Experiences of Minority College Students with Disabilities in STEM

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Abstract

Despite recent growth in the number of college students majoring in Science, Technology, Engineering, and Mathematics (STEM), there is a disparity in participation for students from racial and ethnic minority backgrounds with disabilities. This issue has received little attention in the research literature. We sought to gain a better understanding of the experiences of minority students with disabilities in their pursuits of a degree and career in STEM and their experiences with a program designed to support the accomplishment of this goal—the **Min**ority-**D**isability Alliance in Science, Technology, Engineering, and Mathematics (MIND Alliance). We used the Consensual Qualitative Research (CQR) approach to address the research questions with six former or current STEM students who received MIND Alliance services and supports. Results provide insights into the experiences of STEM students from racial and ethnic minority backgrounds with disabilities, and the influence of the MIND Alliance program on their academic success. Findings emphasize the importance of social supports from peers, family, and the university, as well as the proper handling of accommodations. Participants were generally satisfied with MIND Alliance services and reported positive influences on academic and career goals and on social aspects of college success.

Keywords: Postsecondary education, disability services, social supports, STEM

The science, technology, engineering, and mathematics (STEM) workforce plays a critical role in advancing innovation, enhancing national security, and maintaining overall competitiveness in the labor market (National Science Board [NSB], 2015; Street et al., 2012). The STEM workforce represents a set of fields that are diverse in tasks, employment rates, compensation, and predicted growth. Many of these fields provide relatively high-paying, high-growth employment opportunities (Carnevale & Cheah, 2015; NSB, 2015; U.S. Joint Congress Economic Committee, 2012). Further, growth in some STEM fields has outpaced the supply of qualified workers such that producing enough college graduates prepared for STEM occupations in the United States has become a national priority (Chen, 2013; U.S. Department of Labor, 2007).

Disparities have frequently been cited in STEM education and employment. Women, racial and ethnic minorities, people with disabilities, military veterans, and people from lower socioeconomic backgrounds have all traditionally been underrepresented in STEM fields (NSB, 2015; National Student Clearinghouse Research Center [NSCRC], 2015; Slovacek et al., 2011; The Leadership Conference Educational Fund, 2015). Even when individuals from these groups obtain STEM degrees they have been reported as being less likely to enter a STEM occupation (Beede et al., 2011; McAllister McAllister -Crumb, King, Grodsky, & Muller, 2012; Sevo, 2011). Thus, one solution for increasing the supply of qualified workers is to broaden and deepen the pool of potential STEM employees. Reducing disparities in STEM education and employment provides a pathway to independence for individuals while also increasing the talent pool for organizations seeking qualified employees and the overall competitiveness of the labor market.

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The focus of this research is on students from racial and ethnic minority backgrounds with disabilities. We briefly review the literature for students from racial and ethnic minority backgrounds and for students with disabilities in STEM before describing a program implemented to support minority students with disabilities in their pursuits of a degree and career in STEM—the **Min**ority-**D**isability Alliance in Science, Technology, Engineering, and Mathematics (MIND Alliance).

People from minority racial or ethnic backgrounds were reported as represented only 6% of the general STEM workforce at a time when they represented approximately 30% of the general population (Strayhorn, 2010). Potential reasons for these disparities include the social climate of STEM educational and employment settings, negative perceptions and stereotypes, a lack of same-race peers in classes and labs, a lack of role models, and negative interactions in the classroom (Beasley & Fisher, 2012; Ong, Wright, Espinosa, & Orfield, 2011; Strayhorn, 2010). Given these barriers to STEM education and employment, it is not surprising that faculty from minority racial or ethnic backgrounds are greatly underrepresented in the STEM fields (Flowers, 2012). Recommendations for supporting STEM education include providing support systems that offer academic, social and professional opportunities in a way that supports minority status (Stolle-McAllister, Domingo, & Carrillo, 2011; Strayhorn, 2010) and increasing the number of faculty from minority racial or ethnic backgrounds across STEM disciplines to serve as mentors and role models and to provide encouragement for minority students (Flowers, 2012).

