Perceptions of Self-Efficacy Among STEM Students with Disabilities

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Abstract

Numerous studies examine the relationship between self-efficacy and positive outcomes for postsecondary students. Collectively they echo that self-efficacy is an essential component to positive outcomes. Relatively few studies focused on students with disabilities majoring in STEM fields. Twenty postsecondary students with disabilities participated in focus groups organized around Bandura's key factors leading to self-efficacy: mastery experiences, vicarious experiences, social persuasion, and physiological reaction. By pairing participant-response devices, commonly known as "clickers," with traditional qualitative methods, students provided their individual perspectives as well as reacted to collective responses. Several cross-cutting themes emerged from the study. Instructors set the tone for learning and consequently highly influence confidence, motivation, anxiety and stress, and ultimately success. Applied learning is important, especially in team settings. A student's sense of self influences his or her perceptions of self-efficacy. The results offer insight into designing support services and measuring self-efficacy with this population.

Keywords: Disability, higher education, STEM, self-efficacy

Individuals with disabilities, including military veterans, have talents to offer and want to have careers in science, technology, engineering, or mathematics (STEM), but often lack necessary education for employment in those fields. Because gaps in support services often create barriers for this population, a variety of new, focused programs are being made available to students with disabilities, such as peer mentoring, assistance navigating college programs and systems, career exploration, and college and career preparation workshops. As a needs assessment for a Midwest program focused on postsecondary students with disabilities, focus groups of college students with disabilities were conducted on the topic of self-efficacy. Data gained from these focus groups are being used by project staff to enhance supports provided to college students with disabilities, including veterans with service-connected disabilities.

Undeniably there is a gap between the number of STEM jobs the U.S. economy requires and the number of students who are attaining their college education in these fields (National Science Board, 2004). The persistence and retention of all students in STEM fields is of critical importance. A recent analysis of postsecondary STEM enrollment for students with and without disabilities suggests 1 in 5 students with disabilities choose a STEM major (Lee, 2011). Additionally, this same study using data from the National Longitudinal Transition Study-2 Wave 4 (Lee, 2011) reported a lower rate of students with disabilities in STEM majors accessing accommodations compared to students with disabilities in other degree programs. Yet, the range of access and attitudinal barriers that postsecondary students face has been well-documented (Dowrick, Anderson, Heyer, & Acosta, 2005; Stodden & Conway, 2003; Webb, Patterson, Syverud, & Seabrooks-

Blackmore, 2008). These studies pose further questions regarding retention of people with disabilities in STEM majors and the nature of essential supports and strategies to support their persistence. This study focuses on the student perspectives of confidence in their ability to persist in postsecondary STEM studies and the factors that promote or hinder their confidence.

Perceived self-efficacy has been linked in the literature to numerous personal factors that in turn lead to desired outcomes. Successful college students are more motivated to work toward goals (Bandura, 1994; Kim, Newton, Downey, & Benton, 2010; van Dinther, Dochy, & Segers, in press), more resilient when faced with challenges (Kitsantas & Zimmerman, 2009; Reynolds & Weigand, 2010), more likely to continue in their studies (Kitsantas & Zimmerman, 2009; van Dinther et al., in press), and show greater self-determination (Getzel & Thoma, 2008). As part of an ongoing evaluation of student needs, the purpose of this study was to explore and describe how postsecondary students with disabilities studying in STEM fields perceive themselves as efficacious. The results of this study describe supports and strategies reported by the students to promote their self-efficacy. Additionally, the results provide insight into the roles of college disability support (DS) services, peer mentors, course instructors, and general academic support services in promoting and supporting self-efficacy.

According to Bandura (1997), perceived self-efficacy is defined as "belief in one's capabilities to organize and execute the courses of action required to produce given attainment" (p. 2). In the literature studying college persistence, this personal sense of confidence in abilities has been linked to goal setting and success in college (Bandura, 1997; DeWitz, Woolsey, & Walsh, 2009; Hsieh, Sullivan, & Guerra, 2007). Additionally, the literature suggests self-efficacy is a mediating variable between cognition and performance (Rugutt, Ellett, & Culcross, 2003). In other words, while skills and knowledge are important factors leading to success, students need a sense of efficacy to use their skills, access support, and engage in learning (Bandura, 1994).

Self-efficacy theory identifies four contributing factors to students' sense of self-efficacy: mastery experiences, vicarious experiences, social persuasion, and self-management of physiological reactions (Bandura, 1994). Prior experiences resulting in positive outcomes can boost confidence and willingness to persist when faced with challenges (Bandura, 1997; Schunk & Pajares, 2009). Mastery experiences – feelings of accomplishment and success when faced with challenges – are linked to resilience, perseverance, and reduced stress imposed by daunting tasks. Vicarious experiences refer to observing others succeed and consequently feeling an increased sense in one's own ability to similarly succeed (Bandura, 1997; Schunk & Pajares, 2009). When a person sees someone like him/herself succeed, he/she in turn can feel capable of mastering comparable tasks. Conversely, seeing a peer fail can reduce a person's sense of self-efficacy. The third way that self-efficacy can be changed is social persuasion: Influences of others who either uplift or decrease a person's feelings of confidence and judgment of personal capabilities. Encouragement from parents, teachers, and peers whom students trust can boost confidence. When one is persuaded that he/she is capable, then one is more likely to put forth and sustain greater effort. Lastly, emotional reactions can heighten or diminish confidence. Feelings of stress, tension, and depressed mood have physical and psychological effects that negatively impact performance (Bandura, 1994; Schunk & Pajares, 2009).

