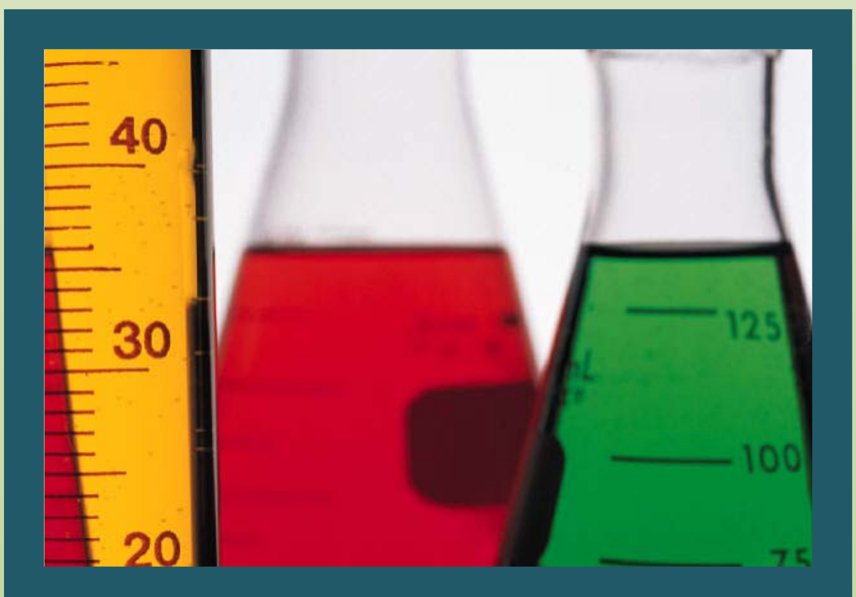
Research in Disabilities Education Synthesis Project Technical Report

Kansas State University
College of Education
Office of Educational Innovation and Evaluation
Office of Associate Dean



Research in Disabilities Education Synthesis Project Technical Report - 2015

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Special thanks to the RDE PIs and their teams, who contributed greatly to this project by sending us reports, answering questions, responding to the survey, and generally supporting this synthesis of the work of RDE funded projects during the program's second decade.

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ABSTRACT

The *Research in Disabilities Education Synthesis Project* (RDE-SP) at Kansas State University (K-State) is a three-year research project to investigate and synthesize the contributions and accomplishments of the National Science Foundation's (NSF) Research in Disabilities Education (RDE) program. Specifically, this synthesis project provides an overview of the 2001-2011 decade of RDE projects, highlighting the lessons learned through 10 years of awards aimed at broadening the participation of students with disabilities (SWD) in science, technology, engineering and mathematics (STEM) fields.

This technical report was compiled to answer the following questions related to the overall synthesis project:

1. How can the RDE project portfolio from 2001-2011 be described as a whole?
2. How has RDE-funded research informed the education of SWD in STEM or contributed to the knowledge base of STEM education of SWD?
3. How have RDE projects influenced the field of STEM education?
4. In what ways have the RDE projects provided resources to the STEM education community?
5. What are the primary lessons learned from the decade of funded projects?
6. What are common problems/issues and what suggestions for solutions have come from RDE projects

The project was led by a team of investigators in the College of Education at K-State: B. Jan Middendorf and Cindy Shuman from the Office of Educational Innovation and Evaluation (OEIE) and Linda P. Thurston, Associate Dean for the College of Education. Middendorf was Director of OEIE and project Principal Investigator from 2011-2014, before taking a position at NSF in fall of 2014. Shuman is the current Acting Director of OEIE and Principal investigator; she was previously the Co-PI of the project. Thurston, project Senior Faculty, is a professor in the Department of Special Education, Counseling and Student Affairs, Associate Dean for Research and Graduate Studies in the College and Lydia E. Skeen, Chair of Education. Evaluators and researchers from OEIE and the Office of the Associate Dean participated in the project.

The team utilized a mixed methods approach to answer the research questions, including document reviews, citation and network analyses, and survey research methods. Data sources included materials submitted by project PIs such as annual reports and evaluation reports, RDE solicitations from 2001 – 2011, publications by PIs and Co-PIs, materials on the DO-IT site funded by RDE for RDE project dissemination, the NSF website, and qualitative and quantitative survey data.

This technical report includes the summary reports from the major studies that were conducted to answer the research questions. Limitations and recommendations for future synthesis studies are also discussed.

Chapter 1 – Introduction

The Research in Disabilities Education (RDE) program at the National Science Foundation (NSF) focused on broadening the participation and achievement of individuals with disabilities in science, technology, engineering and mathematics (STEM) education and associated professional careers. The RDE program funded this objective beginning 1992 under the program's prior name, "Program for Persons with Disabilities". For more than 20 years, RDE has continued to fund projects that contribute to this overarching goal.

In 2012, the RDE Synthesis Project (RDE-SP) at Kansas State University (K-State) was funded to take a more global view of the program and compile the collective contributions to the field from these RDE projects. Specifically, the RDE-SP examined the RDE projects funded between 2001-2011 to synthesize these accomplishments, focusing on lessons learned and best practices relating to working with students with disabilities (SWD) in STEM.

This technical report provides a summary of the synthesis activities that the project team completed from 2012 to 2015, along with key highlights from the research that addressed these questions:

1. How can the RDE project portfolio from 2001-2011 be described as a whole?
2. How has RDE-funded research informed the education of SWD in STEM or contributed to the knowledge base of STEM education of SWD?
3. How have RDE projects influenced the field of STEM education?
4. In what ways have the RDE projects provided resources to the STEM education community?
5. What are the primary lessons learned from the decade of funded projects?
6. What are common problems/issues and what suggestions for solutions have come from RDE projects

The technical report is organized in the following sections:

- Chapter 1 – Introduction: Overview and brief history of the RDE program to provide context for the purpose of the synthesis
- Chapter 2 – Solicitation and award analysis: Summary of NSF RDE solicitations
- Chapter 3 – RDE program portfolio: Summary of projects, publications and products from the RDE projects
- Chapter 4 – RDE Principle Investigator Survey – Summary of findings
- Chapter 5 – Citation analysis: Summary of findings
- Chapter 6 – Lessons learned: Summary of lessons learned and best practices
- Chapter 7 – Summary of research questions: Summary of synthesis findings related to each of the research questions

Appendices with additional supporting documentation from the synthesis activities are also included in this technical report.

Contextual Background for the RDE Program

As the project team described in the initial proposal for the RDE-SP, 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, NSF has played a significant role in maintaining U.S. preeminence in STEM research and innovation through its programs and initiatives. A key element in these is NSF's focus on improving STEM education of all Americans and accessing previously untapped sources of STEM talent. According to the Committee on Equal Opportunities in Science and Engineering (CEOSE, 2006, p.1), "Women, underrepresented minorities, and persons with disabilities constitute the largest untapped pool of potential American scientists, engineers, technologists, mathematicians, and technicians."

Federal laws and regulations enacted over the past four decades have increased access to postsecondary education for individuals with disabilities (Belch, 2004; Strange, 2000; Vogel, Holt, Sligar & Leake, 2008). Thus, the proportion of students identified with a disability in both two-year and four year post-secondary settings has increased dramatically in the last three decades (American Youth Policy Forum and Center on Education Policy, 2002; National Center for Education Statistics [NCES], 2007) and has nearly doubled since 1990 from 3.5% (26% of those with disabilities) to 6.2% in 2009 (46% of those with disabilities) (Samuels, 2011). However, high rates of students with disabilities leave college without earning a degree (Belch, 2004; Nutter & Ringgenberg, 1993; U.S. Department of Education, 1999; Wolanin & Steele, 2004).

Students with disabilities frequently encounter barriers such as lack of funding for needed accommodations, modifications and equipment; lack of rigor in high school STEM courses (or lack of high expectations for students with disabilities); and stereotypes and lack of knowledge about the capacities, strengths and needs of SWD in STEM education settings. Many of these students could succeed in STEM courses and careers if such barriers could be eliminated or at least minimized.

NSF's Programmatic Response to Promoting Individuals with Disabilities in STEM Education and Careers

The final report of the National Task Force on Women, Minorities and the Handicapped in Science and Technology (1987-1990) indicated that the number of individuals with disabilities was seriously underrepresented in science and technology careers in the country. The National Task Force recommended that the U.S. Government establish and operate targeted programs to recruit, train, and retain people with disabilities for careers in these disciplines. During the development of the report, the NSF Committee on Equal Opportunities in Science and Engineering (CEOSE), a congressionally mandated oversight committee, created an Internal Task Force on People with Disabilities in Science and Engineering. This task force report included a series of recommendations to the NSF Director related to how NSF could increase participation of people with disabilities in the nation's science and engineering enterprise.

NSF officially established the Program for Persons with Disabilities (PPD) in 1991, with Dr. Lawrence Scadden, as the first Program Director. The purpose of the PPD was to support innovative projects designed to recruit, train, retain and move students with disabilities into graduate training and careers in these disciplines. The first PPD award was made to the University of Washington in 1992. The project proposed to recruit high school students with disabilities for extensive hands-on experiences in science and engineering. The project's long-range goal was to accommodate the students as undergraduates majoring in science and engineering. Later, the project became known as DO-IT (Disabilities, Opportunities, Internetworking and Technology).

For the first decade of its existence, the program made 91 awards among projects in 30 states, including the District of Columbia, with a total disbursement of $39,426,107. Over the 10 years, the program evolved, with the 2001 program announcement (NSF 01-67) stating the goals of PPD as:

- To develop new methods of teaching science and mathematics;
- To increase the awareness and recognition of the needs and capabilities of students with disabilities;
- To promote the accessibility and appropriateness of instructional materials and learning technologies; and
- To increase the availability of mentoring resources.

Two university-based projects, the DO-IT project at the University of Washington and a regional project at the University of New Mexico (RASEM) supported individuals with disabilities across high school to college settings. The RASEM model emulated, to a certain extent, the LS-AMP alliance model within HRD, and funding for Regional Alliances for Students with Disabilities in STEM (PPD-RAD) began in the fall of 2001 to demonstrate exemplary models of practice.

Three independent program evaluations were conducted during the first decade of the program: two via Committees of Visitors (COV) in 1997 and 2000, and by the Urban Institute of Washington, DC, in 1999. In accordance with recommendations of the COV in 2000, a compendium of the research and products developed by funded projects was produced. The "synthesis of outcomes to date" was published by NSF; it was titled *NSF's Program for Persons with Disabilities: Compendium of Program Activities and Community Impact, 1991-2001*.

Program Re-named Research in Disabilities Education (RDE)

In 2002, PPD was changed to RDE, Research in Disabilities Education. The stated goal of the RDE program was to broaden the participation and achievement of people with disabilities in all fields of science, technology, engineering, and mathematics (STEM) education and associated professional careers. The PPD / RDE program has been funding this objective for over 20 years and has undergone several programmatic changes to further this mission. Chapter two of this technical report provides additional details on these changes by summarizing the program's solicitations from 2001-2011.

The overarching structure of the RDE program were designed to rectify the long-standing underrepresentation of individuals with disabilities in STEM careers by emphasizing four key goals: (1) increasing the knowledge base of research related to the success of students with disabilities in STEM postsecondary education; (2) increasing the number and quality of students with disabilities successfully completing associate, undergraduate, and graduate degrees in STEM; (3) increasing the number of students with disabilities entering the professional STEM workforce; and (4) disseminating information about research and evaluation findings related to postsecondary educational success of students with disabilities in STEM and the STEM workforce.

Beginning in 2002, RDE supported three tracks to achieve its goals:

- The Demonstration, Enrichment, and Information Dissemination (RDE-DEI) program track provides support to institutionalize accessible products and educational materials, enhance STEM learning experiences for students with disabilities, and disseminate information about effective products, pedagogical approaches, teaching practices, and research for broadening the participation of people with disabilities in STEM.
- The Focused Research Initiatives (RDE-FRI) program track supports promising research on assistive technology development, technology use in educational environments, and investigations of effective instructional methods and practices in STEM for people with disabilities.
- The Regional Alliances for Persons with Disabilities in STEM Education (RDE-RAD) program track provides support for comprehensive multidisciplinary networks that increase the quality and quantity of students with disabilities completing associate, baccalaureate, and graduate degrees in STEM who then will be well prepared for science and engineering research, education, and professional workforce.

