Postsecondary STEM Education for Students with Disabilities: Lessons Learned from a Decade of NSF Funding

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Abstract

The Research in Disabilities Education Synthesis Project (RDE-SP), a four-year mixed methods research project, assessed a decade of funded projects (2001-2011) under the National Science Foundation's Research in Disabilities Education program which is aimed at increasing participation and retention of students with disabilities (SWD) in Science, Technology, Engineering, and Mathematics (STEM) education and careers. One of the primary goals of the project was to create a collection of challenges, lessons learned, and suggested practices for SWD and those working with SWD in STEM education and STEM fields. This paper presents those findings, which lend first-hand experience to the challenges and successes of working with students with disabilities in postsecondary STEM education programs. The authors relate the findings to current literature in the field.

Keywords: Disabilities, postsecondary education, STEM, retention

Sustaining the country's global leadership in science, technology, engineering, and mathematics (STEM) remains a top priority for policymakers in the United States. Since its inception in 1950, the National Science Foundation (NSF) has played a significant role in maintaining U.S. preeminence in STEM research and innovation. Integral to the success NSF's goal is the improvement of STEM education of all Americans and accessing previously untapped sources of science and engineering talent. The National Science Foundation report on Women, Minorities, and Persons with Disabilities in Science and Engineering (2013) stated:

> Women, persons with disabilities, and three racial/ethnic groups – blacks, Hispanics, and American Indians – are considered underrepresented in science and engineering because they constitute smaller percentages of science and engineering degree recipients and of employed scientists and engineers than they do of the population. (p. 2)

Federal laws and regulations enacted over the past four decades have increased access to postsecondary education for individuals with disabilities (Strange, 2000; Vogel, Holt, Sligar, & Leake, 2008). Thus, it is likely this legislation has contributed to the increase in the numbers of students identified with a disability in both two- and four-year postsecondary settings in the last three decades (National Center for Education Statistics [NCES], 2007) and nearly doubling since 1990 from 3.5% to 6.2% in 2009 (Samuels, 2011). Other factors include broadening the definition of disability and availability of the post-9/11 GI Bill.

Individuals with disabilities enter postsecondary education and enroll in science and engineering fields at about the same percentage in which they are represented in the general population. The Disability Status Report of 2014 (Erickson, Lee, & von Schrader, 2014) indicated that the prevalence rate for disabilities in the U.S. non-institutionalized population is 12% for all ages, and 10.4% for ages 21-64. In 2012, 11% of undergraduate students, with one in four undergraduates with a disability, enrolled in a science and engineering field (23.2% of all undergraduate students with a dis-

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ability). This is the same enrollment rate as students without a disability (24.7% of all undergraduate students without a disability) (NCES, 2007). Graduation rates and numbers who go to graduate school and enter the science and engineering workforce, however, are less representative of the population.

High rates of students with disabilities leave college without earning a degree (Vogel, Holt, Sligar, & Leake, 2008). In a cohort of postsecondary students beginning in 1989-90, 53% of students with disabilities versus 64% of students without disabilities had completed a degree, vocational certificate or were still enrolled in 1994, and 16% versus 27% had earned a bachelor's degree (U.S. Department of Education, 1999).

In 2012, the percent of enrollment in graduate science and engineering fields by students with disabilities was lower than enrollment data for undergraduate students with disabilities. Seven percent of graduate students in science and engineering reported a disability in 2012. While 20.8% of all graduate enrollments are students with disabilities, 19.2% of that group is enrolled in science and engineering fields (NSF, 2013),

U.S. citizens and permanent residents with disabilities earned science and engineering doctorates, with the number slowly rising from 281 in 1999 to 349 in 2009 (NSF, 2013). Since 2008, they have earned more doctorates in science and engineering fields than in non-science and engineering fields. However, the percentage of students in science and engineering graduate programs and obtaining doctoral degrees is not representative of the population as a whole. For example, in 2005, only 307 individuals (27,989 total degrees science and engineering degrees awarded) who graduated with a doctoral degree in a science and engineering field were registered as a student with a disability (NSF, 2009). The estimated disability prevalence in 2005 was 16.5% for individuals aged 21- 64 (U.S. Census Bureau, 2010). Undergraduate prevalence was 11% and graduate prevalence was 7% in 2004 (NSF, 2009).