Fortunately, self-efficacy beliefs are malleable and, thus, can change over time (Cervone & Peake, 1986). Because self-efficacy is not a static personal state and is linked to positive personal outcomes, it is an important focus and worthy of observation and study. For the general population of college students majoring in the STEM fields, self-efficacy arises frequently in studies of persistence and retention. What STEM students believe about their own self-efficacy and responsibility for learning are linked to their academic persistence as well as their achievement (Eccles & Wigfield, 2002; Hacket, Betz, Casas, & Rocha-Singh, 1992; Lent et al., 2003; Zeldin & Pajares, 2000). Interestingly, the role of instructors can become enmeshed with self-efficacy. There is an increase in the literature describing effective strategies for teaching postsecondary learners with disabilities at both 2-year and 4-year colleges (Moriarty, 2007; Schelly, Davies, & Spooner, 2011). The act of learning at the college level is much more than a reaction to effective teaching; the goal of learning in college is helping students transform abilities into skills and operates as a training ground for life-long learning (Zimmerman, 2002). When college students attribute their achievements to the influence of an instructor rather than their increasing ability to regulate

their learning processes, research shows postsecondary institutions interpret that information as students' avoiding taking responsibility for their learning at levels appropriate for college (Zimmerman, 2002; Zimmerman & Kitsantas, 1999). Through the process of gaining self-regulation of learning, self-efficacy becomes entwined with learning at the college level (Zimmerman, 2002).

How STEM students interpret their experiences in course-related assignments shapes their self-efficacy. Students increase their enjoyment of their learning experiences as they increase content mastery and often attribute good grades to content mastery (Hutchison, Follman, Sumpter, & Bodner, 2006). The quality of challenging assignments is shown to influence the development of college students as learners, particularly in the domain of self-efficacy (Kitsantas & Zimmerman, 2009). When students feel satisfaction from completing quality work, they are positively influencing their own self-efficacy, especially in STEM courses (Hutchison et al., 2006). In the area of social persuasion, STEM students may interpret their grades to be an indication of how their instructors gauge their personal abilities. The verbal exchange between students and those whom they seek for academic help similarly shapes self-efficacy because students may perceive those exchanges as judgments, whether positive or negative. In the realm of physiological constructs of self-efficacy, students associate how they feel during certain academic tasks with what they believe about themselves (Hutchison et al., 2006).

For college students with disabilities, issues of persistence and retention are additionally tied to accommodations and supports matching their disability-specified needs as provided by the campus DS office. A known concern with relying on DS offices is low rates of self-identification of disabilities (Getzel & Thoma, 2008; Klassen, 2002). Not all college students with disabilities want support from the DS office, or they wait until they experience significant academic challenges before requesting accommodations. This reality poses questions for how mentors, advisors, and instructors influence beliefs of self-efficacy among college students with disabilities. Similarly, there are questions as to how general academic support centers such as writing labs, tutoring programs, and supplemental instruction influence student self-efficacy. Questions center on perceptions of roles and responsibilities. How do mentors, advisors, instructors, and staff in general academic support centers perceive their roles in promoting self-efficacy of all students and, in particular, students with disabilities when the interaction with the DS office is minimal or absent? What is their responsibility in supporting students with disabilities in their learning and in boosting their perceptions of self-efficacy?

Research pertaining to college students without disabilities presents recommended practices for promoting student academic success and persistence. Examples of recommended practices include student participation in a learning community of students with common goals (Pandya, Henderson, Anthes, & Johnson, 2007; Wenger, 1998), developing a student-instructor working relationship that increases the instructor's understanding of student learning styles and provides encouragement to persevere (Getzel & Thoma, 2008), and accessing the array of campus opportunities and learning centers designed to support and enhance learning (Kim et al., 2010; Zhao & Kuh, 2004). The present study builds on this research by looking at how postsecondary students with disabilities focused on achievement in STEM personally describe their sense of self-efficacy and the factors that have uplifted or deflated confidence in their ability to be successful in their studies and finish their degree. Existing research comparing the dimensions of self-efficacy between students with and without disabilities in secondary learning settings suggests there is a difference in self-concept, confidence, and level of self-determination (Klassan, 2002; Lackaye, Margalit, Ziv, & Ziman, 2006; Tabassam & Grainger, 2002), thus worthy of further exploration in postsecondary settings.

Evaluation Questions

The two evaluation questions for this study are as follows: (1) From the perspective of postsecondary students with disabilities involved in STEM programs, how do the constructs of self-efficacy relate to their feelings of confidence? (2) How can postsecondary support services and programs be enhanced to better promote the self-efficacy of students with disabilities studying in STEM fields?