RDE Funds Pilot Studies of Alliances for Students with Disabilities in STEM

The Alliances for Students with Disabilities in STEM track historically was funded on a larger scale than the other two tracks and focused on establishing Alliances of high schools, two-year institutions, four-year institutions, and graduate-degree granting institutions. The purpose of these Alliances is to utilize evidence-based practices to recruit, retain, and graduate students with disabilities in STEM post-secondary education and to successfully transition them into graduate school or the STEM workforce. Although RDE supported a range of initiatives, the program expended the majority of its funds (about 60% in 2008) on the awards made in the Alliances for Students with Disabilities in STEM track. SRI, International was funded to conduct pilot studies related to alliances (SRI International, 2007; SPI International, 2009). The studies examined these questions:

- What data are readily available from projects and institutions? What are problems related to data collection that could impact a large-scale evaluation study?
- How many students with disabilities participated in the RAD projects during the three contiguous years (of the past six) in which the project had the highest number of participants?
- What were their demographic characteristics (gender, disability type, and race/ethnicity)?
- For a sample of these past participants, what were their perceptions of the importance of Alliance services and supports relative to retention and progression to degree?
- What data regarding STEM students with disabilities and the interventions they receive are available from Alliances, their host institutions, and comparison institutions?
- Are Disability Service Offices at host institutions influenced by the presence of the Alliances? For example, are they more innovative or more effective than those in comparison institutions?

These investigations demonstrated that there are various challenges to measuring outputs and impacts of Alliance projects. Part of this problem is related to the lack of common definitions of terms used in projects, such a “participant” and “mentoring”. The study noted that this issue provides difficulty in conceptualizing and operationalizing program evaluation for RDE Alliances. Specific challenges discussed by the studies include: definition of alliance “participant”, defining and measuring activities and services; measuring impacts; lack of data about disabilities, and lack of clarity about one or more alliance models.

Publication of “Basics about Disabilities in Science and Engineering Education”

In 2011, Ruta Sevo published a document called “*Basics About Disabilities in Science and Engineering Education*.” This document was funded through the Center for Assistive Technology and Environmental Access (CATEA) at Georgia Institute of Technology, with Robert L. Todd as the Principal Investigator. The book was developed for educators who have little experience or knowledge about students with disabilities, but have an interest in recruiting and supporting students with disabilities in the study of science and engineering. This publication is available through Amazon in paper form or as an e-book. It is also a free download at Amazon and on www.lulu.com.

Major Program Synthesis Funded in 2012

The RDE Program made major changes with the FY2012 solicitation with changes in the purposes and parameters for Alliance and Research tracks (see Chapter 2). In 2011, a decade after the first synthesis was written for the PPD, RDE funded the *Research in Disabilities Synthesis Project* at Kansas State University to examine and describe the RDE portfolio from 2001 – 2011. In addition, the project intended to describe the contributions of the projects, as a collective, to the STEM education of students (SWD) with disabilities. The project also included an investigation and synthesis of the "lessons learned" from projects about promoting the success of SWD in STEM, specifically at the post-secondary level.

The research questions are framed to align with the RDE's Program Logic Model (Figure 1.01). RDE has clearly articulated the intended outcomes from their funding strategies and this project will examine how successful these strategies have been in achieving their programmatic and performance goals at the program and national level by answering the research questions above.

Figure 1.01. *Program Logic Model for Research in Disabilities Education*

Inputs *Resources*	**Activities**	**Outputs**	**Outcomes -- Impact**		
			Short/Intermediate Term	*National Long-term Performance Goals/Outcomes*	*National Impact*
• NSF/RDE funding • STEM students/potential students who are individuals with disabilities • Institutions of higher education with STEM education capacity and commitment / faculty and staff • Research on STEM education of students with disabilities at the post-secondary level • Stakeholders	• Alliances for students with disabilities in STEM • Dissemination Projects • Research Projects	• Number and percentage of SWD entering STEM undergraduate degree programs • Graduation rates: Number and percent of degree-seeking SWD who graduate • Number of high-quality research studies using rigorous research designs • Number of publications in peer-refereed journals, book chapters, proceedings, and books	• Increased number and percentage of SWD entering STEM undergraduate education programs • Improved retention rates of SWD in STEM undergraduate education • Improved graduation/attainment rate in undergraduate STEM education • Increased number and rate of graduates in STEM education entering graduate school in STEM • Increased #/employment rate of STEM graduates in the STEM workforce	• Increase number of students with disabilities (SWD) completing STEM associates and bachelors degree programs • Increase number of SWD entering graduate STEM programs • Increase number of STEM graduates in the STEM workforce • Contribute to educational knowledge base of research on STEM education of SWD at secondary and postsecondary levels	• Increased participation and advancement of individuals with disabilities in the STEM enterprise • Improved quality and excellence of STEM education and research through the participation of individuals with disabilities in the STEM enterprise • Maximal preparation of a well-trained scientific and instructional workforce for the new millennium.

The project was led by a team of investigators at in the College of Education at Kansas State University: Jan Middendorf and Cindy Shuman from the Office of Educational Innovation and Evaluation (OEIE) and Linda P. Thurston, Associate Dean of the College. Middendorf and Shuman were the Director and Associate Director of OEIE and were the original PI and Co-PI of the project. Jan Middendorf accepted a position at the NSF in fall 2014. At that time, Cindy Shuman became the Acting Director of OEIE and the PI of the project. Linda Thurston is Senior Faculty on the project. She is a professor in the Department of Special Education, Counseling and Student Affairs, Lydia E. Skeen Chair of Education and the Associate Dean for Research and Graduate Studies of the College of Education. Evaluators and researchers from OEIE and the Office of the Associate Dean participated in the project.

The team utilized a mixed methods approach to answer the research questions, including document reviews, citation and network analyses, and survey research methods. Data sources included materials submitted by project PIs such as annual reports and evaluation reports, RDE solicitations from 2001 – 2011, publications by PIs and Co-PIs, materials on the DO-IT site funded by RDE for dissemination of information about RDE projects and qualitative and quantitative survey data.

The following chapters describe the work and the findings of this project. Chapter 2 is a detailed analysis of the solicitations to which funded PIs responded during the decade studied by this project. The chapter ends with a comparison of expected funding as outlined in the solicitations with actual funding by program track and in total. Chapter 3 provides an overview of the total RDE portfolio during this time. It describes the projects funded and the publications and products produced. The fourth chapter is the summary of results from the survey highlighting successes, challenges and lessons learned from the RDE PIs. Chapter 5 is the report from the citation investigation and analysis. It describes the publications from the decade and discussed the findings of the analysis of citations of the published works. The sixth chapter utilizes the findings from the previous chapters to discuss lessons learned from a decade of RDE work. These lessons include challenges, solutions, and common strategies. The final chapter summarizes the findings for each of the research questions and discusses limitations of the findings of the RDE-SP project as a whole. Numerous appendices augment the narrative of this report.

Chapter 2 – Solicitation and Award Analysis

Background

The *Research in Disabilities Education Synthesis Project (RDE-SP)* at Kansas State University is an effort to build on previous analytical efforts to examine and describe the RDE portfolio from 2001-2011, as well as to describe the contributions of the projects, as a collective, to the Science, Technology, Engineering, and Mathematics (STEM) education of students with disabilities (SWD). Collectively, the project activities are designed to include investigating, synthesizing, and reporting the findings and contributions of the RDE program to the field.

Part of our approach to "telling the RDE story" includes describing the 2001-2011 decade of the RDE portfolio. In order to document the mission and goals of the program overall, as well as illustrate the context and conditions under which the projects were funded, the research team reviewed the program solicitations from 2001- 2011 for the Program for Persons with Disabilities (PPD), which became Research in Disabilities Education (RDE). This chapter provides highlights from the review and analysis. The complete report is available on the OEIE website at http://oeie.ksu.edu/rde-sp/.

Methodology

The RDE-SP research team reviewed 10 program solicitations, issued for fiscal years (FY) 2001 to 2012. The solicitations, and their applicable fiscal years, are:

Table 2.01. *Solicitations with fiscal year assignations*

Solicitation	Applicable Fiscal Years
00-69	FY2001
01-67	FY2001 - 2002
02-025	FY2002
02-177	FY2003
03-587	FY2004
04-610	FY2005
05-623	FY2006
07-511	FY2007
08-527	FY2008
09-508	FY2009 – 2012*

*The final RDE solicitation included in our analysis (09-508) only referred to FY2009 and 2010; however, the solicitation was open beyond FY2010 where some RDE projects were funded in FY2011 and 2012. The solicitation (12-542) that replaced 09-508 had a June 1, 2012 deadline, which made it applicable to FY2013 and outside the scope of our research.

Of the 10 solicitations, the first four were from the Programs for Persons with Disabilities (PPD) and six for RDE. The team pulled key information from the solicitations and organized it in the tables on the following pages. This information includes the focus and key activities of the program; expected numbers, durations, and funding amounts of awards by program track; cognizant program officers; eligibility requirements and limits to eligibility; program goals; and evaluation plan criteria and outcome measures. Next, award information was analyzed to determine how specifics about the awards remained consistent or changed over the decade of solicitations.

An additional step to this solicitation review and analysis involved a comparison of the expected award numbers and funding amounts to the actual award numbers and amounts, by solicitation. Our synthesis project includes 117 PPD/RDE awards funded between the dates of January 1, 2001 and December 31, 2011. The research team collected the actual award information from the NSF website. Given that the available award information did not include an indication of which solicitation from which they had been funded, the research team made the best educated guess to assign each funded project to a solicitation and track.

To assist with determining which awards were funded under each solicitation, the research team referred to the start date of the project; as a general rule, projects were tied to the last solicitation that was posted prior to their start date. The research team recognizes that this is not a perfect system given that the start dates of awarded projects can experience delays for various reasons. The research team also realizes that some proposals are not submitted in response to a particular solicitation. Please note that for the purposes of our analysis, all PPD/RDE awards that fell within the scope of our project were assigned to a solicitation in order to track the total number of awards and funds against the estimated amounts.

To identify the track, the research team referred to the projects' titles and abstracts as well as information provided in the solicitations regarding the expected numbers, durations, and funding amounts of awards provided related to the tracks within the solicitations. Appendix A provides an NSF RDE Solicitation Snapshot, which the team created to provide guidelines for allocating the projects based on proposal deadlines and expected awards. Appendix B presents the full list of awards by solicitation and track as assigned by the research team.

Findings

Notable points from the analysis include:

1. Solicitation 00-69 (FY2001) was the only solicitation to include tracks called Demonstration and Intervention (DI), Information Dissemination (ID), and Capacity Building (CB). Solicitation 01- 67 (FY2001-2002) introduced the Regional Alliances for persons with disabilities (RAD) track. Solicitation 02-025 (FY2002) introduced the Demonstration, Enrichment, and Information

Dissemination (DEI) track and the Focused Research Initiatives (FRI) track.

2. In solicitation 03-587 (FY2004), the program name changed from Program for Persons with Disabilities (PPD) to Research in Disabilities Education (RDE). This name change reflects a beginning shift of greater focus to the Focused Research Initiative (PPD-FRI).
3. In 03-587 (FY2004), the RDE-DEI track encouraged Minority-serving institutions to apply and then in solicitation 04-610 (FY2005), this was included for all three tracks.
4. In 03-587, the earliest reference in the RDE solicitations to the topic of universal design appeared. Related to the FRI track, a goal mentioned "specific but utilitarian assistive technologies." Later solicitations referenced "universality of design" (starting in 04-610), and then "universal design" (starting in 07-511).
5. In solicitation 04-610 (FY2005), the program solicitation began including the requirement of an IRB pertaining to the use of human subjects in research.
6. In solicitation 04-610, a third goal was included for the RAD track: "support and sustain the intellectual endeavors of STEM professionals who have acquired disabilities later in their careers."
7. In solicitation 07-511 (FY2007), non-profit, non-academic organizations became eligible to apply.
8. Solicitation 08-527 was the first time the term 'broadening participation' was incorporated as part of the overall RDE program goals. The synopsis stated that RDE "<u>seeks to broaden the</u> <u>participation</u> and achievement of people with disabilities in all fields of STEM education and associated professional careers".
9. In solicitation 08-527 (FY2008), the evaluation requirements were substantially revised, providing more description of expectations related to evaluation, listing examples of strategic impacts, guiding readers to several resources that could be used to develop their evaluation plans, and noting the importance of awardees using third-party independent evaluators.
10. In solicitation 08-527 (FY2008), a new project track, Innovation through Institutional Integration (I3), was included in the program solicitation. This track spanned six NSF programs, including RDE. In solicitation 09-508 (FY2009-2012), an additional three NSF programs were added to the I3 track, for a total of nine programs.
11. In solicitation 09-508, another name change within the program occurred, this time specifically for two of the three tracks. The Regional Alliance for Persons with Disabilities in STEM Education (RDE-RAD) became known as Alliances for Students with Disabilities in STEM and the Focused Research Initiative track became known as the Research track.

Throughout the program solicitations, NSF did not state what its definition of a person with disabilities included. One statement found at http://www.nsf.gov/statistics/nsf99338/access/c5/c5s5.htm includes the following:

"NSF's surveys use a functional definition of disability patterned after one developed for a planned survey of individuals with disabilities developed by the Census Bureau."