Limited research has been done to consider disparities for students and employees with disabilities in STEM, a notable exception being the special issue in the 2011 *Journal of Postsecondary Education and Disability* focused entirely on this topic (Burgstahler, 2011). In this issue, barriers were identified as including financial, social, and systemic barriers, such as professor attitudes and beliefs and an underrepresentation of students with disabilities (Jenson, Petri, Day, & Truman, 2011). Multifaceted intervention strategies may be necessary to enhance the experience of students with disabilities in STEM fields (Martin et al., 2011; Moon, Utschig, Todd, & Bozzorg, 2011). Promising practices for current STEM students included the use of student learning communities, which was correlated with enhanced self-advocacy and career development skills (Izzo, Murray, Priest, & McArrell, 2011), and asynchronous access to instructional content, which was found to enhance learning of STEM content (Graves, Asunda, Plant, & Goad, 2011).

As might be expected, people with multiple minority statuses experience greater disparities in STEM education and employment than those with a single minority status (Beasely & Fisher, 2012; Riegle-Crumb & King 2010). Greatest research attention has been placed on women from minority racial or ethnic backgrounds. Ong and colleagues (2011) concluded, after reviewing nearly 40 years of research on women from minority racial or ethnic backgrounds, that this population was grossly underrepresented in STEM fields. Much less is known about the experiences of college students in STEM whose multiple minority statuses include racial and ethnic minority backgrounds and disability. The research students with disabilities in STEM and the research on students from racial and ethnic minority backgrounds suggests the existence of multiple potential barriers in pursuing STEM degrees for students with disabilities from racial and ethnic minority backgrounds.

The MIND Alliance project was implemented at two minority institutions of higher education, Hunter College, City University of New York in affiliation with Southern University, Baton Rouge, Louisiana. The goal of the project was to increase the quality and quantity of minority students with disabilities in STEM. The MIND Alliance project "brings together expertise, experience, and considerable institutional, programmatic, and personnel resources of two institutions of higher education to provide best practice educational and career development services to minority students with disabilities" (Hawley, Cardoso, & McMahon, 2013, p. 193). These multifaceted strategies and services to support students include (a) a summer institute; (b) tutoring, mentoring, and role modeling; (c) career assessment, planning, and counseling; (d) science literacy training/field trips; (e) school counselor and teacher workshops; and (f) research opportunities and internship programs. More on this National Science Foundation funded project (grant no. 083392) can be found at www.mystem.org and in Hawley et al. (2013).

The Workforce Innovation and Opportunity Act (2014) that was recently signed into law allows state vocational rehabilitation agencies to support advanced training in STEM professions. The demand for STEM workers combined with a new emphasis on public funding provide a great opportunity for students with disabilities from racial and ethnic mi-

norities. Therefore, it is important for those involved in the development of higher education policy making or service provision understand the potential as well as the needs and concerns of minority college students with disabilities who are interested in earning degrees in the STEM fields. The purpose of this study was to take an in-depth, qualitative look at the postsecondary education experiences in STEM fields for minority college students with disabilities. We gave particular attention to the influence of the MIND Alliance program on student postsecondary experiences. Qualitative interviews were conducted and analyzed using a consensual qualitative research approach (CQR) developed and updated by Hill and colleagues (Hill, 2012; Hill et al., 2005; Hill, Thomson, & Williams, 1997; Spangler, Liu, & Hill, 2012). An inductive, qualitative approach was appropriate given the limited research for this population of college students in STEM. The following research questions are addressed in this study:

1. What factors influence postsecondary success for minority students with disabilities majoring in STEM?
2. What influence did the MIND Alliance project have on postsecondary success for minority students with disabilities majoring in STEM?

Method

We used CQR to interview, analyze, and report the data. This research method has become a widely used qualitative method in counseling, social sciences, and rehabilitation counseling research (Fleming, Phillips, Kaseroff, & Huck, 2014; Huck, Fleming, Phillips, & Kaseroff, 2014; Kaseroff, Fleming, Huck, & Phillips, 2015; Phillips, Kaseroff, Fleming & Huck, 2014; Ponterotto, 2005). This approach allows for the exploration and understanding of esoteric information while addressing some of the limitations inherent in qualitative research, such as threats to validity from researcher bias and interpretation and lack of structured methods for coding and analysis (Hill, 2012). The approach is based largely on grounded theory. However, CQR and grounded theory differ in that (a) CQR researchers use the same semi-structured interview protocol across all participants (allowing for probing questions) while grounded theory researchers often use a more unstructured, evolving interview protocol, (b) CQR uses multiple judges and auditors to analyze the data while grounded theory often uses only one judge,

(c) CQR researchers quantify the representativeness of main ideas while grounded theory researchers do not attempt to specify the proportion of participants who shared an idea, and (d) the CQR method of data analysis is relatively fixed while the grounded theory method is more flexible.

