# Recruitment of Students with Disabilities: Exploration of Science, Technology, Engineering, and Mathematics

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**Abstract**

Individuals with disabilities are underrepresented in postsecondary education; in science, technology, engineering, and mathematics (STEM) majors; in graduate and post-doctoral work; and in faculty positions, particularly in STEM. Despite these lags behind their non-disabled counterparts, few organizations recruit persons with disabilities into postsecondary education and/or STEM careers and, thus, scant literature exists on targeted recruitment efforts. The intent of this article is to examine data concerning these lags, to review what literature does exist on recruitment of students with disabilities, and to report on promising practices developed by the Midwest Alliance, an NSF-funded endeavor to increase the number of individuals with disabilities in STEM. It is believed that these efforts and descriptions may help other organizations recruit individuals with disabilities into their postsecondary programs.

*Keywords:*

> "Persons with disabilities are a national asset whose productive potential cannot be ignored." (Tororei, 2009, p. 2)

The National Science Foundation (NSF), the premier government agency advancing science, technology, engineering, and mathematics (STEM) in America, has noted that persons with disabilities, along with women and members of ethnic and racial minority groups, are underrepresented in science and engineering in postsecondary education and the workforce (Burrelli & Falkenheim, 2011; National Science Board [NSB], 2003; NSF, 2009). People with disabilities are underrepresented in higher education of any kind, traditional STEM undergraduate majors, graduate schools and post-doctoral work, and faculty positions, especially in STEM (NSB, 2003; NSF, 2009). In order for these deficits to be overcome, special attention must be given to issues related to the recruitment of students with disabilities to STEM education and subsequent STEM careers.

Since few recruitment programs specifically for students with disabilities have been developed and reported in the literature (Fichten et al., 2003), the purposes of this article are to (a) examine the importance of recruiting activities to improving participation by students with disabilities in STEM educational activities, (b) introduce a number of issues related to recruitment of students with disabilities in STEM, and (c) describe several promising practices related to such recruitment. To meet the first purpose, data about people with disabilities in STEM education and careers are presented to illustrate that concerted efforts are needed to bolster the number and success of students with disabilities. Second, three issues prominent in recruitment of students with disabilities to postsecondary education and STEM are discussed. Third, a number of promising practices or strategies related to

the recruitment of students with disabilities in STEM are highlighted. While *best practices* are validated by stringent large-scale research and replicable across multiple settings, *promising practices* are those that suggest effectiveness in addressing a common problem, have shown potential in at least one context, are likely to be replicable, and have initial data supporting positive outcomes (Administration for Children and Families, 2010).

The authors represent the Midwest Alliance in Science, Technology, Engineering, and Mathematics, an NSF-funded, five-year project based at the University of Wisconsin-Madison, with subcontracts to the University of Illinois at Urbana-Champaign and the University of Northern Iowa. The specific aim of the Midwest Alliance is increasing the number of students with disabilities exploring, entering, and succeeding in STEM education and careers. Recruitment and retention of students with disabilities into STEM education and careers is a large part of the Midwest Alliance's activities.

Generically, recruitment and retention activities for many types of students are often referred to as the *STEM pipeline*, representing pathways students may take toward achieving career success in STEM (The Forum for Youth Development, 2010). In general, the idea is to identify and move talented students efficiently and effectively through the educational system. If a student moves through the STEM education pipeline efficiently, graduates, and obtains a job position in STEM, the pipeline is seen as being successful.

The Midwest Alliance staff, however, recognized that the idea of a pipeline is too simplistic for some groups of students, such as those with disabilities. The Midwest Alliance staff believe that students with disabilities are in one of three groups at any time in their educational careers: (1) in the STEM pipeline, (2) not in the STEM pipeline, or (3) undecided about STEM. Given this range of possibilities and the staff's desire to cast the widest possible recruitment net, Midwest's activities had three objectives. First, for students with disabilities already in the STEM pipeline, make sure they stay in the pipeline for the right reasons and not leave for the wrong reasons (such as difficulty with accommodations, participation, or the culture). If they do leave, make sure it is for the right reasons (e.g., they change majors based on passions or desires). Second, if students are unsure or uninformed about STEM goals, attempt to assist them in making informed decisions about opting in or out of STEM majors or careers. Third, if students have already departed the STEM pipeline, attempt to give them a chance to experience STEM in a different way if possible so that they can reevaluate their participation from a new perspective. Instead of singularly focusing on students who were identified to have a disability early in their education, may have STEM talent, and who had already entered the STEM pipeline, this broader, systems-based approach views each student with a disability as having STEM potential throughout the full course of his or her education until he or she made an informed choice otherwise.