In 2010, scientists and engineers with disabilities were more likely than their peers without disabilities to be unemployed or out of the workforce. The employment rate for individuals without disabilities was 83.3%, while the employment rate for scientists and engineers with disabilities was 64.1% (NSF, 2013).

For the most part, data are seriously limited on people with disabilities who study and work in science and engineering (NSF, 2013). Primary data sources are the National Center for Science and Engineering statistics (NCSES) at the National Science Foundation and the Department of Education's National Center for Education Statistics (NCES). Data limitations are due to operational definitions of disability that vary across states, institutions, and data collection organizations. Also, most data are self-reported and these reports utilize various formats for collecting disability data. Despite these problems with data about disability status in postsecondary and workplace settings, it is clear that individuals with disabilities are underrepresented in the pool of science and engineering graduates and the workforce.

NSF's programmatic response to promoting individuals with disabilities in science and engineering education and careers became the Research in Disabilities Education (RDE) program. Although the name of the program and the types of projects funded changed somewhat since it was established in 1991 (Scadden, 2001), in general, funding was provided for three types of projects: research; alliances (pipeline projects); and demonstration, enrichment, and dissemination projects. In the last decade of the program, the focus of the research track became more focused on postsecondary education in STEM and transition junctures in the STEM pipeline.

Research Purpose

The Research in Disabilities Education Synthesis Project (RDE-SP) at Kansas State University was funded by the National Science Foundation to investigate and synthesize the contributions and accomplishments of the agency's Research in Disabilities Education program. The purpose of the project was to provide an overview of the 2001-2011 decade of RDE projects and to suggest lessons learned through the ten years of awards aimed at broadening the participation of SWD in STEM. Among the research questions investigated in the project are two questions related to postsecondary STEM education and students with disabilities that are discussed in this paper:

1. What are common challenges and what suggestions for solutions have come from RDE projects?
2. What are the primary lessons learned from the decade of NSF-funded projects?

This paper describes some of the findings from the project and focuses on the lessons learned that are related to the work on disabilities services professionals in higher education settings.

Methodology

The researchers utilized a mixed method approach to collect and examine a variety of information from the projects funded during the decade in question. One hundred seventeen projects and 97 Principal Investigators (PIs) were part of the study; several PIs were awarded multiple projects during the decade in question. Data sources included: (1) materials submitted by project PIs such as annual reports and evaluation reports; (2) publications by PIs and Co-PIs; (3) materials on project websites and the Disabilities, Opportunities, Internetworking, and Technology (DO-IT)/ RDE site, which was funded by NSF for dissemination of information about RDE projects; and (4) data from an electronic questionnaire sent to project PIs. Data were augmented by current literature in the field.

Three individual research studies were part of the RDE Synthesis Project; they are reported in detail elsewhere (OEIE, 2015). This article utilizes some of the findings from these three studies, briefly described here, to describe barriers, promising practices, and lessons learned related to postsecondary STEM education of students with disabilities.

Portfolio Analysis Study

The research team gathered and synthesized data related to the funded projects and their products. Sources were used for this study were project reports to NSF and PI publications. The team contacted the 97 RDE PIs by email with a request that they share copies of the NSF reports for each of their projects funded from 2001 to 2011. The researchers received reports for 43 of the 97 RDE PIs; the reports corresponded to 51 of the 117 RDE projects. The team reviewed these reports and coded their content for themes related to contributions to the knowledge base of working with SWDs, products, impacts, and challenges. The publication list came from two sources: the publications reported by PIs to NSF and published on the NSF award page for each of the 117 projects; and publications collected in the same manner as those collected for the citation analysis study (the next study described), with an updated list of publications from the two years (2013-2015) post the decade in question for this project. The portfolio study provided an accounting of: the funded projects categorized type and geographic location; PI publications sorted by author and topic; and products produced by topic, category, and project.