Participants

Participants were six college students who received MIND Alliance services and supports while receiving postsecondary education in a STEM related field. All participants were underrepresented minority students with disabilities, and all had completed undergraduate programs or were in process of completing their educations in STEM or a related field. Gender representation was even with three females and three males. Participants presented with the following self-reported disabilities: (a) three individuals with a psychiatric disorder (one with schizophrenia, one with anxiety disorder, and the other with bipolar disorder); (b) one with attention deficit/hyperactivity disorder (ADHD), cognitive delay, and depression; (c) one with a musculoskeletal condition affecting the upper body; (d) and another with Tourette's syndrome and ADHD. All participants managed a disability during the pursuit of an undergraduate degree. Two of the six participants were receiving social security benefits at the time of the interviews.

Participants were at various stages of education and work. One participant was in the process of completing an undergraduate degree while also applying for graduate school, one had completed an undergraduate degree and was deciding next steps, two others had completed undergraduate programs and were currently in graduate training, and the final two had completed graduate school. Of the two who had completed graduate school, one was looking for work in STEM and the other was working as a speech teacher while completing an additional certification in STEM.

Measure

The semi-structured interview was derived from a combination of the literature and personal experience. Interview questions covered areas of K-12 education, postsecondary education, and MIND Alliance services specifically. The CQR interview consists of open-ended questions that provide a framework for responses. These questions were based on a review of the literature about the barriers and facilitators to postsecondary education as well as the experience and observations of the researchers. Structured ques-

tions included, "What did you do to persist and graduate with a degree in STEM?" and "What were some of the barriers you experienced while obtaining your degree?" Follow-up questions are used to encourage elaboration of ideas rather than direct or influence the response. Because participants were in different places with their education and employment, questions varied slightly from interview to interview accordingly.

Researchers

Team members reflected on potential biases they might have in connection with the study topic before conducting any data analysis to increase awareness and reduce undue influence of bias on the results. All four researchers involved in the coding and analysis process reported viewing access to STEM education as being critically important for the population. Researcher biases were more mixed in beliefs about the factors that would influence goal persistence or serve as barriers to achievement.

Procedure

Recruitment of participants. Participants were recruited for interviews as part of exiting from the MIND Alliance program. Participants were recruited by email. The 12 students who had completed the MIND Alliance project were sent an invite for voluntary participation. Six of the 12 who received an invite chose to participate in the study. Interviews were conducted by the first author and lasted approximately 45 minutes to an hour. Four interviews were conducted in person and two over the phone to accommodate for disabilities. The interviews were recorded and then transcribed verbatim through a paid service.

Data analysis. The analysis team consisted of three coders and one auditor, as specified in CQR. Coding of transcripts began with each member of the coding team individually attempting to create domains from the six interviews for participants through an iterative process of identifying and extracting meaningful data units (i.e. phrases, sentences, paragraphs). Coders then met to gain consensus on these initial domains. The next step generally involves the creation of core ideas, which involves summarizing the main points from each data unit. However, this step was not completed for this study. Coders instead chose to work from the raw interview data for the creation of categories within each domain. This process resulted in some alterations in the initial domains, and coding continued until stable domains and categories had been obtained.

An auditor reviewed the final domains and categories upon completion. This auditor was familiar with the project but did not assist with the coding. The auditor provided suggested changes, additions, and deletions to the coding team. The coding team revised the coding in line with several of the recommendations by the auditor, including refining the domain names and recoding categories for some of the data.

The CQR protocol was followed for translating frequency of participant comments to a standard measure of representativeness for each category in the sample. A category consisting of data from all participants was considered general. A category consisting of data from fewer than all but more than half (4-5 participants in this sample) was considered *typical*. A category consisting of only a few (2-3 in this sample) participants was considered *rare*. The variant category often used in CQR research was not employed because of the relatively small sample size.

Results

The six participants in this study spoke of many factors influencing the pursuit of STEM education and employment captured in domains and categories. Four domains emerged from the data: interpersonal factors, accommodations, individual factors, and the MIND Alliance. We proceed by presenting the domains and categories as a means of addressing the two research questions regarding factors that influence postsecondary success and the influence of the MIND Alliance on individuals from racial and ethnic minority backgrounds with disabilities pursuing STEM degrees.

Interpersonal Factors

The interpersonal factors domain consisted of five categories that emerged from participant interviews. The results that follow are presented in order of representativeness from general (Family, Peers, and Faculty and Staff), to typical (Others), to rare (Teachers and Staff).