This model can be of assistance to similar organizations as well as to postsecondary disability service providers, administrators, and recruiters. We acknowledge that not all campuses, academic departments, or disability support offices wish to actively recruit students with disabilities. This may be due to current staff/student ratios, lack of facilities, and/or lack of support from faculty and/or administration. We also acknowledge that our approach often targeted students who had been identified early in their school career as having a disability. For some students, whose disabilities are not identified until they reach postsecondary education, this approach may not be practical.

**Importance of Postsecondary Education and Recruiting Programs for Students with Disabilities**

The Forum for Youth Investment (TFYI, 2010) recently reported critical data regarding the importance of postsecondary education to all individuals, including those with disabilities. Labor market projections suggest that by 2018 nearly 66% of all jobs will require at least some postsecondary education (TFYI, 2010). Over a lifetime, completing a postsecondary education can mean additional earning power (Fichten et al., 2003; NSF, 2009). Individuals with a high school diploma or equivalent are expected to earn approximately $30,000 annually; those with an associate's degree, $36,000; those with a bachelor's degree, $46,000. In addition, the latter two categories of workers are also more likely to receive health insurance and retirement benefits (TYFI). Similar data were reported by Stodden, Whelley, Chang, and Harding (2001) and Yuen and Shaughnessy (2001).

Participation by people with disabilities in postsecondary education has traditionally been low when compared to their representation in the American population (Bureau of Labor Statistics, 2011; Burrelli & Falkenheim, 2011; Fairweather & Shaver, 1990;

NSF, 2009; Stodden & Conway, 2003). In addition, data on employment rates as of March 2011 show that persons with disabilities, at 21.0%, are far below their non-disabled counterparts, at 69.7% (Bureau of Labor Statistics, 2011). National data also show that students with disabilities are underrepresented in STEM (NSB, 2003; NSF, 2009; Rendon, 1985), especially in graduate degrees and careers and in some degree areas such as engineering. While some progress for students with disabilities has been made in computer and mathematical science, lower proportions of students with disabilities are entering engineering (Burrelli & Falkenheim, 2011). See Table 1 for example statistics.

Munro and Elsom (2000) noted that the economy will continue to need a constant supply of highly educated scientific and technological people in the workforce, with skills such as data handling, analysis, problem solving, and information technology. These skills are foundational to STEM. However, students in general are often discouraged from pursuing STEM for a number of reasons. First, knowledge of science and mathematics builds up gradually and, once dropped, subject matter is much harder to grasp. Second, many young people are cut off from entry into STEM as they find out too late the requirements for entry. Third, science is seen by many as a "specialty" rather than as an area of core knowledge. Especially low proportions of students with disabilities in STEM may also be due to additional factors such as perceptions by postsecondary recruiters and faculty, inattention to fully accessible postsecondary education and STEM environments, and lack of targeted recruitment strategies (Dunn, Hanes, Hardie, Leslie, & MacDonald, 2008; Fairweather & Shaver, 1990; Test, Fowler, White, Richter, & Walker, 2009). Therefore, issues such as recruitment of students with disabilities into postsecondary education and STEM need to be examined and promising practices need to be shared in order to work toward equal opportunity for students with disabilities (Fichten et al., 2003). The next section discusses three issues critical to the recruitment of students with disabilities in STEM.

## Issues in the Recruitment of Students with Disabilities in STEM

At least three major issues contribute to the need for recruitment programs for students with disabilities in STEM. The first is the dearth of published program descriptions, program evaluations, and research data about recruitment of students with disabilities to postsecondary education. This is especially true for recruitment into STEM. The second is the need for institutional commitment to the recruitment, retention, and graduation of students with disabilities, again, especially in STEM fields. The third issue is the influence that high school teachers, special education teachers, guidance counselors, and postsecondary education faculty have on whether students with disabilities envision STEM as a future career possibility.

**Lack of data on recruitment of students with disabilities.** Lewis and Farris (1999) reported that research on best practices in the recruitment of students with disabilities in STEM is nearly non-existent, as recruitment programs are either scarce or not well documented. These authors noted that approximately 20-27% of all postsecondary institutions have developed outreach and recruitment activities aimed at students with disabilities. They found that larger institutions were more likely than smaller institutions to develop recruitment materials. Most of their sample institutions provided recruitment materials to high school counselors, transition specialists, and vocational rehabilitation counselors. About half provided them to other vocational rehabilitation agencies, civic and business organizations, and other postsecondary institutions, and less than a quarter shared information with businesses and employers (Lewis & Farris). In more recent years, a few articles have provided recruitment program descriptions for specific educational programs such as social work (Dunn et al., 2008).