Synopsis of Program

Solicitation 00-69 was far different from the remaining solicitations in that the three funding tracks changed and were further defined in the next two solicitations (01-67 and 02-025). The tracks in the 00-69 solicitation were Demonstration and Intervention (DI), Information Dissemination (ID), and Capacity Building within Community Colleges (CB). The track in the 01-67 solicitation was Regional Alliances for persons with disabilities (RAD). The tracks in the 02-025 solicitation were Demonstration, Enrichment, and Information Dissemination (DEI) and Focused Research Initiatives (FRI). Therefore, the synopsis in solicitation 00-69 was quite different from the remaining solicitations. Another significant change in the solicitations was the program name change from Persons with Disabilities (PPD) to Research in Disabilities Education (RDE) in the 03-587 solicitation, which also influenced the synopses.

The program synopses for the three solicitations 01-67 to 02-177 were nearly the same, with slight variations in wording. These synopses indicated that the program was "dedicated to increasing the number of people with disabilities employed in the nation's [STEM/SMET] workforce." Once the program name changed in solicitation 03-587, the synopsis also changed to state that the program "supports efforts to increase the participation and achievement of persons with disabilities in [STEM] education and careers.", and this remained consistent through the 05-623 solicitation. Solicitation 07-511 changed this wording to "makes resources available to increase the participation and achievement of people with disabilities in STEM education and careers." In solicitation 08-527, RDE again changed the wording to state, "seeks to broaden the participation and achievement of people with disabilities in all fields of STEM education and associated professional careers." [While the term 'broadening participation' had been included in previous solicitations, the 08-527 solicitation was the first time it was incorporated as part of the overall program goals. For example, in the 07-511 solicitation, it had been mentioned as a goal of the DEI track. Prior to that, the term 'broadening participation' had been included in the solicitation related to the proposal review information.] The synopsis in solicitation 08-527 also introduced a new interdisciplinary initiative called Innovation through Institutional Integration (I3). I3 projects enable institutions to think and act strategically about the creative integration of NSF-funded awards, with particular emphasis on awards managed through programs in the Directorate for Education and Human Resources (EHR), but not limited to those awards.

Revision Notes

Revision Notes appeared in the RDE solicitations in our review beginning with 05-623. In that, solicitation (05-623) the Revision Notes indicated that proposals could be submitted via FastLane or Grants.gov. The next solicitation's (07-511) Revision Notes included:

- o Proposers are required to submit full proposals via Grants.gov (with the exception of collaborative proposals).
- o All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the *NSF FastLane* system.
- o Program revisions include an extension of the maximum duration of the Demonstration, Enrichment, and Information Dissemination (RDE-DEI) awards to 18 months.

The next solicitation (08-527) provided notes regarding changes in two tracks and the addition of a new track as follows:

- o Program revisions include an extension of the maximum duration of the Demonstration, Enrichment, and Information Dissemination (RDE-DEI) awards to 24 months. The budget limit for the RDE-DEI awards is now $150,000.
- o Changes to the Focused Research Initiatives (RDE-FRI) awards include a revised budged limit of$375,000.
- o A new track for Innovation through Institutional Integration (I3) has been added. I3 challenges institutions to think strategically about the creative integration of NSF-funded awards and is itself an integrative, cross-cutting effort within the Directorate for Education and Human Resources (EHR). For Fiscal Year 2008, proposals are being solicited in six EHR programs that advance I3 goals: CREST, ITEST, MSP, Noyce, RDE, and TCUP. All proposals submitted to I3 through these programs have a common due date and will be reviewed in competition with one another. Awards will be made to institutions of higher education (including two-and four-year colleges). Given the focus on institutional integration, an institution may submit only one proposal to the I3 competition in only one program.

The final solicitation (09-508) noted a renaming of the *Regional Alliances for Persons with Disabilities in STEM (RDE-RAD)* track to the *Alliances for Students with Disabilities in STEM* track, and also renamed the *Focused Research Initiatives (RDE-FRI)* track to the *Research* track. Additional notes related to changes to the Research track included a revised budget limit of $450,000. Changes to the Demonstration, Enrichment or Dissemination track included a revised budget limit of $200,000.

Key Activities

Many of the solicitations provided examples of key activities, based on cumulative research from previously funded projects. These activities reflect the knowledge of the field and demonstrate how this can change over the course of a decade.

In the first solicitation (00-69) there were no program-level key activities listed in the program description, nor were there any program-level activities listed in the last three solicitations (07-511, 08- 527, and 09-508). Solicitation 01-67 provided the following five key activities:

- Hands-on science experiences in pre-college science education environments,
- Formal research experiences as undergraduates,
- Preparation of faculty for inclusion and full participation of students with disabilities in SMET curricula,
- Bridge programs between academic levels, and
- Mentoring by successful SMET professionals and students who have disabilities.

These activities remained the same through the next two solicitations (02-025 and 02-177) except for changing the acronym SMET to STEM. The first major change in key activities occurred in solicitation 03-587. This solicitation retained four of the original activities, and it altered the wording of the other original activity from "Preparation of faculty for inclusion and full participation of students with disabilities in STEM curricula" to "Educating and guiding faculty and caregiver attitudes toward full inclusion of students with disabilities." In addition, this solicitation provided the following four new activities:

- Early identification and nurturing of an interest in STEM in K-12
- Inclusive curricula
- Accessible laboratories
- Fostering student self-advocacy and encouraging peer interaction

The next important change occurred in the next solicitation (04-610) when a new paragraph was added that highlighted Assistive Technology and universality of design.

Expected Awards

The RAD track showed relatively little change compared to the other tracks. RAD consistently expected to fund 1 or 2 awards. Related to expected funding amounts and duration, the RAD track typically had the equivalent of $3,000,000 to fund per project through the decade, and these projects could be funded up to five years.

The DEI track experienced a few more changes. There was variance in the number of expected awards per solicitation; they started with 1-3 expected awards in solicitation 02-025, and this increased more than twofold beginning with the solicitation 03-587. The DEI track consistently offered around $100,000 per award, although this increased to $150,000 in solicitation 08-527. The duration of awards in the DEI track first decreased, then increased. DEI awards first were awarded for 1-3 years, which reduced to 1 year in solicitations 03-587 through 05-623, then began increasing and were up to 2 years in the 08-527 solicitation.

The FRI track also experienced some changes. FRI began with 1-3 expected awards in solicitation 02- 025, which slowly increased beginning in solicitation 03-587, and then increased more dramatically in solicitation 08-527 to 7-12 expected awards. FRI began by offering $100,000 per award, then shifted to offering up to $300,000 per award ($100,000 per year), and by the 08-527 solicitation had increased that to $375,000. The Research track in solicitation 09-508 allowed up to $450,000 per award. The duration of FRI began with an expected duration of 1-3 years in solicitation 02-025, reduced to 1-2 years in solicitation 02-177, then could be funded up to 3 years again in solicitation 03-587 through the rest of the decade.

Table 2.02 on the next page presents key information from the solicitations about the expected number, duration, and funding amounts of award per track.

Table 2.02. *Expected Awards*

Expected Awards				
Solicitation (Fiscal Year)	**Track**	**# Awards**	**Duration**	**Funding (Per award)**
00-69 (FY2001)	PPD-DI PPD-ID PPD-CB	Up to 15 total	Up to 3 yrs Up to 2 yrs Up to 3 yrs	Up to $150,000/yr Up to $100,000/yr Up to $150,000/yr
01-67 (FY2001-2002)	PPD-RAD	1-2	Up to 5 yrs	Up to $700,000/yr, increase annually $50,000
02-025 (FY2002)	PPD-RAD PPD-DEI PPD-FRI	1-2 1-3 1-3	Up to 5 yrs 1-3 yrs 1-3 yrs	Up to $700,000/yr, increase annually $50,000 Up to $100,000 total Up to $100,000 total
02-177 (FY2003)	PPD-RAD PPD-DEI PPD-FRI	1-2 1-2 1-2	Up to 5 yrs 1-2 yrs 1-2 yrs	Up to $700,000/yr, increase annually $50,000 Up to $100,000/yr Up to $100,000/yr
03-587 (FY2004)	RDE-RAD RDE-DEI RDE-FRI*	1 5-6 2-3	Up to 5 yrs Up to 1 yr 2-3 yrs	Up to $600,000/yr, up to $3,000,000 total Up to $100,000 total Up to $100,000/yr
04-610 (FY2005)	RDE-RAD RDE-DEI RDE-FRI	1 6-7 3-4	Up to 5 yrs Up to 1 yr Up to 3 yrs	Up to $3,000,000 total Up to $100,000 total Up to $300,000 total
05-623 (FY2006)	RDE-RAD RDE-DEI RDE-FRI	1 6-7 3-4	Up to 5 yrs Up to 1 yr Up to 3 yrs	Up to $3,000,000 total Up to $100,000 total Up to $300,000 total
07-511 (FY2007)	RDE-RAD RDE-DEI RDE-FRI	1-2 6-7 4-5	Up to 5 yrs Up to 18mos Up to 3 yrs	Up to $3,000,000 total Up to $100,000 total Up to $300,000 total
08-527 (FY2008)	RDE-RAD RDE-DEI RDE-FRI RDE-I3	1-2 2-6 7-12 10	Up to 5 yrs Up to 2 yrs Up to 3 yrs Up to 5 yrs	Up to $3,000,000 total Up to $150,000 total Up to $375,000 total Up to $200,000/yr, up to $1,000,000 total
09-508 (FY2009-2012)*	Alliance RDE-DEI Research RDE-I3	1-2/yr 2-14/yr 5-8/yr 10/yr	Up to 5 yrs Up to 2 yrs Up to 3 yrs Up to 5 yrs	Up to $3,000,000 total Up to $200,000 total Up to $450,000 total Up to $250,000/yr, up to $1,250,000 total

*Changes in expected number, duration, and funding totals of FRI reflect the shift in emphasis to research elements.

Cognizant Program Officers

There were a total of 10 unique cognizant program officers listed through the 10 program solicitations. Table 2.03 presents the cognizant program officers by solicitation. Please note that the titles are presented as they are listed in the solicitations.

Table 2.03. *Cognizant Program Officers*

Cognizant Program Officers	
Solicitation (Fiscal Year)	**Name**
00-69 (FY2001)	Dr. Lawrence Scadden, Program Director, Human Resource Development
01-67 (FY2001-2002)	Dr. Lawrence Scadden, PhD, Program Director, Directorate for Education and Human Resources
02-025 (FY2002)	Arthur Karshmer, Program Director, PPD
02-177 (FY2003)	James Powlik, Acting Program Director, PPD
03-587 (FY2004)	Lerome Jackson, Program Assistant, HRD
04-610 (FY2005)	Ted A. Conway, Ph.D., Program Director, RDE
05-623 (FY2006)	Ted A. Conway, Program Director
07-511 (FY2007)	Mark Leddy, Program Director Martha James, Assistant Program Director
08-527 (FY2008)	Mark Leddy, Program Director Tayana L. Casseus
09-508 (FY2009-2012)	Mark Leddy, Program Director Linda P. Thurston, Program Director Corey Hynson, Office Automation Clerk

Eligibility Information

Each solicitation provided eligibility requirements for submitting proposals. The first and last three solicitations (00-69, 07-511, 08-527, and 09-508) only provided general eligibility information. The second solicitation (01-167) was only for RAD projects, so the eligibility requirements were specific to RAD only. Solicitation 03-587 changed the program name from PPD to RDE and significantly changed the eligibility information by specifically defining requirements. This format followed for the next two solicitations.

Limits of Eligibility

There were PI and organization eligibility limits specified within the first eight program solicitations (00- 69 to 07-511) related to the three RDE tracks. The earliest four solicitations (00-69 to 02-177) did not contain many details about eligibility limits. For example, the first two solicitations (00-69 and 01-67) specified no PI eligibility limits, and the third and fourth solicitations (02-025 and 02-177) did not include any limits to the number of proposals that could be submitted. The solicitations 02-025 to 03-587 referred the reader to the Grant Proposal Guide for PI eligibility requirements instead of including those details within the solicitation. The solicitations 04-610 to 07-511 included more detailed information about eligibility limits for the RDE tracks. These three solicitations consistently included language to specify that a PI, Co-PI, or organization could only submit one proposal to each year's grant competition. They also stated that a RAD PI or Co-PI could not apply as PI or Co-PI on another RAD during the same funding period. Beginning with solicitation 05-623, the solicitations described limits to the number of proposals separately for the organization and the PI. The last two solicitations (08-527 and 09-508) included a track for I3, and this track reflected the only eligibility limits; there were no eligibility limits related to the three RDE tracks.

Program Goals

For the most part, the RDE program goals stated in the solicitations remained consistent through the years for the three RDE tracks: Alliance, DEI, and FRI/Research. The goals listed in the first solicitation (00-69) were not consistent with other solicitations because the three tracks were different (DI, ID, CB). Up until the last solicitation, the goals for the three tracks were specified separately. The 08-527 solicitation included language about the overall goals of the program as well as for each of the tracks individually. The 09-508 solicitation focused on the goals of the RDE program generally, and listed program priorities, rather than specifying goals of each track individually; in this solicitation, the track names also were modified.