General. Categories were considered general when they included comments from all participants. The categories of family, peers, and faculty and staff were identified as general categories. The *Family* category focused on barriers or supports from family. These barriers or supports could be emotional, physical, or financial in nature. Four participants reported family only as a support to their postsecondary goals while the remaining two expressed family as provid-

ing a combination of barriers and supports. One participant whose parents moved to the U.S. primarily so that the participant and her siblings could gain an education described family support as follows,

> That was their hopes and dreams that I go to college, and now that I'm going for my master's they're even more excited and more happy that I'm continuing to pursue an even higher education as well, so they just encourage it and they support it 100%.

Another participant described emotional, informational, and financial supports received from family in saying,

> They send me a bunch of stuff. I actually found out my dad is moonlighting as me online sending inquiries to medical schools, telling them that I want information. I'm also married, so my spouse, he's also in STEM, so that also always helps. And, you know, just sending words of encouragement. There's also financial support because sometimes STEM education can add up, and if you have to pay rent and bills but you're still in school and you don't have time to work a full-time job and be in school, financial support is always important, so they've been helping with that as well.

The two participants who stated family as both supports and barriers to their postsecondary education spoke about unmet expectations for support. It was apparent that family influences could be as detrimental when negative as they were helpful when positive. When asked what barriers were experienced in pursuing a degree, one participant responded, "I would say family, one of the biggest ones."

The next general category, *Peers*, describes the experiences with peers that acted as supports or barriers to participants' postsecondary success. Three participants reported peers only as a support to their postsecondary goals while the remaining three described peers as providing a combination of barriers and supports. One participant who described peers exclusively in a positive light stated,

> On campus, sad to say, the people who help you are not your faculty, they're not the people. Even your advisors aren't there for you like that. If you're lucky, you might get a good one. The peo-

ple who are there for you are the seniors or the ones who are around you. Getting to know your year, your class year, they'll be the ones to make sure, like, oh, you should take this class this time, you should try doing this.

Another participant spoke of peers in relation to the competitiveness of STEM education. The participant suggested that they had success in working with peers in some classes but, "trying to do that in chemistry didn't work because the type of students that take chemistry, the engineering, the medical . . .they don't want any teamwork. They want you to fail as well." Peer support was reported as being complicated at times by peers not fully understanding the needs or the approach to take with participants. For example, one participant reported a close friend as saying that they would "drag [the participant] over the graduation line." The participant continued, "It sounds really empowering, but on the flip slide, it's, 'you're lazy', 'you're not doing your work', or, 'you're not good enough.'"

The final general category, *faculty and staff,* describes the experiences with faculty and staff that acted as supports or barriers to participants' post-secondary success. Some spoke about faculty and staff generally, but most comments centered on individual faculty or staff who were either a support or barrier to their success. Two participants reported faculty and staff as only a support to their postsecondary goals while the remaining four described faculty and staff as providing a combination of barriers and supports. Among the latter, one participant stated,

> I just text[ed] one of my math teachers today. He was extremely busy, but anytime I had a question or I wanted to meet with him he met with me after class. He would like sit in on our study break sometimes just in case we had questions. Most of them were not supportive.

Another participant, after stating that she had not received as much support as she would have liked, shared a purely positive example of a specific professor,

> He took me under his wing and gave me a job and introduced me into a new realm of STEM that I had never heard of before. . . .   And he helped me intertwine it with my interests, so he took me under his wing and opened me to a new job.

It was apparent from these and similar comments that faculty could have a powerful influence on postsecondary success beyond the content they teach.

The influence of participant minority status on postsecondary success came up in relation to faculty and staff, with one female participant stating, "Professors don't understand, can't relate, either from being from the inner city or having a disability or being a woman. . . . There were a lot of boundaries and barriers." Similarly, another stated, "I was in the town and they don't see people of color. And that exists also in the administration."

Participants also talked about the need for more mentoring and guidance from faculty and staff in STEM. For example,

> Getting mentorship—that was a huge barrier, not necessarily knowing how to navigate the road. Also not being aware of the programs that are available for students in STEM like, you know, there are so many programs that can help you move along your education, and I didn't have a counselor in my degree who would meet with me regularly and say, hey, have you heard about this program or that program? You should apply to this; you should apply to that. I was kind of on my own. And a lot of the students, that was the sentiment in STEM, just being on your own.