**Need for systemic and institutional support.** A second issue is the need for systemic and institutional support for the recruitment of students with disabilities and their continued success on campus. Higher education institutions need a strong recruitment message in order to attract students with disabilities, and these messages must come from the highest echelons of the academy such as the president's, provost's, and deans' offices (Ellis, 2010; Hartman, 1993; Mayhew, Grunwald, & Dey, 2005; Palombi, 2000; Ralph & Boxall, 2005). Mayhew et al. (2005) cited Hurtado, Milem, Clayton-Pederson, and Allen (1998) as defining a positive campus climate for diversity by four precepts: (a) the campus' historical legacy of exclusion or inclusion of various underrepresented groups, (b) its structural diversity or representation of various groups on campus, (c) its psychological climate (perceptions, beliefs, and attitudes about diversity), and (d) its behavioral

Table 1

*Statistics Involving Students with Disabilities in STEM (NSF, 2009)*

- Students with disabilities are more likely to enter two-year programs than their non-disabled counterparts.
- Students with disabilities are more likely to be part-time students than their non-disabled counterparts.
- Students with disabilities made up roughly 11% of undergraduate students in most fields.
- Students with disabilities made up roughly 7% of graduate students in most fields; 3% of computer science and engineering graduate students; 10% of social and behavioral science graduate students.
- Graduate students with disabilities are more likely to be women (57%) than men (43%).
- Students with disabilities earned roughly 1% of the STEM doctorates awarded to U.S. citizens and permanent residents.
- Doctoral students with disabilities were more likely to use personal/family funds (31.3% vs. 18.2%) and less likely to be awarded research assistantships (16.4% vs. 24.4%) than their non-disabled counterparts.
- Persons with disabilities made up 7% of all U.S. scientists and engineers; 2% of those younger than 35, 15% of those ages 65 to 75.
- Scientists and engineers with disabilities throughout their lifetimes earn from $4,000 to $13,000 less per year than their non-disabled counterparts.

Note: Data from: National Science Foundation. (2009). Women, minorities, and persons with disabilities in science and engineering. Washington, D.C.: National Science Foundation (NSF 09-305).

climate (how different groups interact on campus). The degree to which these four elements contribute to students from diverse groups feeling comfortable and confident is the extent to which the campus has a positive climate for diversity. Of course the campus climate may be different for different groups of students.

Examples of systemic and institutional support can run the gamut from:

- Inclusive university mission statements (Belch, 1995; Howard-Hamilton, Phelps, & Torres, 1998; Oseguera & Rhee, 2009);
- Recruitment materials that go beyond photographs of students with disabilities in brochures (Belch, 1995; Haller, 2006);
- Accessibility in orientation and new student programs (Hartman, 1993; Smith, English, & Vasek, 2002);
- Informational and application materials in alternative formats for all students (Belch, 1995);
- Faculty training regarding types of accommodations, teaching styles, confidentiality, legal issues, and responsibilities (Belch, 1995; Dunn et al., 2008); and
- Data collection on the types of strategies and supports that affect the enrollment, persistence, and graduation rates of various student groups (Howard-Hamilton et al., 1998).

In her research of university recruitment materials directed at students with disabilities, Haller (2006) noted that although some materials depicted students with disabilities, little effort was expended by the institutions to actively recruit these students. As such, "Universities may be missing out on many excellent students with disabilities who might enroll there" (Haller, Discussion and Recommendations section, para. 2). It is clear that successful strategies for recruiting students with disabilities will require multilevel approaches and significant efforts (Haller, 2006).

**Influence of guidance counselors, secondary teachers, and postsecondary faculty.** A third issue in recruitment is the effect guidance counselors and secondary teachers have on the self-perceptions of students with disabilities regarding their ability to take part in STEM endeavors and pursue STEM careers. For example, Munro and Elsom (2000) studied career advisors (guidance counselors) and secondary education science teachers in the UK and found that these professionals had a strong influence on students' entry into STEM education and careers. The science

teachers had a negative influence on student motivation and enjoyment of science, in and out of the classroom. While high school science teachers were sources of information to both students and their parents about STEM careers, they infrequently talked to students with disabilities about taking high school science courses past the sophomore level to keep their career options open to STEM. The research found, therefore, that students often did not link science topics in class to possible STEM careers. If they were not aware of STEM career possibilities, students saw little use in continuing science beyond their sophomore year. Guidance counselors also had little to no contact with science teachers and the overwhelming majority had humanities backgrounds themselves. The researchers recommended that teachers and guidance counselors work together more closely, students and their parents be informed about the connections between high school science and future STEM careers, and students be exposed to STEM professionals such as alumni and community members.