Method

For both evaluation and research, involving people with disabilities as active, fully contributing partners is a priority. Evaluation emphasizes utilization-focused processes that create a continuous loop of linking evaluation results to programmatic design (Patton, 2008). Similarly, researchers use participatory action research (Garcia-Iriarte, Kramer, Karmer, & Hammel, 2009), thus creating opportunities for participants with disabilities to be involved in the "identification of problems, collection of data, and analysis of their own situation to improve it" (Selener, 1997, p.11). Out of a commitment to involving postsecondary students with disabilities in all aspects of evaluation, this Midwestern program sought input from college students with disabilities. Through focus groups structured for dialogue as well as real-time data from participant-response devices, or "clickers," students discussed self-efficacy and the college experience. By employing "clickers" with traditional qualitative methods, students provided their perspectives as well as reacted to collective responses. While multiple focus groups were held, each student participated in only one focus group.

Participants

In total, 20 college students with disabilities participated in the focus groups. Participants self-reported their disabilities. Disabilities reported included one speech impairment, one visual impairment, three attention deficit/hyperactivity disorders (ADHD), three physical impairments, four learning disabilities, four Autism, and four psychiatric disorders. Students ranged in age from 19 to 51, with an average age of 28 and 75% of students between 19 and 29 years of age. Students came from two urban community colleges (n=10) and one urban university (n=10), of which one student was in a graduate program. Of the participants, four students were veterans with service-connected disabilities. All students majored in the STEM fields as defined by the National Science Foundation, which includes social, behavior, and economic sciences as STEM fields. Participant majored in computer science (n=7), social science transfer degree (n=4), stationary engineering (n=2); and one participant from each of the following: biology, electrical engineering, forensic archaeology, information technology, political science, precision manufacturing, and psychology.

Procedures

Four constructs describing the key factors leading to increased self-efficacy were used as a framework for addressing the evaluation questions. These four validated constructs were mastery experiences, vicarious experiences, social persuasion, and physiological reaction (Bandura, 1997; Schunk & Pajares, 2009). The focus-group and participant-response-device questions corresponded to the four constructs (see Figure 1). Two staff members facilitated each focus group with one serving as the group moderator and the other as the scribe. The moderator used the focus group script to pose questions and prompt discussion and verified responses with the participants during the focus group by summarizing conversation points and asking the group to confirm accuracy, offer clarifications, or correct the summary. The scribe provided a written transcript of the discussions. While a written transcript was obtained, no audio recording was used during these focus groups.

Participant-response devices. The questions posed using the participant-response devices used a Likert-type response scale. A Likert scale has been determined an acceptable method of measuring self-efficacy (Maurer & Pierce, 1998). Participant-response devices are similar to remote control pads and commonly called "clickers." Using a computer, projector, CPS Plus and CPS Power Point, questions are projected onto a screen. The computer has a receiver and as participants indicate their responses on their "clickers," their answers are received via wireless electronic delivery. At the beginning of the focus group, the "clickers" were handed out to all participants. Mock questions were used in the beginning as a way of teaching the participants how to use the devices. Once the group was clear on the instructions, the following questions were posed with a Likert scale of (1) certain cannot do, (2) somewhat certain cannot do, (3) somewhat can do, (4) certain can do, and (5) highly certain can do.

- How confident are you that you can get good grades in your STEM courses this semester?
- How confident are you that you can get help with assignments or studying if needed?
- How confident are you that you can get needed accommodations necessary for full participation in courses?
- How confident are you that you can do as well in your STEM classes as other students?