Principal Investigator Survey

As part of the research project, the team developed an online survey to administer to the Principal Investigators of the projects funded through the RDE program during the timeframe of interest. The purpose of the survey was to gain data to supplement other data collection efforts, to create a more complete picture of the RDE project portfolio, and to gather quantitative and qualitative data from PIs about the impact and contributions of their projects. In developing the survey, the team used quantitative, multiple choice formats whenever possible, to reduce the burden on the participants. The team incorporated the themes coded from the PI reports as response options for many multiple choice items, which allowed for a significant reduction in the number of qualitative items on the survey. The sections of the survey were (1) activities and outputs; (2) outcomes and impacts; (3) goals; (4) evaluation and dissemination; (5) suggestions and best practices; and (6) demographics. The participant population for the survey consisted of 87 RDE PIs of projects funded between 2001 and 2011. The response rate for the survey was 67%. The researchers analyzed the multiple choice and scaled items, producing frequencies and percentages on these items, as well as means and standard deviations for the scaled items. The team calculated sums of the participants' responses on each "select all that apply" item to allow examination of the total number of selections. Open-ended questions were examined for themes.

Citation Analysis Study

The citation research utilized the published works of PIs of projects funded during 2001-2011. The purpose of the citation research was to collect data that could be analyzed to identify the collective influence or reach of these RDE PIs in the field by using the number of times their published work had been cited as evidence. The citation analysis utilized bibliometric methods, which seek to analyze academic literature, such as books, journals, and resource materials. As described by Greenseid and Lawrenz (2011), citation analysis "consists of tracking the number of citations to published works typically using a citation database and then analyzing the data using statistical, content, or network analyses" (p. 393). As such, these analyses document dissemination efforts and track their influence on other researchers' work. Citation analysis can be used to identify the contributions of people (e.g., researchers, grant partners) individually or collectively, and it may prove useful to apply within a single project or across multiple projects. In the case of the current study, the research team gathered information related to the RDE PIs' publications collectively, across all of their RDE projects, as a way to assess the influence of a decade's worth of the RDE program's work on the broader research field. The citation research and analysis supplemented other data collection efforts, allowing a more complete picture of the RDE project portfolio.

Findings

Common Challenges

As part of the survey (OEIE, 2015), RDE PIs were asked about challenges they had experienced in their projects, with one explaining (anonymous quote):

> We faced a surprising amount of discrimination because of the population that we were studying. We treated disability status as a status group that may face discrimination or differential treatment. Our previous work was on other status groups, including women in STEM fields, high performing students of color, and children of immigrants. We have never been marginalized in the scientific arena before this study of students with learning disabilities. The general population and the scientific community did not appear to understand that students with learning disabilities are capable of high levels of achievement if given the opportunity. (p. 84)

An examination of the current literature and data from this research suggest several challenges to successfully including students with disabilities in STEM postsecondary education and, to a lesser extent, conducting research at the postsecondary level with students with disabilities. These challenges include:

- Underprepared students. In general, RDE PI's found that some SWD were not prepared for postsecondary coursework. Research about low expectations and insufficient access to challenging academic curricula in science and math for students in special education in middle school and high school backs up this challenge faced by PIs (Bouck, Kulkarni, & Johnson, 2011; Moorehead & Grillo, 2013) Relatedly, PIs and other researchers found that students had limited self-advocacy skills (Hart & Brehm, 2013; Walker & Test, 2011)
- Lack of understanding and cooperation. PIs reported lack of understanding and cooperation from administrators, faculty, and staff and this challenge is reflected in other research findings (Demirel, Baydas, Yilmaz, & Goktas, 2013; Vogel, et al., 2008). Some PI's reported challenges with the program operations within the university; 36% of the PI's reported administrative and staffing challenges. This challenge may reflect the work of Cheatham, Smith, Elliott, & Friedline (2013) who found a general lack of understanding and acceptance of students with disabilities in postsecondary settings.
- Unavailability of adaptive aids, inaccessible buildings and grounds, and lack of other accommodations. Most of the PIs were STEM faculty, and they found lack of access and accommodations at college and universities to be surprising. Their reports are supported by other findings (e.g., Lowe, Newcombe, & Stumpers, 2012; Supalo, Isaacson, & Lombardi, 2014).
- Knowledge and skills of faculty and staff. PIs reported that their students expressed concern that staff and tutors in academic resource centers knew little about disabilities and were unable to assist or communicate effectively. PIs described these challenges in their annual reports, publications and survey responses. Other researchers (e.g., Aaberg, 2012; Kurth & Mellard, 2006; Lehmann, Daview, & Laurin, 2000; Shigaki, Anderson, Howald, Henson, & Gregg, 2012) have also found lack of faculty knowledge and skills for accommodating and working with students with disabilities.
- Recruiting. Twenty percent of all PIs surveyed reported challenges with recruiting participants for their special programs that serve SWD in STEM and in recruiting SWD STEM students for their research. This is related to identification of SWD, which is the next item.