The goals of the Alliance projects in solicitations 01-67 to 02-177 were to 1) increase the quantity and quality of students with disabilities receiving associate and baccalaureate degrees in STEM, and to 2) increase the number of graduates who enter careers or graduate school in STEM disciplines. Starting in solicitation 03-587, the second goal was modified to "identify early potential in STEM students with disabilities, then nurture such interest with appropriate activities, relevant content, and advisement for careers or advanced study." In 04-610, a third goal was included: "support and sustain the intellectual endeavors of STEM professionals who have acquired disabilities later in their careers." Solicitation 08- 527 focused on the goal of increasing the quantity and quality of students with disabilities receiving associate, baccalaureate and graduate degrees in STEM disciplines and entering the STEM workforce."

The goals of the DEI track remained consistent through the solicitations from 02-025 to 05-623:

- o to further institutionalize products and other educational materials that promote accessibility to STEM disciplines and career experiences by students with disabilities;
- o enhance the STEM learning experience for students with disabilities; and
- o disseminate information about model programs, exceptional products, successful research methods, and proven educational practices to a broad national audience.

The 04-610 solicitation also included language related to the goals of a RAD pilot study. The first two goals remained the same in the 07-511 solicitation, but the third goal was modified to read "disseminate information about model programs, exceptional products, successful research methods, effective pedagogical approaches, teaching practices, and research for broadening the participation of people with disabilities in STEM." In solicitation 08-527, all the goals were modified to be: "increasing public awareness and recognition of the capabilities and strengths of people with disabilities in STEM fields by disseminating evidence-based information that demonstrates success; developing, promoting, evaluating and disseminating the use of accessible and appropriate assistive technologies, and the use of instructional materials and learning resources, for students with disabilities in STEM and for STEM professionals; creating, implementing and disseminating new STEM learning methods and teaching pedagogy, that incorporate universal design learning approaches, to improve the engagement and performance of students with disabilities in STEM coursework and lead to student success in STEM; and employing and disseminating proven practices, such as mentoring, to support the success of students with disabilities in STEM academic courses, critical academic junctures, research and industry internships and externships, and transitions to the STEM workforce."

The goals of the FRI track changed subtly through the decade. In 02-025 and 02-177, the goals were: encourage research and development in the domain of highly focused assistive technologies that will help persons with disabilities pursue careers in STEM; build tools that can quickly be put into the educational environment; and add value to the instructional cycle in the education of persons with disabilities in the domain of STEM. In 03-587, the wording of the first goal was modified to replace the phrase "highly focused assistive technologies" with "specific but utilitarian assistive technologies." [This may be the first reference to the topic of universal design. Later solicitations referenced "universality of design" (starting in 04-610), and then "universal design" (starting in 07-511).] Also, related to the second goal, the solicitation clarified the language to specify that the tools are for students with disabilities and that they can quickly be developed and effectively deployed in the educational environment. The third goal was reworked to be "add value to the education of persons with disabilities in STEM." Then, in 07-511, the third goal was clarified to read "add value to the education of persons with disabilities in STEM by implementing the use of technologies in educational environments." A fourth goal was added: "investigate effective instructional methods and practices for people with disabilities in STEM." In solicitation 08-527, the goals were modified more thoroughly to be "developing, promoting and evaluating the use of accessible and appropriate assistive technologies, instructional materials and learning resources for students with disabilities in STEM and for STEM professionals; and creating and implementing new STEM learning methods and teaching pedagogy, that incorporate universal design learning approaches, to improve the engagement and performance of students with disabilities in STEM coursework and lead to student success in STEM."

Evaluation and Outcomes

For the most part, the RDE solicitations reflected consistent expectations for evaluation through the years. Between the 00-69 and 07-511 solicitations, the solicitations included language that proposals needed to identify the project outcomes to be targeted for each year of the proposed award as well as describe the techniques and/or instruments to be used for measuring the outcomes within an evaluation plan. The solicitations also included a statement that awardees would have to participate in a program-level evaluation. Beginning with the 01-67 solicitation, the solicitations also provided examples of outcome measures to be reported; that list was expanded in the 03-587 solicitation, which also mentioned collecting control data and provided details about outcome measures for faculty-enhancement activities. Starting in solicitation 04-610, a statement on the use of human subjects also was included.

The evaluation sections of the last two solicitations (08-527 and 09-508) changed dramatically compared to the previous solicitations. These two solicitations provided more description of expectations related to evaluation. They stated that all proposals "should explore the use of benchmarks, indicators, logic models, roadmaps or other formative evaluative methods to document progress toward goals, objectives and outcomes defined in the proposal." These two solicitations also instructed that "project evaluation should focus on strategic impacts of project activities" and listed examples of strategic impacts. Further, these two solicitations guided readers to several resources that could be used to develop their evaluation plans. These last two solicitations also noted the importance of using third-party independent evaluators.

These two solicitations also expanded on the description of the program-level evaluation. They described who NSF provides data to (federal policymakers in Congress and at the Office of Management and Budget). They also described the Program Assessment Rating Tool (PART) and the Academic Competitiveness Council (ACC).

In addition to this general evaluation information provided in the solicitations, the solicitations also at times included evaluation guidelines for specific tracks, namely the DI (00-69) and RAD (01-67 to 07-511) tracks. For example, 07-511 stated that RAD proposals "must include appropriate formative and summative evaluation and research activities to assess the effectiveness of strategies and interventions that improve participation of students with disabilities in STEM education that lead to degree completion, and that lead to successful employment in STEM." The solicitations also provided examples of such appropriate activities, but stated that the awardee would not be limited to those specific activities. In the 08-527 and 09- 508 solicitations, only general evaluation information for the program as a whole was included.

Summary

Although the name of the program changed, and SMET became STEM during this time period, the basic commitment of NSF to the inclusion of disabilities in its broadening participation portfolio and the primary mission of the program remained the same. Foci within the program changed and names of tracks within the program changed. For example, RADs became Alliances for Students with Disabilities in STEM and FRI became the Research track. Focus changed from assistive technology and the development of materials to research about models, pedagogies, and interventions and an interest in broader social science research about student with disabilities and STEM education.

Solicitations became more prescriptive during this period, specifying in more detail what kinds of projects would be funded and the expectations for describing the project. For example, aligning with the trend across the agency, more specificity was required about the theory of change and expected outcomes of the project, as well as more rigorous evaluation of projects.

The 10 solicitations during 2001-2011 indicated that between 79-126 awards would be funded for approximately $43,200,000. In actuality, 117 awards were funded for $58,695,385. The first solicitation funded 10 DI awards, 3 CB awards, and 2 ID awards. The remaining nine solicitations funded 20 Alliance (RAD) awards, 41 Demonstration, Enrichment, and Information Dissemination (DEI) awards, 40 Research (including FRI) awards, and 1 Innovation through Institutional Integration (I3) award.

Chapter 3 – RDE Program Portfolio (2001-2011): Projects, Publications and Products

In order to describe the RDE portfolio as a whole during the decade of this study, the research team gathered and synthesized data related to the projects funded and the products of these projects. This chapter provides an overview of the projects funded by: (1) outlining the funded projects by type and geographic location; (2) describing the publications from these projects and the topics of the publications; and (3) enumerating and categorizing the products produced by the funded projects. Three sources were used for this report of project publications: the publications from FY 2001-2011 projects collected for the citation analysis; 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, except updated to address the two years (2013-2015) post the decade in question for this project. Publications are categorized by type and topic.

A decade of awards

A total of 117 awards were funded during the decade studied, for a total of $58,695,385. By track, there were 10 Demonstration and Intervention (DI) awards, 3 Capacity Building (CB) awards, 2 Information Dissemination (ID) awards, 20 Alliance (formerly RAD) awards, 41 Demonstration, Enrichment, and Information Dissemination (DEI) awards, 40 Research (including FRI) awards, and 1 Innovation through Institutional Integration (I3) award. Figure 1 on the following page presents a visual of the total allocation of RDE funding by track. The largest amount of funding was for the RAD/Alliance track, at approximately $35.5 million.

Figure 3.01. *Total Actual Funding Awarded by Track*

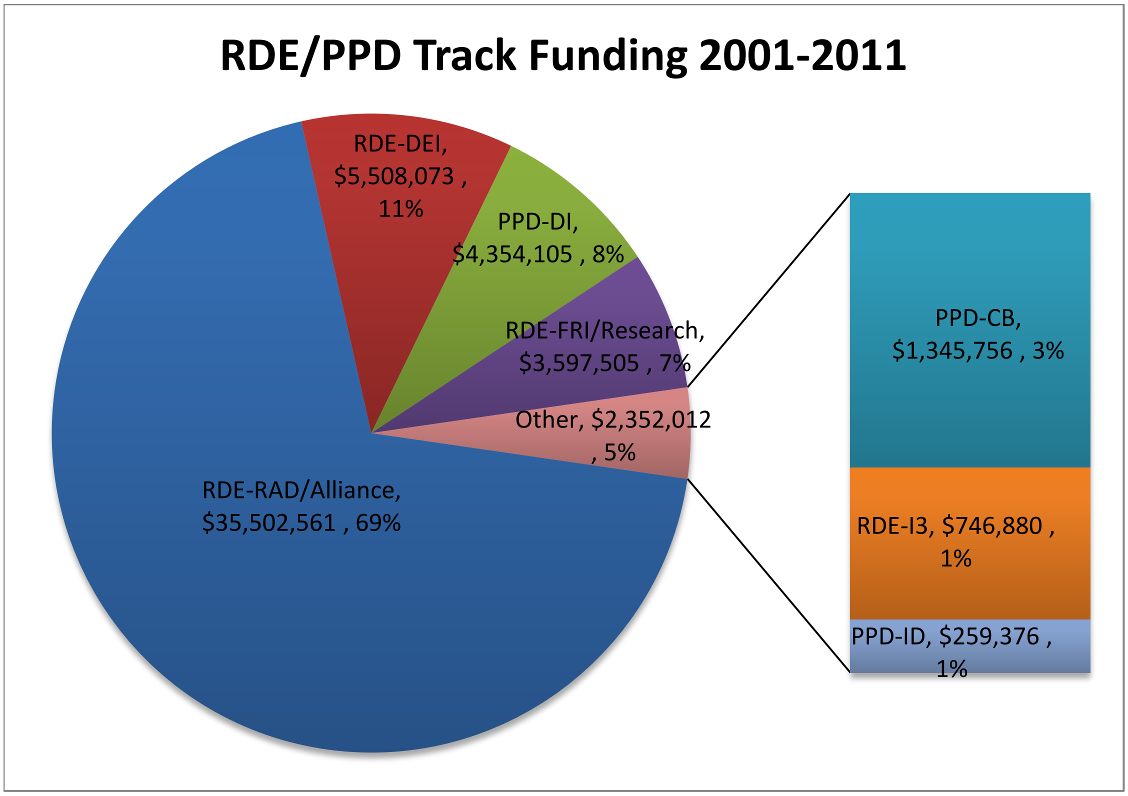
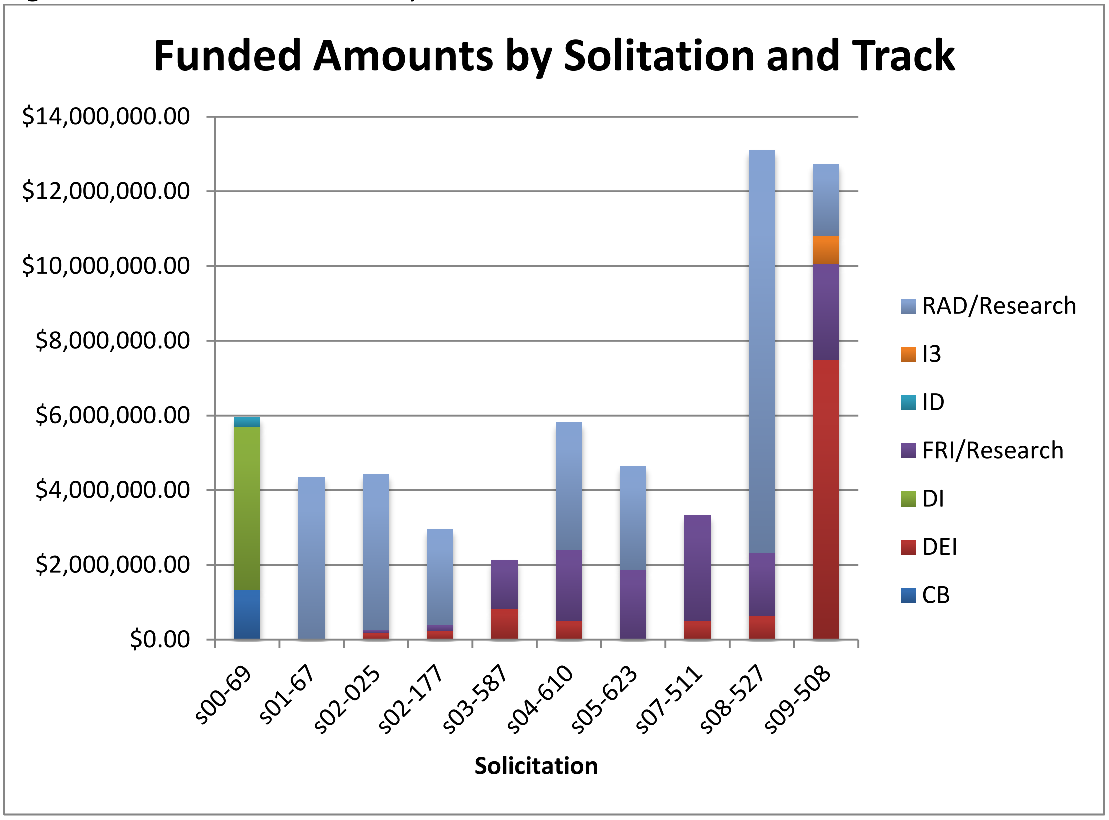


Figure 3.02 presents a visual of the allocation of RDE funding by solicitation and track. The largest amounts of funding were awarded for solicitations 08-527 and 09-508.