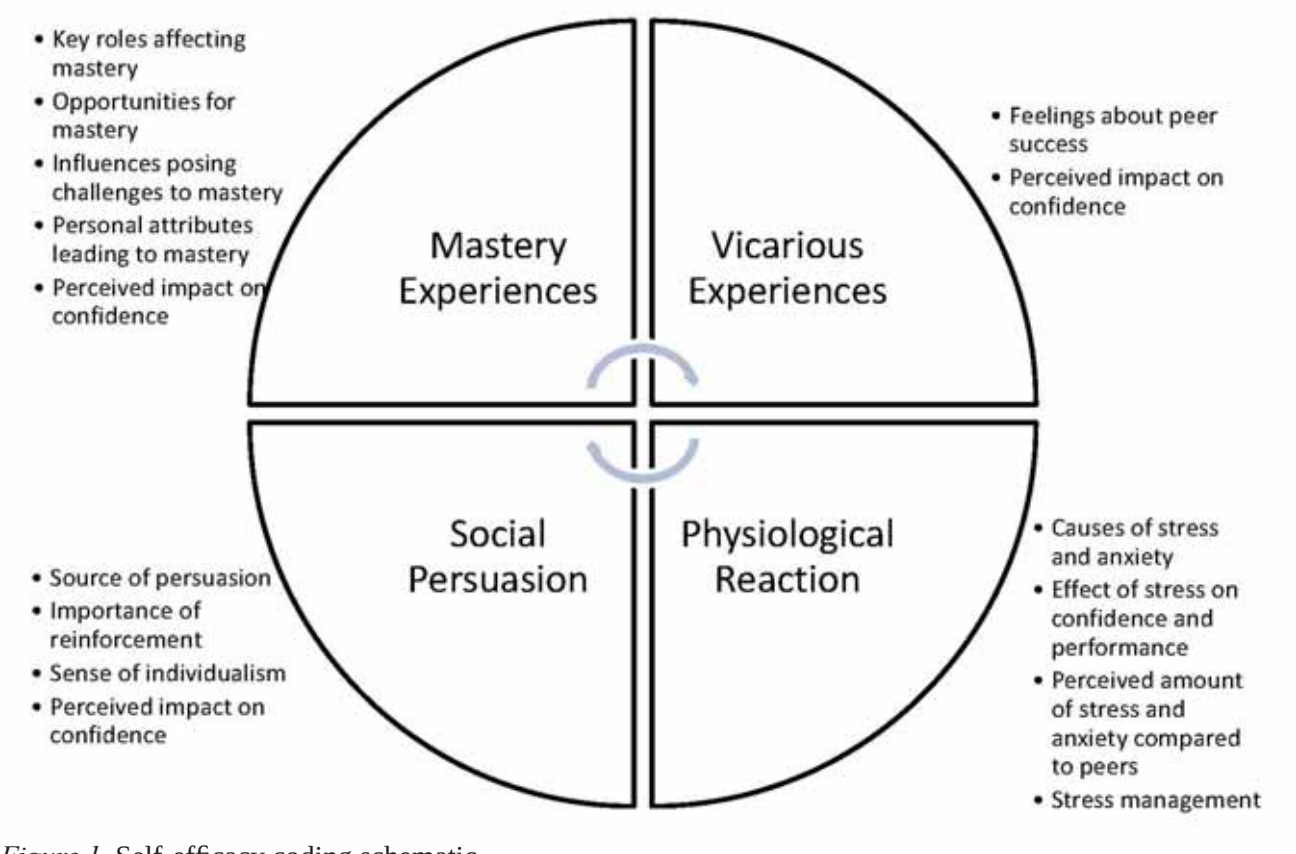

Figure 1. Self-efficacy coding schematic

- How confident are you that you can persist in your STEM courses even when faced with criticism?
- How confident are you that you can remain calm and relaxed during tests?
- How confident are you that you can remain calm and relaxed when expected to complete a challenging assignment?

After all participants responded, the focus group facilitator used the computer to display the collective responses. The participants then viewed the responses and had the opportunity to react and discuss prior to addressing the focus group questions. Reactions and comments to the collective "clicker" responses were included in the focus group transcripts for analysis.

Focus groups. Aligning with the four constructs, the following focus group questions were posed:

- Describe a situation in college when you were proud to have met a challenge and succeeded. Was there someone or something that helped you succeed? How has this success affected your confidence?
- When you see classmates succeed, how does that make you feel? How does it affect your confidence?
- When you see people with disabilities succeed in STEM careers, how does that make you feel? How does it affect your confidence?
- Thinking about your college work, how important is positive feedback from instructors? From classmates? From family and friends? Whose encouragement do you believe more strongly affects your confidence to succeed in college?
- How does stress and anxiety affect your ability to do your best work? Thinking about a stressful course or assignment, do you feel your stress level is more, less, or the same as your classmates?

Data analysis. The responses to the Likert-scale questions administered by the participant response devices are displayed in Table 1. While a Likert-scale presents a rank order, it cannot be assumed that the intervals between ranks are constant (Jamieson, 2004).

Table 1

Participant-response system self-efficacy questions and results (N = 22)

Item	Median	Mode	Range
1. How confident are you that you can... Get good grades in your STEM courses this semester?	3	4	2 - 5
2. How confident are you that you can... Get help with assignments or studying if needed?	4	4	2 - 5
3. How confident are you that you can... Get needed accommodations necessary for full participation in courses?	4	4	1 - 5
4. How confident are you that you can... Do as well in your STEM classes as other students?	3	4	2 - 5
5. How confident are you that you can... Persist in your STEM courses even when faced with criticism?	4	4	2 - 5
6. How confident are you that you can... Remain calm and relaxed during tests?	2	2	1 - 5
7. How confident are you that you can... Remain calm and relaxed when expected to complete a challenging assignment?	3	4	2 - 5

Therefore, calculations of mode, median, and range are most appropriate and displayed in Table 1.

Transcripts from the focus groups were reviewed by a research team of four people. Based on initial review, the team identified meaningful ways of sorting the data and developed a coding tree. A coding tree is defined as the outline structure developed by the users and intended for sorting meaningful chunks of data (Patton, 2002). In order to permit the natural unfolding of key themes, the levels are broad. After developing the coding structure, all data were coded by three members of the team to determine areas of consensus and discrepancy in interpretation. Areas of discrepancy were discussed until the full team arrived at consensus. As the team went through the process of coding and discussion, additional themes emerged and the coding tree was transformed into the coding schematic displayed in Figure 1. The figure shows that the four constructs are integrated and compensatory; that is if a particular construct is strongly present it may compensate for a weaker construct. Informing understanding of the constructs as they apply to postsecondary students with disabilities in STEM fields are the lists of coded items as they apply to each construct.

Credibility. Credibility is established through a number of methods traditionally associated with qualitative research (Denzin & Lincoln, 1994). For this study, a standardized protocol was used with respondents and triangulation through consensus coding was used. The value of coding data in a collaborative fashion using a consensus approach is the reduction in bias in interpretations and judgments made about the data. During the coding process, the research team discusses the qualitative data and arrives at a common understanding of the emergent themes (Hill et al., 2005). An audit was also conducted by a person with expertise in the field of disability studies and postsecondary education. The auditor thoroughly read the findings, traced suppositions to the original raw documents, and reported that *"data files were consistent with the results reported in the findings of the study. Furthermore, no contradictions of information were*

found nor was there any evidence to suggest contrary findings were not included." Thus, all propositions have been verified as credible.