PIs speculated that because of confidentiality issues, having access to known SWDs to promote their STEM programs was difficult.

- Measurement. Program evaluation and tracking participants were challenges that involved identifying students with disabilities, measuring program impact, and tracking for long-term follow up. These challenges were reported by 41% of the PIs in the survey and were mentioned in many of their publications. They cited significant issues related to identification and tracking at the program or university level due to confidentiality and due to low self-disclosure rates of SWD. Obtaining data relevant to students with disabilities at the institutional level was extremely difficult because: (1) institutional data do not include disability, or (2) institutional data could not be linked with data regarding students with disabilities which was housed in Disabilities Services Offices / Access Centers; or (3) institutions would not allow such linking because of confidentiality concerns. Students who receive services at the postsecondary level are ALL self-identified. In addition, 92% of Access Centers require verification, such as an IEP from high school or results from a battery of tests. That means faculty will have many students with impairments in their classes who are not recognized as such.

Solutions to Common Challenges/Successful Practices

Practices or strategies to solve or prevent common challenges were reported by PIs and suggested in their reports, publications, and survey responses all of which were analyzed in the three studies of the RDE-SP described above. General, summarized suggestions and practices were sorted into three categories listed in Figure 1.

Successful Practices

Other findings from the research included PI reports of practices that successfully addressed the problems identified in the literature and in their own work with their research and alliance projects. These successful practices have been described by many of the project PIs. These practices relate to the STEM faculty and other personnel who work with STEM education students who have disabilities.

1. Engage campus disability services. All campuses have services for SWD ("it's the law; it's the right thing to do"). Of course, this varies greatly – from a one-person shop that also deals with non-traditional students, veterans, and affirmative action issues, to Access Centers with specialists in various forms of impairments and various academic content areas. The NCES report found that 92% of all institutions did one-to-one work to assist faculty and staff make accommodations for SWD (NCES, 2007). Types of accommodations NCES reported were: additional exam time (93%), provision of classroom note takers (77%); faculty-provided written course notes or assignments (72%), help with learning strategies or study skills (72%), alternative exam formats (71%), and adaptive equipment and technology (70%). These campus centers have many names, such as Disabled Student Services or Student Access Center. Faculty and researchers in STEM higher education may need information about these centers to understand their roles and ways they can assist students and other faculty.
2. Use existing resources; do not develop new ones. PIs reported that project staff often initiated programs, such as tutoring, help with assistive technology, and career advisement, when they discovered the need through working with STEM majors. Later project staff learned of existing campus and community resources that had more experience and history in meeting specific student needs. When faculty and staff in STEM fields knew about and utilized existing resources, they had more time to work with students on specific STEM content and professional competencies.
3. Use multi-faceted interventions/programs. RDE-funded pipeline programs found the multi-element approach successful for SWD in STEM postsecondary education. The common strategies PIs reported using included: STEM peer tutoring, learning communities, lab internships, mentored tutoring, stipends, advocacy and self-advocacy training, support of faculty, industry externships, job shadowing, undergraduate research experiences, and transition support. These are described in the reports, publications, and materials on the

Alliance website and the RDE dissemination website by DO-IT. In addition, PIs reported providing a variety of academic and social supports for their students after they were recruited into postsecondary institutions. Although the types of relationships between students and project staff varied, personal connections with students was a common practice. In some cases, students met as needed with staff in person to discuss problems and concerns. Others facilitated more intensive in-person contact with staff, developing close supportive relationships. Staff provided students with intensive help, support, and advice on how to deal with academic problems and also encouraged students who had not registered with the Disability Services Office to do so.