Figure 3.02. *Funded Amounts by Solicitation and Track*



RDE awards were made to the 97 PIs' institutions in 34 states and Washington DC (35 territories in total). Figure 3.03 shows the number of awards per state with the data in Appendix A. Massachusetts had the highest number of awards associated with it at 13 awards over the ten-year period. 16 states in total did not contribute as principal investigators. Ten states were home to the PIs that were awarded funding under Alliances (Figure 3.04).

Figure 3.03. *Number of projects awarded by state. (Washington DC is just listed as DC.)*

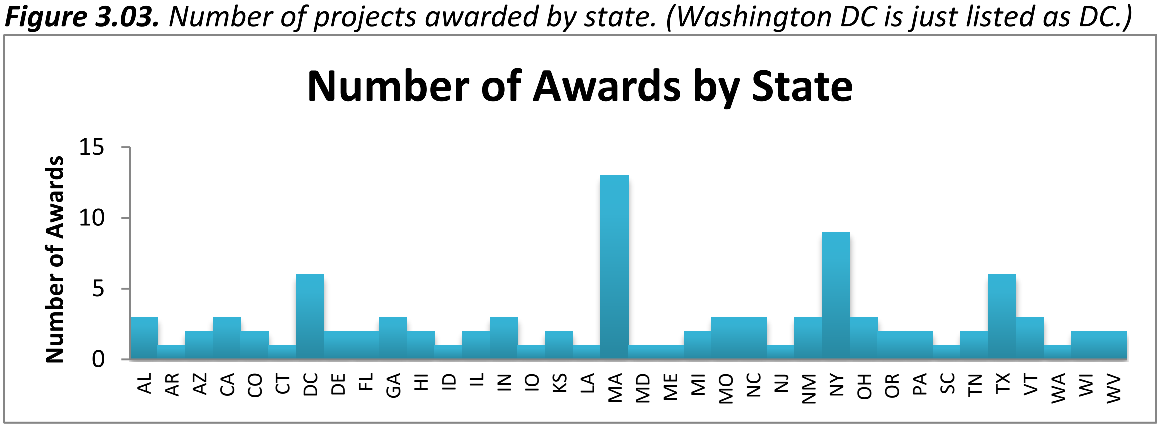
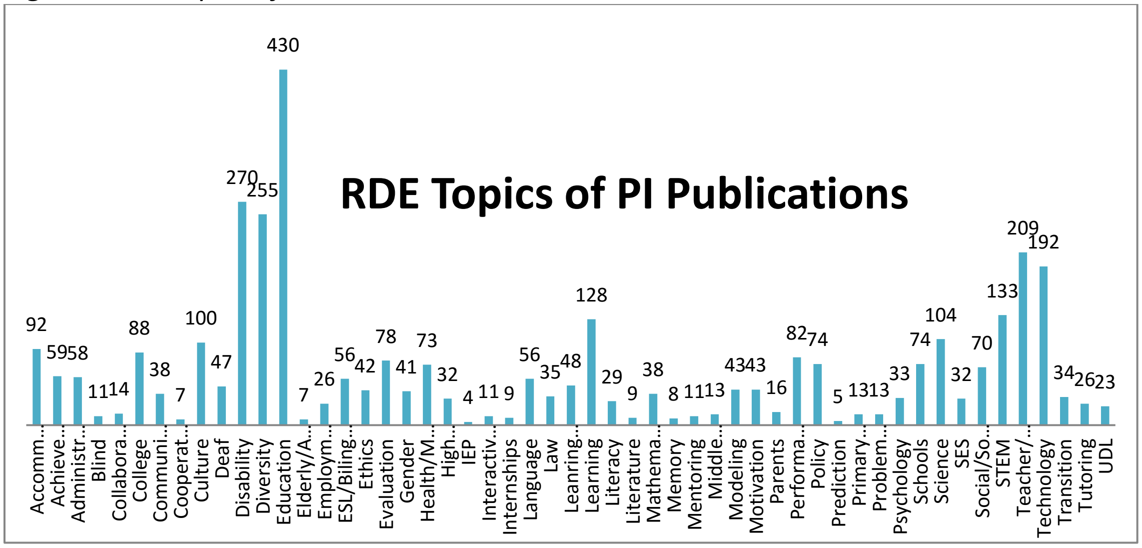


Figure 3.04. *Locations of the original PIs for RDE/PPD Alliance Awardees from 2001-2011. The raw map image is from Google (2015).*

A Decade of Publications

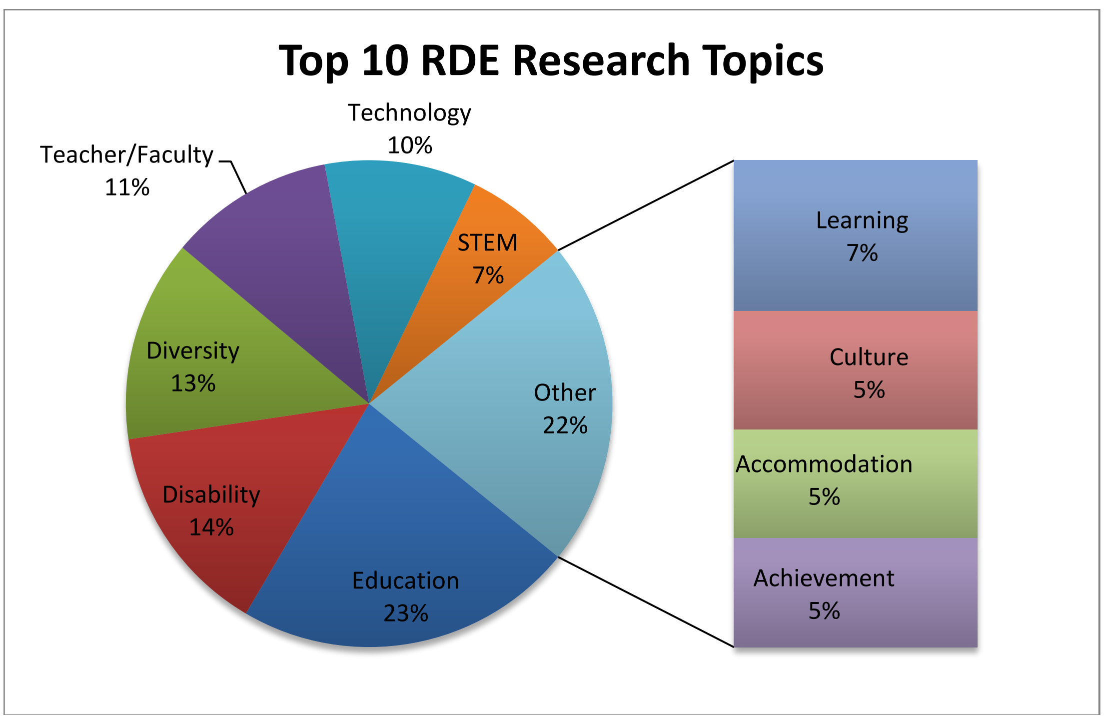
For the period that the RDE-SP team analyzed the RDE Program, the team identified publications produced by RDE PIs. The analysis searched for 97 PIs using Google Scholar, Scopus, and Web of Science looking specifically for publications to journals, magazines, and books. The search resulted in 673 direct publications across 117 NSF RDE funded projects. We conducted a topic analysis of the citations to understand the topics of the publications; this shows project influence in various fields of study with particular focus on STEM, STEM education, and disabilities. During this analysis, 52 primary topics were identified (Graph 3.05). A single article often had several topics addressed, thus the entries resulted in more than 673 topical entries. The top 10 topics were education, disability, teacher/faculty, technology, STEM, learning, culture, accommodation, and achievement (Figure 3.06).

Figure 3.05. *Topics of PI Publications.*



Specific topics such as blind (11), deaf (47), and gender (41) were also somewhat common themes. A bar graph below illustrates the frequency of entries with all the topics identified (Figure 3.05). The inherent problem with this analysis is that if the PIs did not address primary topics within the title of a specific publication, then this analysis would not have recorded the particular topic for that publication.

Figure 3.06. *Top 10 RDE Publication Topics.*



Teacher/Faculty represents information aimed at professional development. Technology was separated from STEM as most entries were geared at producing a specific product.

Publications & Presentations Reported to NSF

The purpose of this section of Chapter 3 is to catalogue what was reported to NSF as a direct result of the NSF PPD/RDE funding based on award. For a comprehensive analysis of the publications of NSF RDE PIs during the decade in question (Chapter 4), the citation analysis study searched for publications by PIs was done using data banks such as Scopus (2015), Google Scholar (2015), and Web of Science (Reuters, 2015). Thus, the resulting list of publications by RDE PIs may have been the result of NSF RDE/PPD funded research, prior research, or research funded from other sources. Therefore, in addition to the citation analysis, which was conducted for the 2001-2012 period, a review of the publications and presentations as reported to NSF (that is, placed on the NSF project award webpage) for each of the 117 RDE awards was conducted (NSF, n.d.). These were reported by PIs rather than identified through typical search processes, and therefore may or may not be part of the listing for the citation analysis study. In addition, this listing was gathered in 2015 and in some instances undoubtedly had more recent additions that were identified in the 2001-2011 citation analysis study.

Each funded project was researched using the NSF website. Performing an NSF simple award search of current and expired awards by the seven-digit award number resulted in an extensive list of reported publications and presentations by the funded NSF RDE/PPD 2001-2011 projects. Documentation of all publications and presentations has been taken without the restrictions posed by the citation analysis team.

During the award search it was found that 44 of the 117 funded projects had no publications or presentations recorded on their award page (Table 3.01). This may be due to PIs still working on publication materials; materials had been reported to NSF but are delayed for posting; or the PIs not yet having reported to NSF of published materials. There were a total of 452 ‘unique’ publications or presentations. Of these unique publications and presentations, 11 were reported under two different awards, and eight were reported under three different awards (Table 3.02). Publications were grouped into 10 groups based on type; these groups were: blog, book, form, information, journal, media, presentation, student, video, and unknown (Table 3.03). These types were defined as follows. Blogs were web postings in a non-official format that were on personal sites. Items registered as books ranged from a chapter within a book or encyclopedia to an entire book. Forms were publications for internal use within an institute or agency. Information includes pamphlets, staff training documents, website information, outreach materials, etc. Journals include peer reviewed and non-peer reviewed publications. Media entries were those made in newspaper, newsletter, or live news reports. Presentations ranged from conference presentations to staff and NSF presentations, and include posters, courses or speeches. Student entries were specifically for thesis or dissertations. The single video entry was a set of six informational videos produced for staff trainings. The unknown category contains reported items had insufficient information and were not found during database searches with enough information given to determine the type of publication or presentation the entry fell under. Table 14 provides an overview of the associated reported publications per category/type. The full list of publications and presentations in all categories is in Appendix B.