Typical. Categories were considered typical when they included comments from 4 to 5 participants. Only one typical category emerged for interpersonal factors. This category, labeled *Others*, represented interpersonal supports or barriers experienced with unspecified mentors or service providers outside of the college they attend. Four participants spoke exclusively of positive supports while one spoke only of barriers to postsecondary education experienced from others. An example of support came from a participant who stated, "I've had several mentors who are physicians, who are public health workers, who, you know, eventually they became my mentors over time once they realized my dreams were in alignment with what they do."

Rare. Three participants spoke of the support received in K-12 education that was important to them. This category, labeled *Teacher and Staff*, reflects statements about teachers or staff in their K-12 experience who were important for the participants' success. All responses in this category were positive and responses ranged from general assistance they re-

ceived from teachers, to specific teachers or staff who were integral to participant successes in K-12. "I can honestly say [my high school teacher is] one of the people that really pushed me to go to the next level of science . . . He was so proud of the fact that I was able to overcome [having a disability]."

Accommodations

The accommodations domain consisted of two categories. Both categories (faculty or staff response and Peer Attitudes Toward Accommodation) had general representativeness. Of the five who spoke of effectiveness of accommodations received, three reported only positive experiences, one reported mixed experiences, and one more neutral experiences.

General. The first category involved *faculty and staff* responses to accommodations. Three participants spoke only of negative and one only of positive faculty or staff responses to accommodations. Of the remaining two participants, one described a mix of negative and positive responses while the last participant provided only neutral statements about the accommodations response from faculty and staff. Of all the responses, the negative faculty and staff responses were the most abundant. One participant stated,

> I had one professor tell me, "why do I have to constantly sign your test accommodation forms," in a very snarky kind of way. It annoyed him that I had to go to him, even when I asked him if he'd be willing to sign them for the rest of the semester, if it bothered him, he refused. But every time I would go to him, he would give me an attitude, and it made me really uncomfortable asking him for the accommodations. . . . I've been asked by three professors what my disability is and I heard they weren't supposed to do that, but I didn't know.

Other negative faculty and staff responses were described to include a lack of understanding or awareness about individuals with disabilities and the accommodation support needed in an academic setting. Another more specific negative response described how STEM specific faculty and or staff were not supportive of individuals with disabilities. One participant commented,

> Most of them did not really give a crap about special needs because they're very elitist in STEM courses. So, as far as they're concerned, you're

dumb . . . And I did not find a lot of support in the field for people with disabilities.

A participant who described only positive faculty or staff responses to accommodations suggested that the procedural announcement about the Disability Services Office at the beginning of class each semester from a professor was discreet and seemed to be beneficial.

The second general category, *peer attitudes towards accommodations*, included participant statements about peers' attitudes toward accommodations. Three participants reported negative peer attitudes toward accommodations while three reported neutral experiences of peer attitudes toward accommodations. Participants who expressed negative peer attitudes towards accommodations explained the disapproval experienced from peers due to receiving accommodations. In the context of explaining their difficulty with negative peer attitudes one participant stated, "so they'd say, why do you get to take the exam somewhere else? Why can't you take the exam with us? And they would kind of like make a snide remark like, oh, you look fine to me." Other negative peer attitude statements discussed issues of disclosure and the implicit negative bias that came with having a disability (e.g., being thought of as "lazy"). The three participants who only provided neutral responses stated, "They didn't care that much." Other participants mentioned that with invisible disability there was more control over whether peers knew of the accommodation. One participant stated, "I was very discreet about it, so no one ever knew," and another said, "Hardly anybody really noticed because I don't look like I have a disability. My disability's not visible."

Individual Factors

The individual factors domain consisted of five categories that emerged from participant interviews as well as a miscellaneous category of individual factors that were mentioned by only one participant. The results that follow are presented in order of representativeness from typical (motivation) to rare (difficulty forming relationships, help-seeking, participation in college organizations, and confidence). No general categories emerged from the data.

Typical. Five participants identified *motivation to learn* as one of the most salient individual factors present in their collegiate experience. Within this category, three emphasized the importance of motivation to their postsecondary success. The two remaining participants spoke of their motivation to learn as a key to success while also noting struggling, at times, with a lack of motivation. Of the positive statements, most participants noted similar motivations toward learning. One participant demonstrated motivation in spite of trials in stating," I tried to give it the best that I could, given my circumstances. It may not be great, but I'm just going to persevere and just keep at it. I just kept at it. Even when I would fail miserably . . . I just didn't give up."