4. Use a variety of recruitment strategies. Alliances also used a range of strategies to recruit postsecondary students with disabilities. These strategies included referrals from Disability Services Offices, STEM faculty, and students. Materials on the DO-IT RDE Dissemination website indicate that students were recruited to NSF-funded projects through newsletters; presentations at community colleges and high schools; advertisement and recruitment efforts at college fairs, career fairs, and science fairs; and distributing informational brochures to STEM departments and classes. Most PIs reported that personal connections and relationships with school personnel and others were the most successful means of recruiting students to STEM programs. The Ohio Alliance found student learning communities to be a successful recruitment strategy (Izzo, Murray, Priest, & McArrell, 2011).
5. Develop or adopt quality mentoring programs. Several funded alliance PIs have written about mentoring and attested to the success of personalized STEM mentoring (e.g., Leake, Burgstahler, & Izzo, 2011; Martin et al., 2011; Stumbo et al., 2011/2010).
6. Provide self-advocacy training for students. One of the PI's discussed the importance of training students in self-advocacy. Understanding their own disability, learning style, and STEM interests and strengths is imperative. One Alliance team wrote about self-efficacy among students with disabilities attending STEM courses in their article, published in the Journal of Postsecondary Education and Disability (Jenson, Petri, Day, Truman, & Duffy, 2011).
7. Provide professional development and support in Universal Design for Learning (UDL). This is one of the most frequent topics for PI publications and presentations. Universal design is an approach that integrates accessibility features into the overall design of products and environments – it means that all products and environments are as usable as possible by as many people as possibility regardless of age, ability, or situation. The approach began with architecture and was parent to a philosophy and set of principles of UDL. UDL strives to remove barriers from the learning environment. The goal is to build a model for teaching and learning that is inclusive, equitable, and guilds the creation of accessible course materials. In postsecondary institutions, faculty find that UDS helps guide the selection of teaching strategies and the design of course materials that support the diverse learning needs of students (Burgstahler, 2008). According to David Rose (Council for Exceptional Children, 2011), one of UDL's founders, "UDL puts the tag 'disabled' where it belongs – on the curriculum, not the learner. The curriculum is disabled when it does not meet the needs of diverse learner." Universal Design is based on the socio-cultural theory of disability. The premise of Universal Design recognizes barriers to access can be imposed/increased, by the environment. PIs have written about specific Universal Design applications for STEM (e.g., Burgstahler, 2008; Thompson, 2008).

Lessons Learned

A synthesis of findings from the PI survey and the analysis of project publications indicate an array of lessons learned from a decade of NSF funding for projects related to students with disabilities in postsecondary STEM education. Seven of these lessons are described below.

1. Identifying students for special programs or for research is generally problematic. At the

postsecondary level, identification of students with disabilities was a surprising challenge for many PIs. This relates to the discussion earlier in this chapter about identification, self-disclosure, and confidentiality of university records.

2. Faculty and staff may have stereotypes about the capacity of students with disabilities to do STEM work. There seems to be work to be done at institutions to improve faculty and staff understanding of students with disabilities, improve instructional skills, and create a welcoming climate. RDE projects developed resources and strategies that were somewhat successful in overcoming these challenges. The use of UDL concepts and instructional strategies was a common practice in RDE alliances.
3. In general, there is a paucity of resources for students with disabilities. PIs looked to Disability Services or Access Centers for collaboration in providing needed services to their students; however, many Centers were understaffed and underfunded. Such partnerships were not always successful.
4. Willingness and commitment of staff and faculty to "change their ways". An unexpected outcome for several projects was the ability of faculty to adapt to working with SWDs. After observing that some project participants had intensive needs and lacked study skills, time management skills, and needed additional academic supports, project staff and faculty changed their foci, made adaptations, solicited assistance, and made changes in their regular practices.
5. Providing the necessary environment and supports for SWDs takes considerable collaboration and teamwork. As one PI said, "it takes a village" to reduce barriers and provide supports such as adaptive equipment, UDL classroom strategies, and follow-up with students to assure success. For example, another PI noted that they had "discovered the importance of professional development and consistent use of proven strategies," while another discussed the importance in the "development of faculty learning communities" and others focused on self-advocacy training and mentoring for SWDs in the event of an environment lacking in support.
6. Collecting data in research projects and for project evaluation requires knowledge about disabilities and the types of prompts and responses that are needed to collect valid data. The NFS-funded project *BeyondRigor.com* provides examples of the kinds of measures and data collection protocols that may be needed for SWD. For example, students with ADHD may not have the capacity to sit through long interviews or take lengthy tests.
7. Success is possible. And success is both possible and likely when best practices, collaborations, and multiple program elements are in place for faculty and students.