Table 3.01. *NSF RDE/PPD Funded Awards that have no reported publications or presentations.*

Total	Award #				Publication or Presentation
44	0004326	0333381	0533251	0928340	**None reported to NSF**
	0090070	0333396	0630274	0928356	
	0095392	0435582	0726252	0929079	
	0095948	0435627	0726424	0929409	
	0095994	0435631	0734078	0963626	
	0099125	0435640	0830408	1032033	
	0099216	0435658	0833392	1032075	
	0099230	0435679	0833608	1128948	
	0227992	0533182	0833969	1138801	
	0228116	0533185	0834178	1144046	
	0228133	0533212	0928074	1145541	

Table 3.02. *Publications and Presentations that were reported in multiple projects.*

Reported	Award #		Publication or Presentation
2	929268	929248	(2010). National Science Foundation Officials Visiting Local STEM Faculty and Students. The Wire Eagle.
	929248	929268	(2010). TV News Interview with Dr. Linda Thurston, NSF RDE Program Officer. NBC WLTZ 38 News, February 22, 2010.
	929268	929248	(2011). $2,000 - $3,500 Per Year Scholarship Opportunity for Undergraduate and Graduate Students. AASD-STEM Bridges Application Form.
	940201	725917	Beal, C and Shaw, E (2008). Working Memory and Math Problem Solving by Blind Middle and High School Students: Implications for Universal Access. Proceedings of Society for Information Technology and Teacher Education 2008.
	833504	929006	Burgstahler, S (editor) (2011). From the Special Issue Editor. Journal of Postsecondary Education and Disability (Vol 24, No 4, pp 265).
	929006	833504	Burgstahler, S and Comden, D (2011). Computer and Cell Phone Access for Individuals with Mobility Impairments: State of the Art. Journal of Neurorehabilitation (Vol 28, No 3, pp 183).
	833504	227995	Burgstahler, S, Anderson, A, and Lewis, K (2008). Universally Designed IT: Experiences of One University. Design for All Institute of India (Vol 3, No 12, pp 143).
	929248	929268	Chidume, C, Abebe, A, Dunn, C, Jenda, O, Marghitu, D, Pettis, C, Qazi, M, Ray, G, and White, M (2011). Alabama Alliance for Students with Disabilities in Science, Technology, Engineering, and Mathematics (AASD-STEM). Alabama Transition Conference, Opelika, AL, March 2011.
	929248	929268	McCullough, B, Jenda, O, and Qazi, M (2012). Using an Alliance Approach to Increase the Retention of Students with Disabilities in STEM. 2012 Pacific Rim Conference on Disability and Diversity, Honolulu, Hawaii, March 2012.
	834177	965444	Shifrer, D, Muller, C, and Callahan, R (2010). Disproportionality: A Sociological Perspective of the Identification of Students with a Learning Disability. In Barnartt, S and Altman, B (2010). Research in Social Science and Disabilities Series (Volume 5). Emerald Group Publishing: Bingley, UK.

Reported	Award #		Publication or Presentation
	833561	833644	Wheatly, M, Flach, J, Shingledecker, C, and Golshani, F (2010). Delivering on the Promise of Plato's Academy: Educational Accessibility for the 21st Century. Journal of Disability and Rehabilitation: Assistive Technology (Vol 5, pp 79).

Reported	Award #			Publication or Presentation
3	929276	929268	929248	(2009). $3 Million Grant for Students with Disabilities Majoring in Biology, Physical Science, and Mathematics. AUMnibus (16 November 2009).
	929276	929268	929248	(2010). Alabama Alliance for Students with Disabilities in Science, Technology, Engineering, and Mathematics (AASD-STEM). AASD-STEM Bridge Application Form 2009-2010.
	929276	929248	929268	(2011). Alabama Alliance for Students with Disabilities in STEM Minigrants Research in Disabilities Education Program. Minigrant Application Form 2011-2012.
	929276	929248	929268	Chidume, C, Abebe, A, Dunn, C, Jenda, O, Marghitu, D, Pettis, C, Qazi, M, Ray, G, and White, M (2010). Alabama Alliance for Students with Disabilities in Science, Technology, Engineering, and Mathematics (AASD-STEM). Annual NSF 2010 Joint Annual Meeting, Washington, DC.
	929276	929248	929268	Chidume, C, Abebe, A, Dunn, C, Jenda, O, Marghitu, D, Pettis, C, Qazi, M, Ray, G, and White, M (2010). Mentoring Students with Disabilities in STEM Subjects. 2010 Alabama Transition Conference, Auburn, AL, March 2010.
	929276	929248	929268	Gaines, C (2009). Grant Provides Funds to Students with Disabilities. The Auburn Plainsman, October 22, 2009, pp A3.
	929006	833504	833561	Leake, D, Burgstahler, S, and Izzo, M (2011). Promoting Transition Success for Culturally and Linguistically Diverse Students with Disabilities: The Value of

Reported	Award #			Publication or Presentation
				Mentoring. Creative Education (Vol 2, No 2, pp 121).
	929276	929248	929268	Nettles, A (2009). Grant to Help Disabled Students. Montgomery Advertiser, October 16, 2009, pp 2A, 8A.

Table 3.03. *Categories for publication types and the number of projects.*

Publication Category	Number Reported
Blog	2
Book	53
Form	7
Information	60
Journal	104**
Media	45
Presentation	171
Student (thesis & dissertation)	7
Video	1
Unknown	2

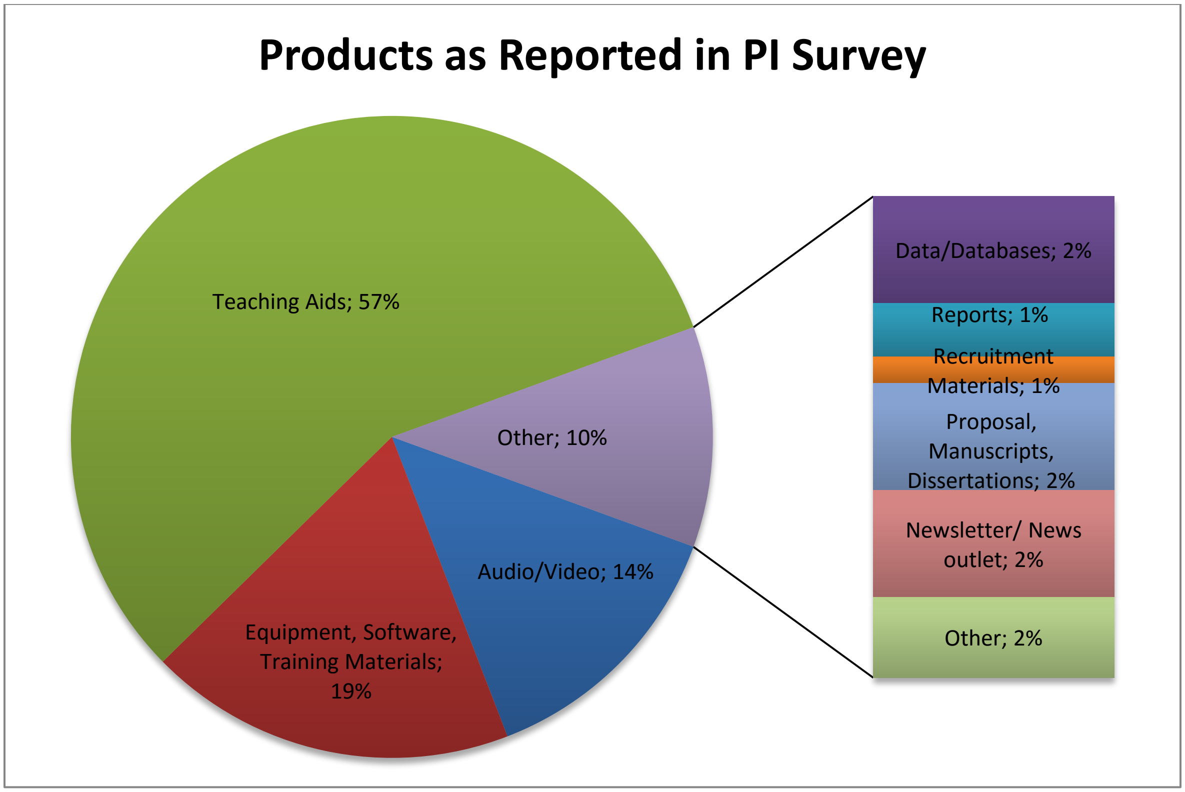
** 3 of these were published outside of the citation analysis timeframe scope

Products Produced by RDE Projects

Using the Principal Investigator Survey responses (Chapter 5) an analysis was completed to identify types of products that were developed as a result of RDE funding and reported by the PIs. These product types were further analyzed based on alliance and non-alliance reporting. It should be noted that the PI survey was sent to 87 PIs, with a 67% response rate. Thus we assume that either the non-responders had no products to report or that they chose not to respond to the survey but had many products. Therefore, we cannot state that these are all the products of RDE awards during the period of the study.

As part of the PI survey, PI's were asked to report products that had been developed as part of their RDE award. Information collected was then coded based on whether the PI was a member of an alliance award or was funded under a non-alliance award. Only 18 PI's commented on this section for the PI Survey, so applicability and the actual representation of products is unclear. What was reported was a net of 162 products. These products were coded by type. Figure 3.07 below illustrates the relative percent of the product types produced overall by the reporting PIs. The primary type of product produced was teaching aids; 92 teaching aids were created, accounting for 57% of the 162 products. The next two most frequently reported product types were Equipment, Software, and Training Materials (30) for 19% and Audio/Video (22) for 14% of the 162 products. The remaining 10% of products include Data/Databases (4), Reports (2), Recruitment Materials (1), Proposal, Manuscripts, Dissertations (4), Newsletter/News Outlet (4), and Other (3).

Figure 3.07. *Products as Reported in PI Survey. Data represented by 162 products from 18 awards.*



The non-Alliance PIs (12 awards) reported covering a total of 28 awarded projects with 132 products produced. The Alliance PIs (6 awards) reported covering a total of 15 awarded projects with 30 products produced. Figure 3.12 (above) illustrates the total reported products however, Figure 3.13 and Figure 3.14 (below) represent the relative percentages and differences between the Alliance and non-Alliance foci. Essentially the non-Alliance PIs focused more on generating teaching aids (66%), instrumentation (11%), and software (11%), whereas the Alliance PIs focused more on generating Audio/Video (37%), teaching aids (17%), and newsletters (13%).

Figure 3.08. *Products as Reported by non-Alliance PIs. Data represents 12 awards and 132 products.*

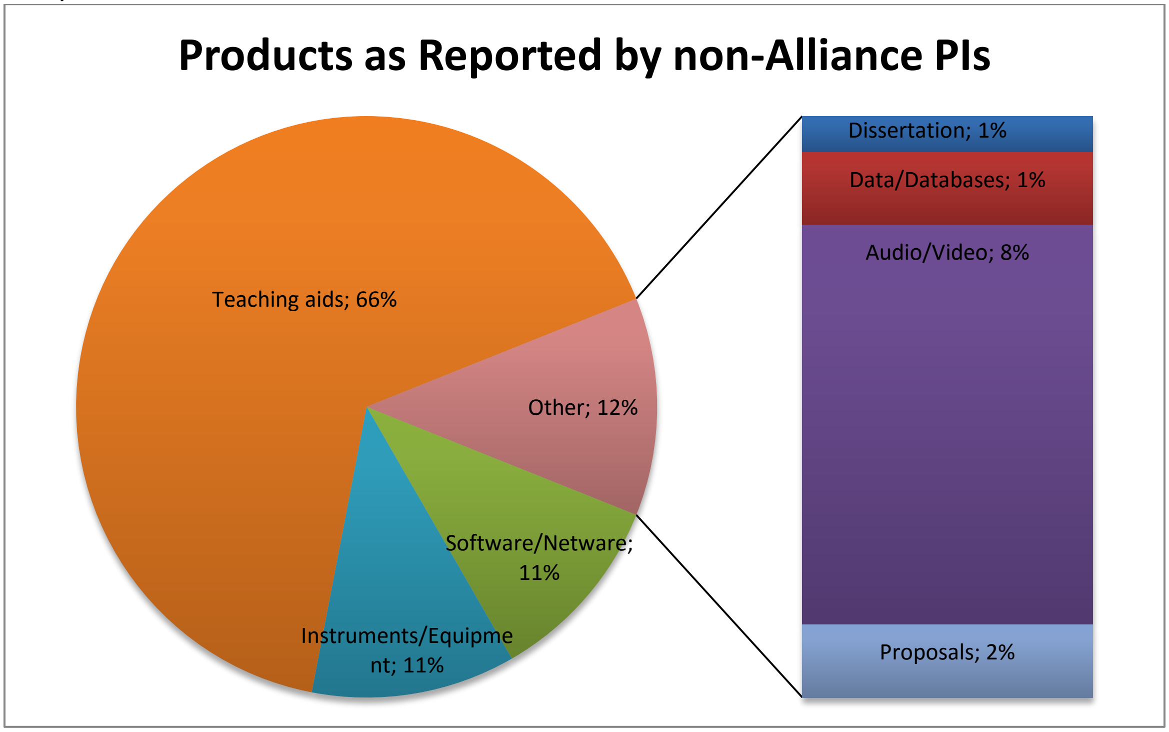
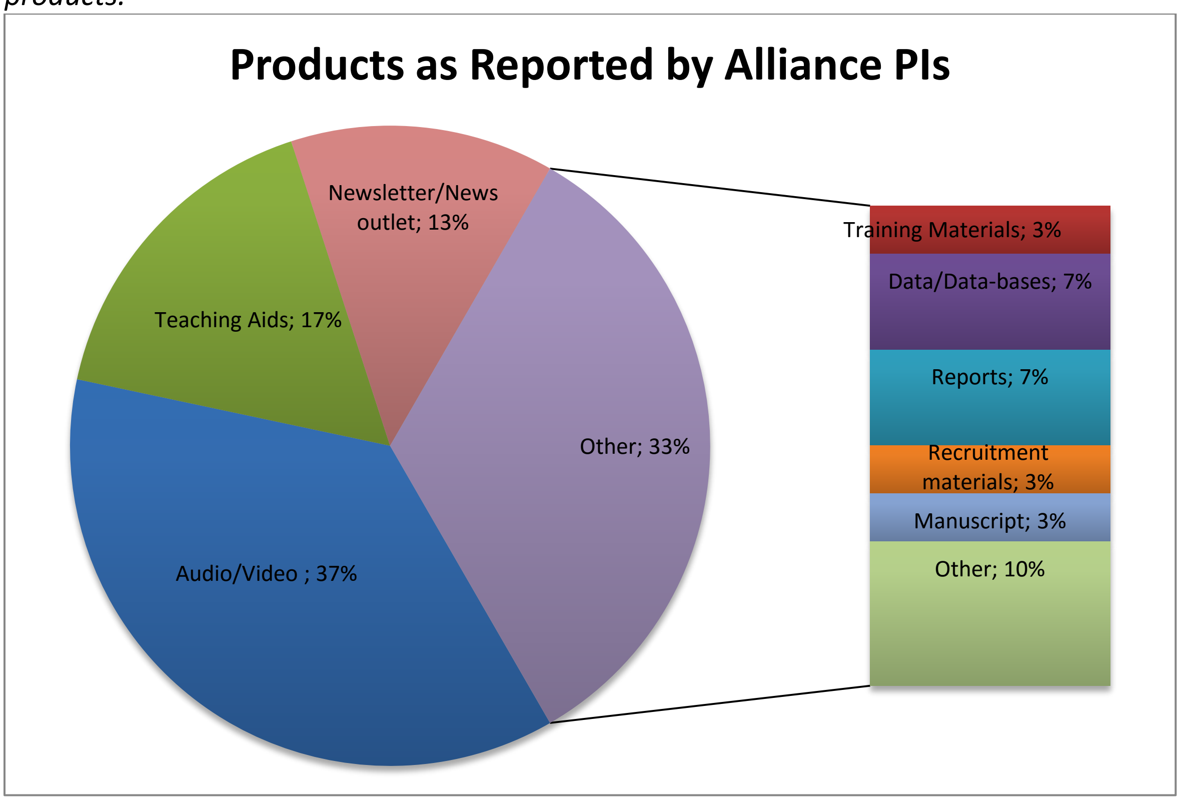