Results

To address the evaluation questions, the results of the focus group conversations and the participant response device questions are organized by each of Bandura's (1994) four constructs and within each construct is a discussion of the roles of support services and programs in promoting self-efficacy. It is important to recognize that themes overlapped and cross-cutting themes emerged. The themes that emerged from the focus groups were organized by Bandura's constructs, as listed below:

- Mastery experiences: key roles affecting mastery, opportunities for mastery, influences posing challenges to mastery, personal attributes leading to mastery, and perceived impact on confidence.
- Vicarious experiences: feelings about peer success and perceived impact on confidence.
- Physiological reaction: causes of stress and anxiety, effect of stress on confidence and performance, perceived amount of stress and anxiety compared to peers, and stress management.
- Social persuasion: source of persuasion, importance of reinforcement, sense of individualism, and perceived impact on confidence.

Each of Bandura's constructs and the findings from the focus groups are discussed below.

Mastery Experiences

Participants in the study reported that success in their STEM classes added to their overall sense of accomplishment and self-confidence as they made their way through college. Representative statements include, "Success has made me more confident," and, "I didn't think I could, but I got through it." The most frequent response to "clicker" questions about academic confidence (i.e. earning good grades in STEM courses, getting help with class work, and working with faculty on accommodations) was, "I am certain I can do."

Students reported that several factors contributed to their mastery experiences in college, ranging from the role of instructors, family, friends, and classmates to the assistance of the college's academic and disability support offices. Having opportunities to apply learning was also reported as valuable. As one student noted, "When I work with other people and accomplish a goal, that teamwork makes me feel successful." Students also reported that personal attributes such as perseverance, self-confidence, and an unwillingness to fail contributed to these mastery experiences. One student discussed the connection between a course and confidence: "I took speech class, worked on becoming more comfortable talking in front of people and am now more confident." Students recognized self-responsibility in content mastery. When they struggle, they generally did not consider it to be the fault of the instructor and, if they have success, they attribute it to studying and to going to class.

Of the people in their lives, the participants credited instructors as having the most impact on their ability to experience success in their classes. Several students told of instructors who went out of their way to provide extra support: "We had class two days a week, but we convinced the teacher to host extra study sessions once a week." Another student associated attention from a teacher with an increased ability to be engaged in class: "When I was going through [personal] … drama in 2007, I was in a math class. The teacher stayed after class and talked to me. [This] helped me not to hesitate to ask questions." Instructors created a valuable culture for learning in a class that students appreciated and that promoted mastery experiences.

Vicarious Experiences

When focus group participants were asked if they were confident they could do as well in their STEM courses as other students, the most frequent response was "I am certain I can" (see Table 1). Predominantly, students reported positive feelings when they saw their classmates succeed and this boosted their confidence. In particular, students reported positive value in seeing their peers with disabilities experience success. According to one student, "If they can do it, I can do it too." Another student echoed this conclusion by saying, "What helps more is hearing success stories of people with disabilities who succeed beyond you." In contrast, a small group of students reported feeling happy for the success of peers, but that peer success did not affect their confidence. Some participants stressed that it is important to keep focused on one's own work and studies and to avoid allowing the success or struggles

of peers affect one's performance. One student summarized this sentiment by saying, "I can't judge myself based on them, just based on how hard I work." None of the students reported that seeing their peers succeed lowered their confidence.

Although all of the participants agreed they were happy to see others with disabilities succeed, two participants expressed concern about the way others viewed them. These students described how, in college, they felt many viewed them from a needs-based perspective and not a strengths-based perspective. One student noted that, while she needed accommodations in classes, there were areas in her life where she did not need accommodations. "I've got a comprehension disability, but I've been a manager at my job for five years. And I worked up to that position. Not everyone can do that!" Another participant, though happy when someone with disabilities succeeded, worried about being lumped together with other people with disabilities. "There are 100 million factors at play, and, though it does help my confidence, it does get weird, kind of like *Beautiful Minds*." The students shared concerns that others viewed them all in one category, disability, instead of seeing them as individuals.

For the students, teamwork and collaboration was part of seeing peers succeed and the effect of that success on self-confidence. Numerous students, from two-year and four-year colleges, reported positive experiences when completing team projects. Being part of a team gave students the opportunity to see peers succeed, to observe the steps leading to success, and to join the collective positive feeling of completing the project. In addition, teamwork seemed to reinforce the learning and understanding of new concepts being addressed. Peers had a role in boosting confidence in the short term – such as asking a peer to look over an assignment, studying together for a test, or doing a more formalized peer critique in the classroom setting. "Doing peer critiques on work increased my confidence because then I knew my peers liked my work." Students felt increased confidence when their colleagues succeeded in class. The four participants who had military backgrounds spoke most often about teamwork – they valued connecting with their peers and noted that it bolstered their confidence. The community college students spoke of an additional importance between the instructor and feedback in a class. Many community college students viewed instructors as gatekeepers to a STEM career path. Students noted that instructors' encouragement to pursue a particular career path held more value than encouragement from family or friends. One student described how he turns to his instructors first, before family or friends, for feedback: "Instructors know what they are talking about when it comes to my future careers. My family and friends don't always know why something matters or is important."