Additional literature, albeit from dated sources, has addressed the influence of postsecondary faculty on the perceptions of students with disabilities, both in general and in STEM specifically. West et al. (1993) found that poor faculty attitudes and lack of instructional accommodations for students with disabilities were problematic within Virginia postsecondary institutions. Likewise, Hill (1996) found that faculty members' unwillingness to make accommodations and lack of accessibility were primary reasons for the withdrawal from postsecondary education by students with disabilities. In fact, this sample of students with disabilities reported that "laboratory instructors" were the most unaccommodating of all faculty and students with disabilities believed they were seen as an "inconvenience" in laboratory settings. A study of 16 students with disabilities at a mid-Atlantic university found that similar negative experiences with professors were one of five major barriers reported (Marshak, Van Wieren, Ferrell, Swiss, & Dugan, 2010). For example, students with disabilities experienced faculty who did not believe they had a disability or that their disability affected class participation, although whether these faculty members were in STEM curricula was not reported. The other four reported barrier categories in this study included (a) self-identification/disclosure of disability issues, (b) desire to avoid stigma and not be singled out, (c) insufficient student knowledge of their disability and appropriate accommodations, and (d) perceived lack of quality and usefulness of services from the disability support office.

Brockelman (2011) studied 107 full-time faculty at a large Midwestern university by comparing STEM and non-STEM faculty in providing accommodations to students with psychiatric disabilities and rating the effectiveness of those strategies. Engineering faculty (representing over half of the STEM faculty sample), on average, were more likely to provide accommodations to students with psychiatric disabilities. They were most likely to provide these accommodations: extended test time, private testing rooms, alternative formats for test answers, consultation with disability professionals, and discussions with the student. The engineering faculty members were much more likely than non-STEM faculty to rate extended test time as an effective accommodation strategy. Brockelman suggested that additional research with larger samples and more detailed demographics be conducted.

A more comprehensive study used a broad sample of American institutions (n=56) and students with and without disabilities in STEM and non-STEM majors (n=16,995) while reviewing data from the National Survey of Student Engagement (NSSE) (Hedrick, Dizen, Collins, Evans, & Grayson, 2010). The purpose of this study was to examine if and how college students with disabilities differed from their peers without disabilities, and how STEM majors differed from non-STEM majors, on five benchmarks. The five benchmarks included: (a) academic challenge; (b) an atmosphere of active and collaborative learning; (c) student-faculty interactions; (d) enriching educational experiences; and (e) supportive campus environments that allow students to succeed academically and socially, and promote supportive relationships across campus. The authors found: (a) students with disabilities, compared with students without disabilities, reported less supportive campuses (e.g., in social, extra-curricular, and non-academic arenas); (b) no differences among any of the five benchmarks between students with disabilities and students without disabilities based on STEM or non-STEM majors; and (c) regardless of disability status, STEM majors felt their institutions provided greater academic challenges and opportunities, their faculty were more supportive, and the campus environment was less supportive than non-STEM majors. This study noted minimal differences between students with disabilities and other students,

and few effects of STEM vs. non-STEM majors. These results may be encouraging for those involved in the recruitment of students with disabilities to STEM educational programs and careers.

**Strategies for Success in Recruiting Students with Disabilities to Explore Opportunities in STEM**

Midwest Alliance staff experienced some surprises and learned many lessons prior to their current success at recruiting students with disabilities into STEM. These lessons can provide important information for others who are interested in developing similar recruitment programs. The first lesson concerns the message being sent to students with disabilities. The second lesson concerns the ability to quickly locate students with disabilities to participate in programs.

Students receive different messages regarding educational and career choices. Students with disabilities receive an additional set of messages, including those related to their potential to be successful in STEM. By talking with student participants, Midwest Alliance staff found that STEM stereotypes and/or the stigma associated with self-reporting a disability (Marshak et al., 2010; Trammell, 2009) significantly limited students with disabilities' participation in STEM. The first concern is that participation in STEM requires specific special abilities such as math excellence, which may or may not be true. Unfortunately, this misperception is continuously reinforced via many sources students encounter when thinking about what they might study and what career they might choose. The second concern is the stigma associated with self-reporting their disability (Fichten et al., 2003; Marshak et al., 2010). Unless students choose to disclose their disability and register for support services, they often are not afforded services and accommodations that are essential for participation and their continued success in STEM.