Figure 3.09. *Products as Reported by Alliance PIs. Data represents 6 awards and 30 products.*



PI Follow Up: Activity 2013 to 2015 (April)

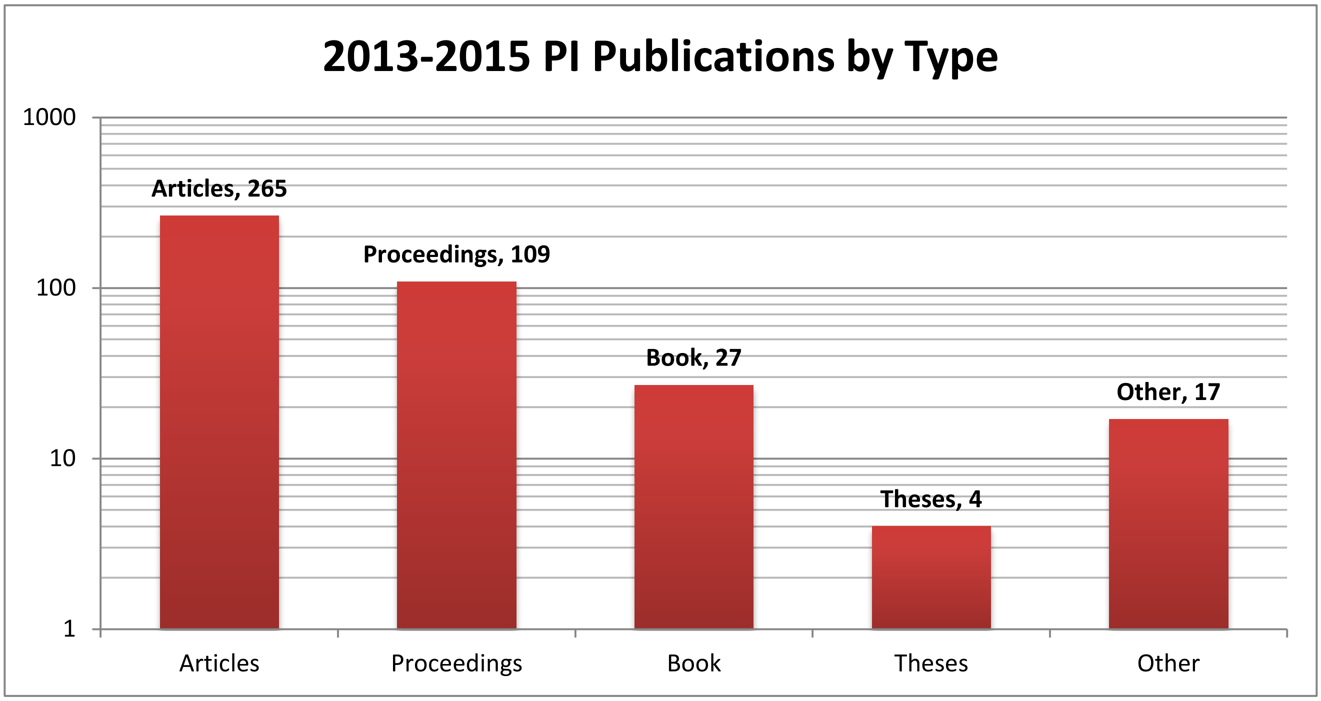
To assess publications after the 2012 ending period for this study (covered by the citation analysis team), researchers conducted a search for RDE PI publications between 2013 and 2015 (April). These publications were analyzed by type and topic. Then the post-decade data were compared to the citation study data to identify any shift in research focus in the last two years by PIs of 2001 – 2011 funded projects.

The citation analysis searched for publications by PI from 2001-2012 using the following data banks: Scopus (2015), Google Scholar (2015), and Web of Science (Reuters, 2015). The team sought to duplicate this method to look at the work since the 2012 cut-off from the citation analysis in order to understand PI activity since the RDE 2001-2011 funding. This search expanded the publication criterion to illustrate other activities in which the PIs have participated. The search categorized publications into five types: articles, conferences, books, theses, and other. All the articles were from peer-reviewed journals. The items under proceedings included conference presentations and posters. Items listed under books include encyclopedias, textbooks, and chapters in collaborative books. The theses category also includes undergraduate theses, master’s theses and doctoral dissertations. The other category includes items such as letters to editors and/or readers, editorial work, work as a reviewer, reports and patents.

Of the 97 PIs, 64 (70%) have published in the categories above that registered in Scopus, Google Scholar, and/or Web of Science. Thus 33 PIs showed no publications in this analysis. Of those that published, they were responsible for 422 publications during that two-year period. The most prevalent publications by type were peer-reviewed articles (265, 63%), then proceedings (109, 24%), books (27, 6%), other (17, 4%), and theses (4, 1%) (Figure 3.10). If comparing production of publications between the decade of the study and the two years following the study, the comparison would be between the 422 found for 2001-2011 and 292 in the following two years. This compares only journals and books, which were the focus of the search for the decade study.

It was of interest to note that for the 97 PIs, Google Scholar produced 343 hits for publications, and often there were duplicate hits with alternate citations for the same article though this data bank does include patents (Google, 2015). Scopus produced 246 hits; this data bank was found to have the most robust search engine for this type of search (Scopus, 2015). Web of Science produced 156 publication hits, which was found to have the easiest interface and was a close contender for search engine robustness (Reuters, 2015). No single data bank was found to be better than the others, as each data bank had some of the same publication hits along with those not in the other data banks. Thus, the researchers’ use of three search sources was justified.

Figure 3.10. *PI Publications by type 2013 to 2015 (April).*



The new search focused on all publications listed within the two-year time frame. These publications were then subjected to a topical analysis as previously performed and reported earlier in this chapter for the 2001-2011 publications. There were a total of 422 publications, which were then represented as seen below (Figure 3.11). STEM, technology, science, education, and social/sociology were the most common topics, in order.

When added to the data from the 2001-2011 publications' topical analysis, a shift in the overall topics can be noted (Figure 3.12). The primary objective of the comparison was to denote the shift of topic choice by PIs after the RDE program. This can be seen most when comparing the top 10 topics between the two periods of observation. The RDE period top 10 publications in order of greatest percent are: Education, Disability, Diversity, Teacher/Faculty, Technology, STEM, Learning, Culture, Accommodation, and Achievement. The post RDE period top 10 publications in order of greatest percent are: STEM, Technology, Education, Social/Sociology, Disability, Psychology, Culture, Evaluation, Health/Medicine, and Diversity (Figure 3.13).

Figure 3.11. *2013-2015 PI Publications – Topical Analysis.*

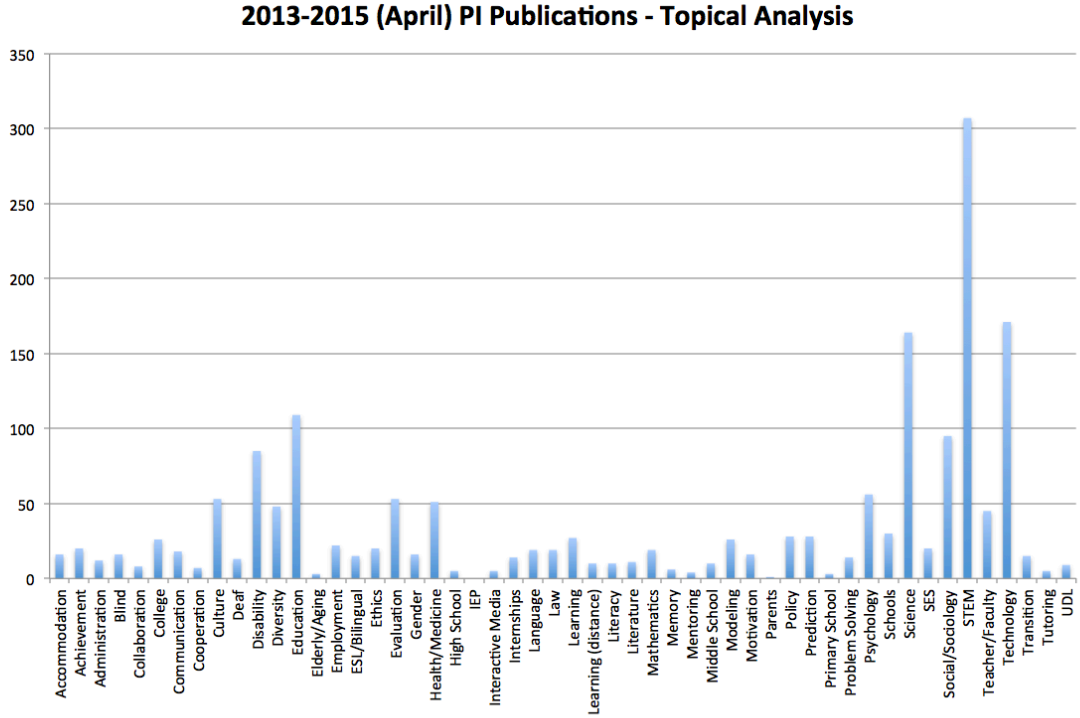


Figure 3.12. *RDE PI Topical Analysis Comparison. Note: there were 422 publications in the Post RDE period including proceedings, books, theses, articles, etc. as opposed to the 673 publications that were in the RDE 2001-2012 period which were only articles and books.*