Participants reported that self-efficacy increased through the vicarious experiences of their peers as well as their instructors. They felt a special connection to others with disabilities and their success— whether these were fellow students or someone famous in the STEM fields whom the students admired. One student observed, "Stephen Hawking is the most brilliant person in science. I have high hopes for me to be the best I can be from seeing him do what he does. It gives me motivation."

Social Persuasion

From the comments of participants in the focus groups, it is evident that social persuasion is a vital construct in positive academic experiences. There are four distinct players when it comes to social persuasion for the students with disabilities studying in the STEM fields: instructor, classmates/peers, self, and family and friends. Participants discussed the role of family and friends as related to their self-efficacy. All students expressed having someone in their life, whether a family member or a friend, who has provided general support and encouragement: "My mom always has encouraging things to say." Students expressed that their support systems outside of college often knew little about what it like to be a student majoring in the STEM fields. For example, most family members had not been in a laboratory and did not know what transpires in lab settings. Students noted that the support of family members tended to be more general in nature. One student echoed, "my uncle always encourages me."

Students in the focus groups described a difference between peers and classmates— peers were others with disabilities majoring in the STEM fields or enrolled in college. They defined classmates as students who were in classes but who did not necessarily have a disability. Students talked about how their classmates were sometimes uncomfortable being honest with them because of their disabilities. This further complicated the challenges of peer-feedback in the classroom:

> Criticism from teachers is helpful so you can tell what you're doing wrong and right. We've done peer reviews and they weren't as helpful, because the students aren't always as honest [as teachers] because they don't want to hurt your feelings.

Many participants noted that it could be discouraging when classmates without disabilities did not have to put forth the same amount of effort as they did but achieved higher grades. Students expressed that this sometimes formed barriers between themselves and their classmates.

Students described an important connection between positive feedback and motivation: "Positive reinforcement works the best with me…. It is an ego boost. I am motivated by a good job or a great job and good grades. Negative reinforcement bogs me down. I feel in a swamp." Of the respondents, 17 noted that positive reinforcement from the instructor was very important, 11 respondents noted that positive reinforcement from family and friends was very important, and 7 out of the 11 noted that both were equally important but for different reasons. Students commonly identified the following reasons for why instructors are important factors in social persuasion: they have content mastery, they often have specialized knowledge in one area of STEM, and they may offer potential connections to employment due to their role as an expert in a particular field.

While many participants noted their peers were helpful, rapport with instructors was considered to be "most important." Rapport building is something that happens between instructors and students; the energy the instructor gives to building relationships with the students and setting a tone for the class matters. Students could tell if instructors wanted them to succeed and push beyond their present academic difficulties to meet their goals. "If you get a bad grade, but you still have a rapport or a good relationship with the teacher, there is still hope. Otherwise you're trying to do it all alone." Students identified the value of constructive criticism in addition to positive feedback. The value of positive feedback spoke to evidence of success; success feels good; things that feel good are motivators. Success also increased students' confidence. A few students noted the importance of constructive criticism as a motivator because it helped them increase their content mastery, which then led to increased confidence and/or positive feedback. "Since they [teachers] are experienced and have mastery [of the content] it is good to hear what you need to improve on and what you have done wrong." "There is still that little devil in my head going 'probably you should overcome this before [you] move on, otherwise you will miss some critical principle to help you move forward.'" Participants viewed negative feedback or criticism that was not constructive as unhelpful. Students identified examples of negative feedback, including a bad grade without explanation or dismissive remarks such as, "This is not college level writing."

Interestingly, and somewhat unexpectedly, many students discussed the importance of their role in social persuasion. With all of the players in their lives, both collegiate and personal, students believed that their motivation ultimately involved their own belief in themselves. "Instructors, very important; family and friends, not as important. [Peers], yes, definitely [important]. We are like a cohesive element. [But] it's really up to the individual. You have to believe in yourself, have focus, initiative, and drive." As one student who had struggled in some courses said, "If I need the course, I can persist…. It has to be you that encourages yourself. You have to believe in yourself." The role of the self became important to understanding how social persuasion affects confidence in the academic setting. The students who participated in this study have persisted against the odds. They have had to find and utilize an inner reserve of motivation to persist at their goals. This intrinsic motivation was an important resource to students. "I don't know whether it's confidence or bravery that keeps me going sometimes." This student added that, after positive feedback from STEM instructors, his "own feedback is more important to me."

As shown in Table 1, the majority of participants responded positively to the "clicker" question related to the social persuasion construct (item 5) and were at least "certain" they could persist in STEM courses when faced with criticism (16 out of 19 or 84%). This important result speaks to rapport with instructors and peers as well as support from family and friends. Perhaps most importantly, it shows how central self-determination is to persistence. When facing criticism, the majority of students had rapport with instructors and peers, social supports for encouragement, or self-determination. One student described that "I adamantly deny my mind from [the thought] 'I want to quit' because I have quit at things before and I have regretted it. I never think of [the thought] 'I quit.' I keep going forward."