Rare. Three participants identified *difficulty forming relationships* as one of the salient individual factors present in their collegiate experience. Within this category the personal impact of disability was the most identified reason for difficulties forming relationships (e.g., depression). Participants also identified fears about stigma from peers as salient in their difficulty forming relationships. One participant commented, "I was always worried that I might get judged differently or viewed differently by others. So I always had difficulties talking about my disability. I always had this feeling that people were going to look at me differently."

The second rare category involved three participants and their *help-seeking behaviors* within collegiate settings. Comments were categorized as being help-seeking behaviors when participants stated an effort to reach out to others in connection with their postsecondary success. Each of these participants emphasized the importance of communication to their success in school. Participants focused on developing academic networks, which included other students, faculty, and/or support staff to increase their likelihood of success. One participant explained, "Studying with your peers, with some assistance from the teacher, is essential because not everybody is going to get everything, but together you can fill in the gap."

The third rare category, *Participation in College Organization*, involved two participants and reflected positive collegiate experiences specifically related to joining and participating in campus organizations. The positive aspects of this form of participation noted by interviewees included belonging, social and career networking, philanthropy, and increased self-confidence, for example,

It was when I started to get more involved in the different organizations and clubs for students with disabilities that I started to kind of learn that I shouldn't be embarrassed about my disability or shouldn't be afraid of being labeled and that I'm not on my own.

And another participant stated,

> And you can also get some type of . . . pride for being a student at a specific college. It makes you feel like a unit. And when you join little clubs, like I'm vice president for Society of Automotive Engineering now, you know, and you start to work with your team, you start to feel like, oh, this is us, this is our own, even if it's against the world. It feels good.

Of particular note was an emphasis on disability advocacy. One participant states, "I'm so active in these organizations, to try to help . . . [include] the students in the same activities that the other students do because we can do them. It has to start from somewhere, the advocacy and standing up."

The final rare category, *confidence*, was expressed as an important individual factor for two participants. One participant stated a purely negative reflection of confidence, when asked if they sought out a mentor in college responded with, "No, I did not feel like I was worthy of one." The other participant made statements connecting confidence to postsecondary success while also noting a lack of confidence at times that was a barrier to success. This participant, after speaking of successful efforts to maintain high levels of confidence stated, "Another challenge, too, is being so scared of failure that you can't even open the textbook and your hands are sweating and, you know, not having anybody to talk to and say I'm feeling this kind of way."

Miscellaneous. Categories were miscellaneous when they included comments from fewer than two participants. The three miscellaneous categories encompassed statements from participants on the personal importance of disability acceptance, prioritization, and faith. Although these individual factors did not receive much attention from multiple participants, they are interesting aspects to consider in regards to college success.

MIND Alliance

The MIND Alliance domain consisted of two categories that emerged from participant interviews. The two typical categories (influence of the MIND Alliance and effectiveness of the MIND Alliance) are presented.

Typical. Participants identified *influences of the MIND Alliance* in two subcategories, *academic and career,* and *social.* Within the subcategory of academic and career influences of Mind Alliance, five participants noted specific their educational and career influences. Several students mentioned the influence of the various workshops provided by MIND Alliance, with the resume building workshops said to be particularly influential. The MIND Alliance was stating as having a broad influence ranging from shaping interest in STEM (e.g. "It helped affirm that I wanted to go into behavior science.") to positively affecting opportunities for work experience (e.g., "I was able to get my hands dirty, especially in the chemical lab… it was a really good resume builder. [It] helped me understand that, my disability isn't the end of the road …[It] made me feel fortunate.").

The other subcategory influence of the MIND Alliance was *social influence*. Four participants reported a positive social influence of the MIND Alliance program. One participant stated, "[Students with disabilities] were also treated like regular students with goals and ambition and it was great." Another student commented, "I was also able to network with some other students. Even though we all knew we were in there with disabilities we didn't have to talk about it. It was just nice seeing one another."

The second typical category was *effectiveness of the MIND Alliance* with four participants commenting. Participant remarks included general statements, for example, the graduate student who praised MIND Alliance services then stated, "if I had [MIND Alliance] when I was an undergrad it would've been totally different—totally different." Another graduate stated, "I just thought it was a well-run program and it gave me a lot of inspiration and commitment." Participants tended to express that the program was executed successfully and contributed to their personal achievements in STEM postsecondary education.