In addition to these practices and lessons, the RDE projects' studies have contributed significantly to the resources available for faculty and practitioners in postsecondary education. Publications were primarily in the form of articles, proceedings, theses and books, but also included reports and book chapters. The researchers identified 1,095 publications for the projects funded during the decade studied. PIs reported the development of 162 products, most of which were teaching aids, equipment, software, and training materials. Because the account of products developed was based on PI report, with not all PIs reporting, the authors believe this total is underestimated.

Summary and Discussion

This description of the findings from the RDE-SP is based on two of the questions addressed in the project:

1. What are common challenges and what suggestions for solutions have come from RDE projects?
2. What are the primary lessons learned from the decade of NSF-funded projects?

In answering question one, the authors found that PIs confronted six problems or issues during the process of their research on SWDs. These problems were: SWDs were unprepared for undergraduate level coursework coming out of high school; uncooperative partners (administrators, faculty, and staff) especially in secondary and postsecondary education environments; lack of accommodations ranging from accessible buildings to adaptations allowing lab participation; faculty and staff were unaware of the needs and strengths of SWDs; difficulty identifying and recruiting SWDs; and difficulty accurately tracking and measuring program impacts. In general, the difficulties that the PIs faced were not uncommon to those who educate, support, and conduct research with SWDs on a regular basis, however it was useful to identify the list of primary problems and to investigate the solutions that PIs were able to use to overcome or address these problems.

Answering question two provided some general lessons that will be beneficial to researchers, faculty, and staff at postsecondary institutions. The general lessons (positive, neutral, and negative) included: identification of SWDs is problematic for numerous reasons; faculty may have negative stereotypes regarding SWDs that affects the quality of education and interaction; resources are limited for SWDs; faculty and staff are often willing to modify their approaches to promote successful education and interaction with SWDs; faculty and staff collaboration is essential; data collection is difficult as many measures are not validated on SWDs; and success is possible for all parties involved with an open line of communication and respect.

Underlying most of the challenges identified by PIs in their work with SWD in postsecondary education are, as in society in general, an understanding of disability beyond history, language, and stereotype. This will take a cultural shift. Faculty and staff in postsecondary STEM programs need to understand that disability is a socio-cultural concept. Sullivan (2009) looked at it this way; a person may have a cognitive, emotional or physical impairment (e.g., hearing loss, visual impairment, learning disability, and orthopedic impairment). But he said, disability is a negative social response to an individual with impairment. Therefore, this perspective is that a disability is not something a person has, but the exclusion imposed on impaired people is societies designed for and by able-bodied and able-minded individuals. Disablement is not the inevitable outcome of physical, sensory, or cognitive impairments (Barnes, 2009).

Many individuals, from university presidents to parents of young children in special education, understand disability from the medical model – if a person has an impairment the solution is to fix the person. Our education system and many services for individuals with disabilities are based on the medical model. However, this is not a universal concept. For example in UK, disability is cast as social oppression (Sullivan, 2009). The social model sees barriers to normal life and life patterns as a product of social attitudes. So individuals with impairments don't need to be fixed by an expert; they need social barriers / attitudes fixed. It should be noted that psychiatric services recipients are still more on the medical model than other impairments.

This perspective of disabilities is espoused in the publications of the RDE PIs and is exemplified in the book by Ruta Sevo that was commissioned by the Georgia RDE Alliance project. The book *Basics About Disabilities and Science and Engineering Education*, (Sevo, 2011) contains materials, a slide show, and activities that were developed to facilitate the cultural shift necessary for success of SWD in STEM postsecondary programs.

In general, PIs had several suggestions for facilitating a cultural shift among faculty and staff in their projects. These included:

- Adopting the socio-cultural model of disability.
- Providing faculty development.
- Adopting Universal Design.
- Using "PR" campaigns about the strengths of students with disabilities.

