Mentoring Perceptions

	Mentees	Mentors
	2012-14 Hours per month (*n*=114)	2012-14 Hours per month (*n*=93)
Mentoring Scales	r (Sig.)	r (Sig.)
Personal Responsibility	.307***	.301**
Personal Fulfillment	.229**	.270**
Support seeking	.254**	.319**
Communication	.273**	.234*
TOTAL SCALE	.265**	.323**
Overall Satisfaction	.315***	.244*

Note. *p<.05, **p<.01,***p<.001.