In addition to the previous categories, five participants made suggestions for improvements to the MIND Alliance. The majority of suggestions were for increased outreach, promotion, and networking. Some participants commented that they would have benefited from learning about MIND Alliance earlier and other participants commented that there were more who could benefit but may not be aware of its existence. One student explained, "I only found out by accident, so I think had I known before I probably would've jumped on ship earlier." These comments, in the face of a thorough marketing and recruitment effort, highlight the difficulty of effective outreach to this population of underrepresented college students on commuter campuses through traditional mecha-

nisms (e.g., flyers, posters, advertisements). Two students who enjoyed the lectures and workshops hosted by MIND Alliance stated an interest in having more of them. Another student noted the need for increased networking with professors as well as with mentors in STEM stating, "Creating a mentorship connection, having a one-to-one connection where you assign a mentor to one or two students, kind of creating a regular interaction. I think that's important." Despite the provision of some mentorship and internship services, two participants suggested that the MIND Alliance have an increased role or focus on facilitating internship opportunities in STEM.

Limitations

The implications of this study should be considered within the context of a few limitations. First, we do not expect that the beliefs and behaviors of this small sample are inclusive of all postsecondary students from the target population. Additionally, although our research team followed the recommended guidelines for self-identifying bias and other processes for analyzing the data objectively, including bringing in an auditor to minimize the likelihood of clear misinterpretation of comments, it is possible that a different research team may have found other ways to organize the data. Another aspect of the study that could be considered a limitation was in the few participant comments that centered directly on the influences of minority statuses other than disability or the combination of disability and other underrepresented statuses as was expected in response to the questions about barriers and facilitators of postsecondary STEM education or about their experiences generally. This result is similar to that found by Erten (2011) in studying the experience of women with disabilities in postsecondary education, where only disability was primarily highlighted. There are several potential explanations for this result, including the following: a) less comfort for participants in discussing other underrepresented statuses, b) greater challenge for participants in describing the lived experience of intersectionality and how it shapes the college experiences, c) disability may be viewed by participants as a more salient status for college students in STEM fields, especially on a campus with a larger number of students from racial and ethnic minority backgrounds. Given Erten's findings, the latter seems likely. Future research focused on this area is needed to interpret these results. Finally, data from the interviews was not shared with participants for a check of the accuracy of information, also known as member checking. Despite these limitations, we believe that our study has important implications for postsecondary research for students from racial and ethnic minority backgrounds with disabilities pursuing STEM or related fields.

Discussion and Implications

This study provides postsecondary disability service providers, faculty, and staff insights for understanding the experiences, supports, and barriers of STEM students in from racial ethnic minority backgrounds with disabilities. Current results indicate several important areas for supporting postsecondary STEM education for students from racial and ethnic minority backgrounds with disabilities. Having adequate interpersonal supports, meeting accommodation needs, and possessing certain individual factors were reported as playing key roles in postsecondary STEM success. The MIND Alliance was viewed as providing valued supports and services for this sample. It is important to understand how postsecondary disability providers such as professionals in disability services centers or offices, administration, and or educators can help aide in these specific concerns for minority college students with disabilities in STEM.

The domain of interpersonal factors was the most prominent to emerge from this study. Participants spoke of family, peers, faculty, staff, and others influence on their pursuit of STEM education. Results show that postsecondary service providers, educators, and advisors, although not typically the primary provider of interpersonal support, must appreciate the importance of supportive relationships to educational success as well as the barriers and facilitators for achieving these relationships. College and university disability service providers have a unique opportunity to provide direct mentoring and to connect students from these underrepresented backgrounds to mentors who tend to have fewer role-models than the general population (Dunn, Rabren, Taylor & Dotson, 2012).

The culture of competitiveness experienced by some in STEM education is cause for concern in light of the effect it was reported to have on interpersonal relationships. Seymour and Hewitt (1997) similarly reported a major cause of students with and without disabilities switching from science degrees related to the overall coldness of the classroom. Participants from this study described classrooms with a culture of excessive competition as having the potential to alter

faculty-student interactions as well as student-student interactions. It is possible that a competitive educational climate where one persons success is perceived as requiring another's failure (as is the case when grading on a curve) may create a higher risk social environment that is more taxing for students whose disabilities create additional difficulty forming relationships.

Recent research suggests an improving climate in STEM education and faculty-student interactions (Hedrick, Dizén, Collins, Evans, & Grayson, 2010), but results from the current study highlight continued need in this area. It is important that disability service providers working with this population recognize and understand the intended and unintended consequences of classroom competitiveness on interpersonal supports and on success generally. Disability service providers, in collaboration with faculty and staff, may identify opportunities to encourage more cooperative methods of teaching and assessment when specific instructors or classes display a culture of competition that appears to discourage interpersonal supports. Examples of cooperative methods include the use of the inverted classroom (Strayer, 2012) and the incorporation of team projects (Jenson et al., 2011).