Physiological Reaction

The last lens of analysis is the physiological reaction to the college environment students experienced. Participants in the focus groups reported struggling with physiological reactions to stress and anxiety. As shown in Table 1, responses to the "clicker" question related to the physiological reaction construct (item 6) vary more than the other constructs, with more participants responding that they were unsure if they could remain calm during tests. More participants responded they were at least somewhat certain they could remain calm when completing an assignment.

The main situations reported to produce stress or anxiety were tests and courses that are based on abstract concepts that form the basis for advanced understanding or application, such as algebra or chemistry. Students noted that applied courses did not produce as much stress, unless there is a time when they need to perform certain tasks in a timed setting. For abstract courses students were concerned about their ability to grasp the information. They studied and did their assignments and still struggled. "Whatever pressure I feel, 90% of it comes from me. This Math 120 [college algebra] is no joke. I don't skip class, so I figure the light bulb will come on and go 'bling' and I'll get it. If I keep doing these math problems, something will click."

A few of the older students, especially those with military experience, noted that they had largely "outgrown stress." They referred to a combination of maturity and finding ways to cope with situational stress and/or anxiety in explaining this development. These same students also saw a connection between stress and positive outcomes. They noted that sometimes stress could boost adrenalin and lead to improved performance. These students were in the minority. Across age and disability, tests and challenging assignments caused stress and anxiety for most participants. A few students reported that they tried to find motivation in their stress. "I try to know the materials… It's just that, a challenge, but you go into it because you like the challenge. Challenges are the rewards." Other students described how they coped with stress and anxiety. As one student noted, "When I started I wasn't [very confident that I could relax during tests]. But now, I sit outside in the hallway and practice deep breathing exercises."

Overwhelmingly the students reported that they want to do well in their classes. Many of the students echoed the sentiment, "I put a lot of pressure on myself to do really well." Sometimes this internal pressure led to procrastination when students wanted to perform perfectly and then had difficulty getting started. "I make too many changes if I do it too far in advance and feel like it has to be perfect, so I do it last minute and then I just have to get it done." Other students felt their stress was higher because classes were more difficult for them. "For me it's like if I don't pass this class then I'm just going to quit, because I'm not taking it a fourth time… So there's a lot of pressure." There was also a connection between wanting to do well as a person with a disability and […]. "[Instructors] know I have a disability and I wonder if they're wondering if I can do this. And the anxiety comes from wanting to do well as a person with a disability."

Students had different reactions to their physiological reactions. Some students described how stress had a detrimental physiological effect on them. "It hampers me." "My mind goes blank." They also reported that stress causes them not to remember what they had studied or learned. Students felt that the information was in their brains but stress interfered with their ability to retrieve it. "With tests, I want to place my brain on the table and say, 'Here it all is.'" Other physiological symptoms caused by tests included feeling shaky and sick to the stomach. Several students mentioned "trying to stay relaxed" but also expressed not having control over what they were experiencing with their test anxiety and academic stress. A few students presented strategies for trying to overcome their physiological reaction to the stress and pace of being a student with a disability and majoring in STEM. These students talked about the importance of getting enough sleep and studying hard and frequently. One student described the following strategy for reducing test anxiety: "Before the class, I sit outside in the hallway and practice deep breathing exercises to help me relax during tests."

Discussion

Two central concepts emerged from the mastery experiences construct. Participants reported a positive relationship between success in their STEM classes and their overall sense of self-efficacy in college. From the participants' perspective, many people and roles affected their self-efficacy about content mastery—instructors, student support offices, family, friends, classmates, and peers. In addition, having opportunities to apply learning reinforced their self-efficacy. Most commonly, students echoed the critical role of

instructors in helping them master a challenging concept, validating their effort, and designing learning opportunities that gave them opportunities to apply learning and experience success.

Participants also noted that vicarious experiences could increase their feelings of self-efficacy. For example, seeing other students with disabilities succeed boosted their self-confidence. Additionally, learning in the context of a team project provided opportunities for students to observe peer success and the steps taken to achieve mastery. Thus, students with a disability reported that team activities could increase their sense of self-efficacy. Vicarious experiences that decreased participants' self-efficacy involved situations when they felt they were being judged based on their disabilities, especially when connected to classroom performance situations such as lab work.

The construct of social persuasion builds off of that of vicarious experiences and mastery experiences. While peers and teamwork have a unique role in boosting confidence, students with disabilities overwhelmingly noted the importance of positive feedback from instructors to enhanced motivation to persist in their academic studies. Participants also noted the importance of their own roles in social persuasion. Despite all of their collegiate relationships, students indicated that believing in themselves had the greatest impact on their motivation. After all, the students themselves are the ones in class, working toward a degree. Perhaps most importantly, this finding shows how important self-determination is to persistence. Regarding the physiological reaction construct of self-efficacy, students reported struggling with stress and anxiety. Situations most likely to produce stress or anxiety were tests and abstract or theoretical courses. Older participants identified successful strategies for coping with stress and anxiety, but most of the participants reported that high-stress situations made it difficult to recall information, even when they felt well prepared. Many of the students noted that they put pressure on themselves to perform well.