**Limited Numbers Lead to Programmatic Changes**

When Midwest Alliance staff began the recruiting process, for example through mass mailings to school districts and disability organizations, the number of students recruited for our programs was less than anticipated. To improve our recruiting numbers, we employed two marketing consultants. They asked, "What is the message you want potential recruits to hear?" As staff reviewed the Midwest Alliance message via printed materials and website, we realized the message being communicated was not the one we intended. What Midwest Alliance materials told a student with disabilities was, "*If* you are sufficiently talented and accomplished, then these activities are appropriate for you." This is a message with which students with disabilities are very familiar, as they have heard it repeatedly from various sources. As Midwest staff considered this, two premises became apparent. First, the Midwest Alliance wanted to promote a message about participation in STEM that most students with disabilities had not heard, that is, that they *were* capable and had talent. Second, the Midwest Alliance wanted students with disabilities to determine whether STEM was an appropriate choice for them, independent from and in some cases despite what others had told them. This meant that students with disabilities were encouraged to *explore* participation in STEM in order to make their own informed choices about pursuing majors and careers in these disciplines.

Second, we found that we lacked the ability to easily and quickly locate and attract students with disabilities into programs. For organizations new to recruiting students with disabilities to opportunities in postsecondary education, it is perhaps surprising that it can be difficult to find students with disabilities to participate in the organization's programs. We had operated with the implicit assumption that students with disabilities were interested, eager, and actively seeking opportunities to explore possible educational and career paths. Unfortunately, our experience suggests that this belief is not true for most students with disabilities. Instead, recruiting potential participants requires significant resources and effort.

Our initial recruitment efforts produced extremely low rates of return from contact with school districts. The first attempt included bulk emails to every school district throughout the three-state region. The return rate was less than 5%. It quickly became clear that merely offering programs to help students with disabilities explore STEM education and career paths would not be sufficient. In fact, the recruitment program needed to be planned and multidimensional if it was going to be effective (Haller, 2006; Roessler & Brown, 2000).

To overcome these obstacles with a comprehensive recruitment plan, a system design process was used. This process began with an examination of the needs of the stakeholders, including students with disabilities, their parents, their teachers (including special education teachers), and school administrators. After the

needs were determined, a multilevel recruitment plan was established to maximize the penetration and efficiency of staff efforts. We redesigned our recruitment model to include three sequential components. The first part is termed "Finding Students with Disabilities," the second "Reaching Students with Disabilities," and the third "Assisting Students with Disabilities." This multilevel approach is outlined in Table 2.

**Finding Students with Disabilities**

Each component of the systems-designed plan consists of several sub-components. Logically, identifying students with disabilities for participation in postsecondary STEM begins with contact with personnel in the middle and secondary school system (Fairweather & Shaver, 1990), key stakeholders, and persons involved in disability-related networks. Each of these focal points can be a significant source for finding students with disabilities.

**Through secondary schools**. An initial portal to potential participants is through the school districts (Fairweather & Shaver, 1990). This early student-identification process can be helpful, since the continuance from high school to postsecondary education is considerably lower for students with disabilities than their non-disabled counterparts (Fairweather & Shaver, 1990). Garrison-Wade and Lehmann (2009) noted that high school students with disabilities are rarely encouraged to identify possible postsecondary education institutions and programs of study in which they might be interested. Changing this pattern takes concerted effort (Palombi, 2000).

Our experience suggests that the difficulty in reaching students with disabilities through interactions with school districts arises from the need to pass several gatekeepers before communication with the student can occur. Recruitment efforts should address this barrier by employing two approaches. First, staff needs to take steps to ensure that school districts are familiar with the organization attempting to recruit its students. Second, staff needs to cultivate "word of mouth" support from students with disabilities who have participated in activities provided by the organization. The development of relationships and establishment of a quality reputation require time and patience, a difficult proposition when continued funding for recruitment efforts depends on the ability to recruit sufficient numbers of students relatively quickly.

**Through key stakeholders and gatekeepers.** Key stakeholders and potential gatekeepers span a wide range of individuals and groups, including general education teachers, special education teachers, local boards of education, and educational administrators (Fichten et al., 2003; Roach & Salisbury, 2006; Roessler & Brown, 2000; Tororei, 2009). Midwest Alliance staff initially targeted our message directly to special education teachers because of their familiarity with students with disabilities. However, we have experienced instances where special education teachers have not passed invitations on to students because they felt our programs were not appropriate for their students. In order to counteract this pattern, we directly contacted many stakeholders and attended their functions to explain the purpose and activities of the Midwest Alliance and invited them to Alliance events. Taking a more proactive approach to recruitment, such as through parents' groups and at professional and transition conferences, paid greater dividends and helped spread the word more effectively than widespread mailings and indirect contact.