Limitations

Limitations for the RDE-SP study were associated with how data were reported and the participation of the principal investigators for the PI survey. Data reported by PIs in NSF reports and publications could not be readily compared because of the identification and measurement issues discussed earlier, although the PIs seemed to be conscientious about the accuracy of their reporting. Issues related to identification and tracking were limiting factors. The primary limitation effector for this study is data from the PI Survey. The response rate for the PI Survey was 66.7%, which meant that only 58 of 87 PIs were represented with their personal insight and commentary. An additional 15 PIs did not participate in the survey, but they submitted reports and project materials that aided in other analyses that contributed to the findings

Conclusions

Many students with disabilities could succeed in science, technology, engineering, and mathematics programs and careers if barriers associated with including individuals with disabilities could be overcome. The RDE-SP has shown that over the last decade our understanding of factors related to the STEM education of students with disabilities has increased; however, the ideal postsecondary education for students with disabilities who are interested in and have the capacity for a STEM degree and career has yet to be realized. A decade of RDE-funded projects has brought us closer. As a result of NSF-funded projects, there are more disability services practitioners who know more about STEM education and careers. There are more STEM postsecondary faculty members to have experience with and better understand SWD and UDL strategies. There are more universities and STEM programs that are providing welcoming environments and quality programming for SWD. There is more research about effective practices, technological tools, student characteristics, and collaborative efforts related to SWD and STEM education and careers. There are more resources for faculty, staff, students, parents and advocates

Ultimately, the suggested practices based on the lessons learned from a decade of NSF funding will be useful general life lessons: respectfully communicate with people, challenge your preconceptions, collaborate with your community, and be adaptable and creative in order to overcome challenges or obstacles encountered along the way.

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Acknowledgement

This material is based upon work supported by the National Science Foundation under Grant No. HRD-1145541. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author.

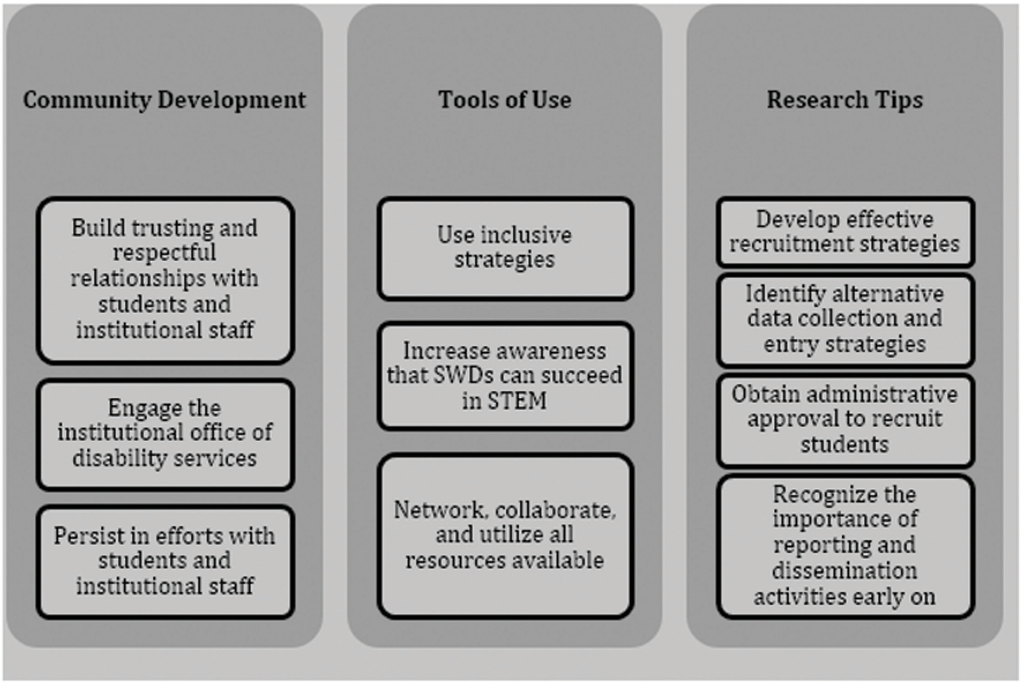

Figure 1. Reported Practices and Strategies to Overcome Obstacles. cited in RDE PI publications, reports to NSF, and the PI survey. Cited in RDE PI publications, reports to NSF, and the PI survey.