Several cross-cutting themes emerged from the qualitative data. First, instructors set the tone for learning and consequently highly influenced students' confidence, motivation, anxiety and stress, and – ultimately – success. Student rapport with instructors was important because it reinforced learning and encouraged students to ask questions and seek assistance. Additionally, by building rapport with students, the instructor could be more aware of factors that created stress and when students were feeling a great deal of stress. All of these instructor behaviors, as well as providing positive feedback and constructive criticism, were valued by the STEM students with disabilities as ways to boost their self-efficacy.

Second, when discussing self-confidence as learners, many STEM students with disabilities noted the importance of applied learning, especially in team-oriented settings. The students described how team projects gave them opportunities to learn from each other, exchange peer-to-peer feedback, and share positive feelings of accomplishment. Participants reported that accomplishing a goal with a team was personally rewarding and boosted their self-efficacy.

The last cross-cutting theme to emerge from analysis of the focus group data was a sense of self and how that influenced perceptions of self-efficacy. Many STEM students with disabilities believed that they often needed to work harder than their peers without disabilities but did not mind doing so because they valued hard work. Rather than lowering their self-confidence, participants found that hard work strengthened their resilience and perseverance. Students spoke of keeping focused on their personal goals and purposefully avoiding distracters such as comparing themselves with peers as a way to keep motivated and maintain self-confidence. Stress and anxiety triggered other insights about a sense of self. While many of the students reported numerous academic situations that caused them to feel stress and anxiety, they described strategies to minimize those negative emotions. The students believed that their ability to successfully manage their stress and anxiety strengthened their self-efficacy.

These cross-cutting themes add a unique perspective to the current literature. College students believe their instructors influence their achievements (Getzel & Thoma, 2008), but some publications report that institutions view this as a sign of students shirking expected levels of responsibility for their college learning (Zimmerman 2002; Zimmerman and Kitsantas, 1999). The focus group participants described a strong sense of personal responsibility for their learning. Perceived self-efficacy can change (Cervone & Peake, 1986) due to an array of influences including feelings of stress (Bandura, 1994; Kim, Newton, Downey, & Benton, 2010), disconnected relationship with instructors (Getzel & Thoma, 2008), and lack of access to needed accommodations and supports (Getzel & Thoma, 2008).

The focus group students confirmed that these factors did influence their self-efficacy. However, they reported that this influence did not have a negative impact on their personal levels of responsibility for carrying out their own responsibilities as learners. Indeed, as Bandura's model predicts, students were able to enhance their self-efficacy as learners with the influence of instructor support, vicarious learning experiences with peers, and positive reactions to high levels of stress while taking STEM and other rigorous courses.

Implications

Several recommendations emerged from this study that could improve access to STEM careers for individuals with disabilities. First, on an institutional level, students could benefit from colleges and universities strengthening the connections between their full range of support centers and labs to build natural bridges to DS offices. Students in the focus groups expressed gravitating to classes or labs with opportunities for hands-on or applied learning. Many students also expressed struggling with abstract theory courses, such as mathematics. While it is a challenge, and two students shared it may be a barrier to degree attainment for them, all students need to pass college algebra. Student retention may be improved by finding "hands-on" or applied ways to teach traditionally abstract theory classes such as college algebra.

Participants in the study referred regularly to instructors who helped them succeed by taking extra time to explain concepts in class or making time to work with them after class. Clearly, having a rapport with students is a powerful instructional and retention tool and perhaps the simplest recommendation to incorporate into working with students with disabilities. To increase retention of students with disabilities, campuses may wish to offer faculty workshops on universal design for learning or teaching circles to explore techniques for building meaningful relationships with students. When students feel they have a positive relationship with their instructors, they often feel greater motivation to work diligently in their classes. When instructors provided regular and timely feedback, participants reported feeling encouraged and able to persevere even when the class grew more difficult. Another recommendation for faculty would be to incorporate more team projects in their course design, even though many students find these projects more difficult. For students with disabilities, in particular, these projects allow more opportunities to build rapport with others, learn necessary workplace skills, and master class subject matter in different ways.

Institutions of higher education can play an important role in supporting students with disabilities, specifically those in STEM majors. The focus groups clearly highlighted how important instructor beliefs and behaviors are to student success. Institutions of higher education may want to address this importance systemically by providing resources that enhance instructors' capacity to make classroom learning accessible to the widest variety of learners. Paying attention to how the DS offices are promoted or marketed may also help more students with disabilities seek accommodations they need. Lastly, for institutions struggling with retention, finding ways for students to obtain effective support in difficult classes may reduce some of the barriers they face in degree attainment.

Limitations

Caution should be exercised in interpreting the results of this evaluation project. First, due to the small number of participants, inferences to a larger population are limited. Second, the student perspectives are a snapshot of their experiences at the current stage of their education. Their perspectives may change as their experiences unfold. Third, student perspectives are limited to experiences in a small geographic area with regard to a few higher education institutions. Finally, there is the possibility of bias due to employing self-report strategies and the likelihood of participants being influenced by peer responses in the focus group setting.

Conclusion

The relationship between faculty and student is extremely important in postsecondary settings. Faculty not only grade students' work, they can influence career decision-making and provide compelling forms of motivation. In conclusion, students with disabilities at three colleges were informative. The focus groups helped the authors identify ways to bolster the self-efficacy of postsecondary students with disabilities taking STEM and other courses.

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