***Parent groups***. Many groups exist for parents of children with disabilities, such as Easter Seals, United Cerebral Palsy, The Arc, and related groups. In addition, the Internet hosts many online parent groups, as shown in Table 3. Both face-to-face and online parent groups can be powerful means of recruitment. Similar to school districts, recruitment through parents requires developing familiarity and reputation before successful recruitment can occur. One method used successfully by Midwest Alliance staff has been to include parent groups in a variety of programs (e.g., discussion panels during college preparation workshops and campus tours). In addition, parents are an integral part of many Midwest Alliance activities, such as the immersion camps discussed below. While students were engaged in exploratory activities in the immersion camps, parents simultaneously attended informational sessions about postsecondary disability services, academic skills needed in postsecondary education and in STEM, and postsecondary accommodations. At the conclusion of the immersion camp, students and parents worked together to plan a higher education path in which the student could utilize information gained during the camp.

***Professional conferences and workshops.*** Another means of establishing relationships with key stakeholders is through participation at targeted conferences and workshops. The Midwest Alliance routinely

Table 2

*Midwest Alliance Strategies for Recruiting Students with Disabilities to Explore STEM*

- Finding Students with Disabilities
  - Through secondary schools
  - Through key stakeholders and gatekeepers
    - Parent groups
    - Professional conferences and workshops
    - Transition conferences
    - Targeted recruiting through special programs
  - Building recruitment networks
- Reaching Students with Disabilities
- Assisting Students with Disabilities
  - Creating a community and answering questions
  - Offering career guidance
  - Opportunities for exploration
  - Providing guidance and/or direct financial support

Note: Information extracted from: www.stemmidwest.org

Table 3

*List of Online Groups for Parent of Students with Disabilities*

www.childrensdisabilities.info

www.disaboom.com/children-with-disabilities

www2.ed.gov/parents/needs/speced/edpicks.jhtml

www.our-kids.org

www.lookinglgass.org

www.disabledparents.net

www.parentcenternetwork.org

www.lookingglass.org

www.pacer.org

www.supportforfamilies.org

www.LDonline.org

participates in a wide variety of conferences, including making presentations and hosting booths at national and regional conferences for special educators and secondary science and math teachers. Examples have included the National Science Teachers Association, Association on Higher Education And Disability, the Wisconsin Department of Public Instruction, and the Science Education for Students with Disabilities Association.

***Transition conferences.*** We have also found that conferences designed for professionals and teachers involved in students' transition from high school to postsecondary education are an effective way to engage another group involved with students with disabilities. Midwest Alliance staff sponsored informational booths and presented numerous sessions at annual transition conferences in Illinois, Wisconsin, and Iowa. In addition, the staff hosted public webinars on transition planning and employment to organizations and associations involved in transition services.

***Targeted recruiting through special programs.*** Science Olympiad (SO) is a national science competition for middle and high school students. Student teams conceptualize and create hands-on activities and projects based on categories such as earth science, chemistry, or astronomy. Each team competes against all other teams in their category. The SO has been operating since 1982, has grown in both prestige and coverage, and currently registers more than 6,200 teams and representation in all 50 states (SO, 2011). Students who participate in SO often are already viewed as being skilled at STEM. Recruiting these students, who have been identified by their teachers as talented, often produces a high rate of return.

Students with disabilities participate in SO activities, which produces two recruiting opportunities. First, like their non-disabled peers, students with disabilities participating in SO are likely to have an existing interest in STEM, so recruiting these students to further explore opportunities in STEM is natural. Second, because students with disabilities and their teams' coaches may be seeking resources to enable participation by everyone in SO activities, providing assistance in accommodations can serve as an additional recruitment means. We believe that our help in providing accommodations to facilitate full inclusion in SO creates a compelling interest in students, coaches, and others for Midwest Alliance programs.

**Building recruitment networks.** Ultimately, the objective of many of these activities is the development of recruiting networks. The message provided in the recruitment materials needs to be consistent with what the recruitment networks value, such as specific information on how the program will benefit the student. Recruitment networks can be established with other programs such as NSF funded projects (e.g., Research in Undergraduate Education [REUs]); with disability support services offices at technical and vocational schools, community colleges, and universities; and with disability advocacy organizations.

## Reaching Students with Disabilities

Once students with disabilities have been identified, strategies for reaching the students need to be developed. There are two main features essential to this stage. First, multiple means of dissemination is necessary, and second, the message sent to key stakeholders including students is essential.