The MIND Alliance was reported as facilitating a sense of belonging and interpersonal support by a majority of participants. Although these results are based on a very small sample, disability service providers and other administrators may see an opportunity for incorporating similar programs targeted to this population as a means for facilitating healthy interpersonal support from peers and faculty. In a path-analytic study of MIND Alliance students, interpersonal support was found to have robust direct effects on STEM goal persistence and barrier coping efficacy, as well as a strong indirect effect on goal persistence through its influence on STEM outcome expectancy (Dutta et al., in press). In support of the approach taken with the MIND Alliance, Vaccaro, Daly-Cano, and Newman (2015) suggested disability service providers work closely with academic and student affairs staff to design and implement programs policies, and services that go beyond the classroom to other areas of campus life, such as residence life, orientations, and other student activities. In circumstances where formal programs that involve multiple entities on campus are not feasible, student-led organizations and support groups may still serve to provide increased supports for this population.

Given the emphasis on interpersonal support received from peers, the creation of peer-led team learning, particularly, mastery peer-led team learning developed by Street et al. (2012) may fill a need for this population. This approach to peer-led team learning combines peer-led team learning with universal design for instruction principles The weekly group meetings in this model of learning provide an opportunity for more senior students to lead newer students in collaborative learning experiences in ways that account for diverse learning styles. In a small sample, Street et al. reported better grades and higher levels of persistence in STEM courses for students with learning disabilities or ADHD who participated in mastery peer-led team learning vs. those who did not.

Providing adequate accommodations was another domain emphasized by participants. Many challenges can arise when attempting to provide individualized accommodations in large STEM classrooms (Love-Stowell et al., 2015). Yet, it was apparent from this study and others that accommodations can have a great influence on self-efficacy, self-determination, and academic outcomes (Cardoso et al., 2013; Dunn et al., 2012). Students rarely reported being unable to get needed accommodations, but instead focused on how those accommodations were provided. Multiple participants talked about the negative effect of an accommodation that was given grudgingly or with skepticism about the need. It is apparent from students in this sample that more work can be done to help faculty with the process of accommodation even when the outcome is to provide it (Erten, 2011; Jenson et al., 2011).

Peer perceptions of accommodation also had a great influence on how participants felt about seeking and using accommodations, with negative or ambiguous peer responses decreasing the likelihood of students with disabilities using them. Disability service providers must be mindful in their marketing and promotion of accommodation services of a dual need to reach those needing accommodations but also to influence faculty and peers perceptions of the legitimacy and importance of accommodations on campus for students with visible and invisible disability. When disability service providers recognize the negative attitudes of others in creating resistance to accepting or using accommodations, they should balance efforts to teach self-determination and self-advocacy with efforts to train and influence attitude change of students and faculty. Mamiseishvili and Koch (2010) suggested that meeting a course instructor outside of class

to discuss accommodation needs. This approach, although more time consuming than other approaches, may help to breed more positive attitudes about accommodations in giver and receiver. Disability service offices can help facilitate and aide these conversations between faculty and students where needed.

Finally, individual factors played an important role in STEM success for this sample. Disability service providers can have a great influence by emphasizing and encouraging the use and cultivation of strengths in processes that are more often focused on the identification of limitations. Recent research suggests the strength-based approached stressed in positive psychology can be very effective in shaping attitudes and influencing outcomes (e.g., Chou et al., 2013; Smedema, 2014). In the spirit of positive interventions, disability service providers can also share success stories about students who experienced a similar situation and achieved their academic and career goals (Hartley, 2013).

Conclusion

The experience of STEM students from racial and ethnic minority backgrounds with disabilities has received little attention in the research. This qualitative study provides insights into the experiences of this population and highlights some of the areas of greatest importance for encouraging STEM success. Participants noted both supports and barriers to the pursuit of their STEM education, with the greatest emphasis being placed on the influence of interpersonal supports. The MIND Alliance played an important role in facilitating interpersonal supports and other forms of support for students from racial and ethnic minority backgrounds with disabilities. Disability service providers can play a critical role in addressing each of the factors that emerged from this study, including facilitation of interpersonal supports, accommodations, and addressing individual factors.

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Acknowledgement