We have used five different approaches to reaching students with dissemination methods. The first four are examples of social media that align with how students routinely interact with one another: email, the Midwest Alliance website, listservs, and social networking. We have used all of these approaches extensively, including a Facebook page. We also have published a quarterly newsletter as our fifth dissemination method. All the online material is provided in multiple formats and is routinely checked for accessibility.

## Assisting Students with Disabilities

In addition to finding and reaching students with disabilities, programs such as the Midwest Alliance need to assist them in achieving academic success and persisting to graduation. For most students, this means creating a positive peer climate, exercising choices, self-advocating, and being engaged in both academic and extracurricular activities (Mayhew et al., 2005; Oseguera & Rhee, 2009; Roessler & Brown, 2000). Adams and Proctor (2010) noted the importance of attitudes and skill sets in addition to traditional skills that may be required by STEM majors. For example, they recommended personal and counseling services, advocacy services, social-networking activities, and services that oriented students to college life. These opportunities and skill sets are the target of many Midwest Alliance programs.

**Creating a community and answering questions.** Individualized and group programs such as mentoring (Brown, Takahashi, & Roberts, 2010; Stumbo, Lindahl-

Lewis, & Blegen, 2008; Stumbo et al., 2010/2011) and tutoring are important recruitment tools. Mentoring, especially in cases where the mentors are upperclassmen or STEM employees in the workforce, can help high school and beginning postsecondary education students with disabilities learn about campus and community services for students with disabilities (Hill, 1996), for example, the disability services office.

In the case of the Midwest Alliance, mentorships are conducted either face-to-face or electronically. The best possible matches are created based on major or career interests, location, and disability. Mentorships focus on self-advocacy, transitioning from high school to postsecondary education, academic accommodations, and study skills such as time management. The primary benefit for the mentees is the ability to ask questions about the postsecondary education environment, about STEM majors, and about disability issues without fear of stigma, ridicule, or embarrassment. The primary benefit to the mentors is the satisfaction of guiding an individual toward his or her path of success (Stumbo et al., 2008; Stumbo et al., 2010/2011). Many of the individual success stories are published in the Midwest Alliance newsletter (cf. Midwest Alliance, 2010) in order to encourage additional students to apply for the program and to continue to build the mentoring community.

**Offering career guidance**. Mowbray et al. (2005) noted that transitioning is focused on a "choose-get-keep" premise that helps individuals make choices about their own paths for education and training, get an appropriate education or training, and keep on track until their goals are achieved. According to these authors, services that help individuals choose-get-keep include career planning, academic survival skills, and outreach services and resources. Career planning may include self-assessments, career exploration, and goal setting. Academic survival skills might include stress and time management, developing social support networks, tutoring and mentoring, and social skill development. Outreach services include financial aid offices, disability service providers, vocational rehabilitation agencies, and on-campus centers such as those for computing and writing skills.

The Midwest Alliance staff provides a number of activities that help students explore career opportunities and develop career-related skills. Campus tours of university laboratories and departments are offered to students with disabilities and their parents. These tours allow high school students with disabilities to learn about potential career options; visualize themselves in these settings; and familiarize themselves with the facilities, equipment, and language of STEM-related careers. Students with disabilities and their parents are also invited several times a year to workshops and panel presentations that include students and scientists with disabilities, personnel from university disability offices, transition specialists, and other parents. The focus of these information-sharing activities is to acquaint students with disabilities and their parents with various options available within the wide spectrum of STEM, in an effort to allow students with disabilities to determine if a STEM-related career suits their own abilities and preferences. In addition, the Midwest Alliance staff aids students with disabilities in developing interviewing and job application skills, resume writing, and disclosing disability information as they progress further into their education and career.

**Opportunities for exploration.** It is essential that students with disabilities have opportunities to actually participate in STEM activities and visualize themselves engaged in a STEM profession. The Midwest Alliance refers to these experiences as immersion and enrichment experiences and offers them to all students regardless of prior interest and/or ability in STEM. According to Melber and Brown (2008), these "authentic, inquiry-based experiences" (p. 36) that occur outside of a classroom are important for student exploration and discovery, empowerment, and creating a self-portrait of being successful in STEM.

Midwest Alliance has developed and hosted two-, three-, and five-day immersion camps on design in 2009, 2010, and 2011. These camps, with titles such as "Exploration by Design: How Stuff Works," allow high school students with disabilities to explore design and engineering activities in non-traditional ways. Approximately 15 students with disabilities and 25 parents participate in each of these immersion experiences. For the most part, the students and the parents participate in separate activities. Students experience a wide range of physical, visual, hearing, psychological, and learning disabilities.

A variety of activities were part of the immersion camps. The camp typically begins by introducing the students and parents to one another with activities such as, "What Do You Know? Competition," and tower and boat building. The students learn about the design process and how things work. One design problem was to develop a game. The game may involve physical

activity or be a table-type game. Examples activities include study of the Wii controller and bridge building, including simulation of the bridge designs the students put together. At the conclusion of the camps, students present and demonstrate their designs. Concurrent with these activities, parents are gaining information on postsecondary education disability access and supports, and skills that the students would need to be successful at the postsecondary level. The camps are held on college campuses and include tours of campus and the disability service offices with question/answer sessions on two-year and four-year colleges.

**Providing guidance and/or direct financial support.** Financial aid is designed to help students and their families meet the gap between postsecondary education expenses and their own personal resources. Typically, four types of aid are available: grants, which generally do not have to be repaid; loans that typically need to be repaid with interest in the future; work-study, or university-based employment during or between periods of enrollment; and scholarships, which are gifts and awards based on academic achievement, background, or other criteria. In addition, many students with disabilities, especially undergraduates, may qualify for assistance through their state vocational rehabilitation agency (Gardner & Ward, 2007). Most financial aid options are based on need, although many scholarships are merit-based, that is, based on the student's exceptional abilities or achievement in certain areas, such as mathematics, drama, or overall grade point average.

St. John (2000) stated, "While for a brief period in the 1960s and 1970s there was sufficient aid to promote equal opportunity, federal student aid is no longer adequate for this purpose" (p. 72). Additionally, students with disabilities may have above average costs due to disability-related equipment and its maintenance; personal help such as interpreters or personal care assistants; transportation when accessible means are unavailable; and disability-related medical expenses not paid by insurance. To cover these expenses, scholarships and/or other forms of financial assistance are needed for students with disabilities (Lau, 2003; Mobility International, 2011).

In the second year of operation, the Midwest Alliance provided scholarships to selected students with severe physical disabilities who were majoring in STEM. However, one student withdrew for medical reasons and another had his vocational rehabilitation aid lowered by the amount of the scholarship. Since that seemed unproductive for both the students and Midwest Alliance, no additional scholarships have been awarded. However, the Midwest Alliance does provide stipends to students who are mentees, mentors, and interns. While these stipends do not offset the expenses mentioned above, they do provide an income for students and encourage continuance of their commitment to their education and career.

Table 4 represents data on the number of students involved in various programs during the six years of Midwest Alliance. The numbers show continued growth in each program. The first years show modest progress, while later years shown increasingly robust numbers of students. While this continued growth cannot be attributed to particular recruitment efforts, it is felt that the increases reflect the success of the systems-designed, multilevel approach used by the Midwest Alliance. Hopefully, other programs recruiting students with disabilities into STEM can learn from this approach.

## Conclusion

"Persons with disability must be equipped with the necessary skills required in the performance of tasks before them if they are to compete favorably with non-disabled workers in an already saturated labor market" (Tororei, 2009, p. 4). This statement resonates deeply with individuals and organizations tasked with providing educational and support services to students with disabilities. In order to be afforded equal opportunity, especially in STEM fields, people with disabilities must be able to work their way through multiple barriers. A systems-designed, multilevel approach aimed at reducing or eliminating these barriers is required. The comprehensive approach taken by the Midwest Alliance, an NSF-funded program that recruits students with disabilities and helps them succeed in postsecondary education/STEM majors, is described. As promising practices, the ideas presented here are intended to help other individuals and organizations determine if recruitment is desired and, if so, to conceptualize and create multi-level systems-designed recruitment plans. Understanding what has and has not worked for the Midwest Alliance may help others to more efficiently and effectively meet the challenges of recruiting students with disabilities.

Table 4

*Numbers of Participants in Midwest Alliance Activities 2005-2011*

| Year/ Program | 2005-2006 | 2006-2007 | 2007-2008 | 2008-2009 | 2009-2010 | 2010-2011 | TOTAL |
|---|---|---|---|---|---|---|---|
| Internships | 6 | 10 | 18 | 32 | 29 | 17 | 112 |
| Mentoring | - | 15 | 21 | 40 | 41 | 42 | 159 |
| Immersion Experiences | - | - | - | 13 | 38 | 27 | 78 |
| Webinars | - | - | - | - | - | 160 | 160 |
| TOTAL | 6 | 25 | 39 | 85 | 108 | 246 | 509 |

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