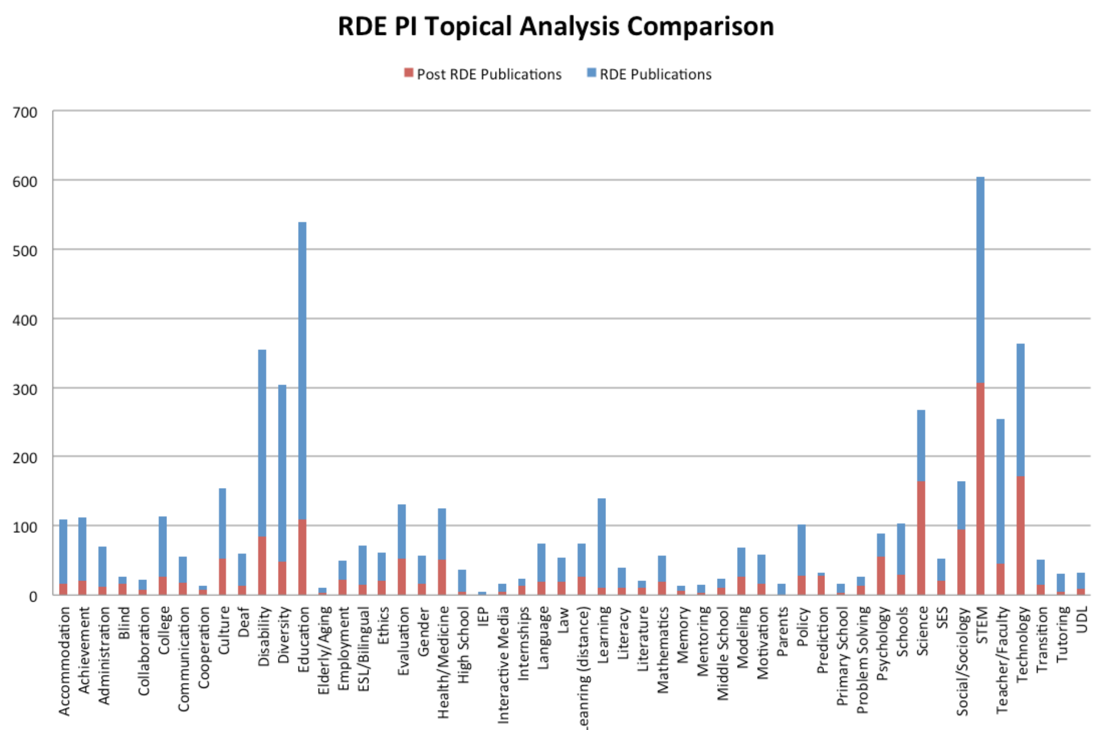
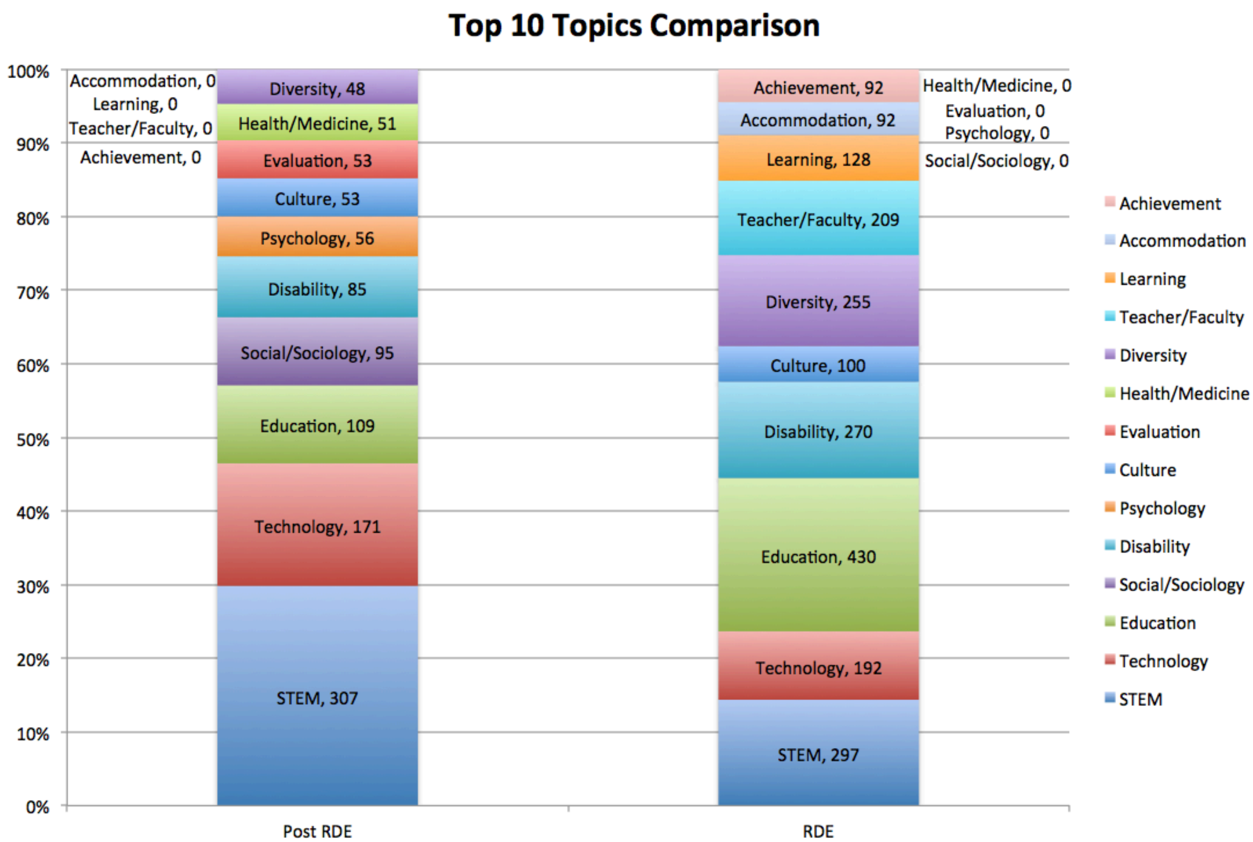


Figure 3.13. *Comparison of Top 10 Topics RDE v Post RDE. Percentage values have been normalized based on the number of hits within the top 10 topics of each group (RDE, Post-RDE).*



Summary

This chapter is an overview of the RDE portfolio from 2001 – 2011. We outlined the funded projects by type and geographic location, described the publications from these projects and the topics of the publications, and enumerating and categorizing the products produced by the funded projects. Three sources were used for this report of project publications: the publications from FY 2001-2011 projects collected for the citation analysis; the publications reported by PIs to NSF and published on the NSF award page for each of the 117 projects; and publications collected for the two post-decade years (2013-2015). During the decade, 117 projects were funded for a total of $58,695,385. The track that was allotted the highest funding was the Alliance for Students with Disabilities in STEM (formerly Regional Alliances for Students with Disabilities or RAD), at $35.5 million. Twenty Alliance awards were made and about 40 each for Demonstration, Enrichment and Dissemination, and Research. During the decade studied, these 117 projects produced 673 publications (journal articles and books) authored by 71 PIs. In the two years following the decade, RDI PIs produced 422 publications, 292 of which were journal articles and books. A topical analysis of the articles showed a shift in primary topics addressed between the decade and the plus two publications. PIs reported the development of 6,622 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, we believe this total is underestimated.

Chapter 4 – RDE Principal Investigator Survey and Findings

Background

The *Research in Disabilities Education Synthesis Project (RDE-SP)* at Kansas State University is an effort to examine and describe the RDE portfolio from 2001-2011, as well as to describe the contributions of the projects, as a collective, to the STEM education of students with disabilities (SWDs). Collectively, the project activities are designed to include investigating, synthesizing, and reporting the findings and contributions of the RDE program to the field.

As part of the RDE-SP synthesis efforts, 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 and to create a more complete picture of the RDE project portfolio. The survey sought to collect:

1) Project-specific background data that could be used to inform and update the RDE Synthesis Database, which was created to house internal information about the RDE projects funded from 2001 to 2011 to support the researchers' analyses;
2) General insights from PIs' RDE experiences regarding their PPD/RDE projects' contributions, challenges, and lessons learned that could be reported back to NSF and shared with the field through presentations and publications

The next sections of this chapter present the methodology and results of the survey data collection. The chapter concludes with a synthesis and summary of the survey data collection.

Methodology

Survey Development

Survey development for the 2001-2011 RDE PI Survey occurred during March and April 2013. During the fall 2012 semester, the RDE-SP team had conducted a data collection with the RDE PIs. That data collection involved contacting the 97 RDE PIs by email with a request that they share copies of their RDE reports, including annual performance reports (APRs), evaluation reports, and RDEWeb (PDMS) reports, for each of their PPD/RDE projects funded from 2001 to 2011. The email listed the projects of interest. The RDE-SP team received reports for 43 of the 97 RDE PIs; the reports corresponded to 51 of the 117 RDE projects. The RDE-SP project 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.

When developing the PI survey, the team sought to gain data that would answer the synthesis questions. 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 several multiple choice items, which allowed for a significant reduction in the number of qualitative items on the survey.

Survey Description

The final survey contained 27 unique items. See Appendix D for the survey and unique item responses. The first section contained six items that requested project-specific information. These items asked about the project's solicitation, funding track, disability focus, STEM focus, target audiences, and the institutions/organizations of the co-PIs. A PI received this set of items for each project funded through PPD/RDE during 2001-2011; they could receive this set of items up to three times (if they were PI on three projects). Each time, the name and award number of the project appeared at the top of the page to indicate the project about which they should respond to the items.

The remaining 21 survey items were organized in six sections and asked once of each PI. For these items, the survey instructed PIs to reflect on their experiences related to all their RDE projects from 2001-2011. The sections were:

- *Activities and Outputs* (4 items) – This section requested information about the types of organizations with which PIs collaborated, the types and numbers of products the projects produced, the types of contributions made to the knowledge base of working with SWDs, and the greatest achievement/accomplishment of the projects.
- *Outcomes and Impacts* (4 items) – This section asked about project impacts, challenges, unexpected experiences or outcomes, and primary lessons learned that would assist others conducting projects related to persons with disabilities.
- *Goals* (4 items) – This section asked the extent to which the projects achieved their project- specific goals and PPD/RDE program-level goals, and whether or not their project goals changed after they received funding. Those who indicated their goals had changed received two follow- up questions requesting the reasons for the change in goals and how the changes impacted their ability to achieve the project goals.
- *Evaluation and Dissemination* (2 items) – This section asked PIs to select the types of metrics used to evaluate their projects and the methods used to disseminate their project findings.
- *Suggestions/Best Practices* (2 items) – This section requested PIs share best practices/strategies they have identified for overcoming some common RDE obstacles and any additional comments they wanted captured in the synthesis

effort.

- *Demographics* (5 items) – This section collected data on the PI's gender, ethnicity, race, organization type, and disability status.

Survey Administration

The RDE-SP team pre-tested the survey using the online survey system to assure a successful administration. On May 3, 2013, the research team administered the online survey by email to 87 RDE PIs. The email invitation, addressed from RDE-SP PI Jan Middendorf, requested that the PIs respond to the survey by May 31st. Reminder emails were sent on May 9, 15, 21, 28, and 31 to PIs who had not yet responded. Upon discovering some PIs had submitted a blank survey, the RDE-SP team sent these PIs an email with a refreshed survey link and extended the survey deadline to June 7. This allowed one additional week for the submission of their project data, if they chose to do so.

Participants

The participant population for the survey consisted of 87 RDE PIs of projects funded between 2001 and 2011. The PI population for the RDE-SP project consists of 97 unique RDE PIs; 10 of these PIs were not included in the survey administration due to various circumstances. PIs were excluded if deceased, had retired or stepped down as PI and a successor could not be identified, had requested not to be contacted for RDE-SP data collections, or served as RDE-SP PI.

Analysis

The RDE-SP team conducted quantitative analyses on 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.

After reviewing the data, the research team disaggregated the responses into two groups: 1) Alliances and 2) Research and Dissemination. Based on the responses and scope of the projects, the Alliances are reported as a stand-alone group. Due to the similarity in responses from both the research and dissemination categories, the research team decided to collapse these into one group in order to streamline reporting. All results are presented in the report. The RDE-SP team also conducted qualitative analyses on the open-ended survey items by identifying themes in responses and counting the frequency with which each theme appeared. Those themes appear in the Results section below.

Results

Response Rate

Fifty-eight of 87 RDE PIs who were invited to participate in the survey submitted a response, for a 67% response rate.

Project-Specific Background Data

The first section of the survey requested project-specific data from the RDE PIs. Participants received a separate set of six items for each of the PPD/RDE projects they led between 2001-2011. This section presents these data, overall and by project type (Alliance vs. All Research & Dissemination Types). Of the 58 respondents, 44 PIs had led one project so received one set of items; fewer PIs responded about 2 projects (*n*=10) or 3 projects (*n*=4). Because an individual PI could have had an Alliance as well as another type of project, it is possible for an individual PI to be included in the respondent *n* for both the Alliance and the Research & Dissemination columns of the tables in this section. This occurred in two instances; thus, the Total column *n* (58) equals two less than the sum of the Alliance column *n* (11) and the Research & Dissemination column *n* (49).

Also note that because an individual PI could have had multiple Alliance projects or multiple other types of projects, it is possible for an individual PI to have multiple responses included within the same column in the tables in this section. This occurred in several instances, as is evident when comparing the number of respondents and the number of projects in a given column (i.e., for Alliance projects, there are 11 respondents and 13 projects; for Research & Dissemination projects, there are 49 respondents and 63 projects). This happened for two respondents in the Alliance column and 11 respondents in the Research & Dissemination column.

In this section, the percentages in the tables have been calculated based on the number of projects (rather than the number of respondents) in that column.

The first item in the set asked participants to indicate which solicitation they had responded to in order to receive their PPD/RDE award. They could select one of 13 options, which included the 10 PPD/RDE solicitations available during the timeframe of interest, “Unsolicited”, “Don’t Know”, and “Other” (for which they could write in details). Respondents most frequently selected “Don’t Know” (*n*=21, 28%). The solicitations most frequently selected were 09-508 (Proposal Deadline February 2009, February 2010) (*n*=16, 21%) and 08-527 (Proposal Deadline April 2008) (*n*=10, 13%), the final two solicitations of the decade.

Table 4.01. *Solicitation to Which PI Responded to Receive the Award*

Response Option	**Alliance (n=11)**	**R & D (n=49)**	**Total (n=58)**
00-69 (Proposal deadline Aug 2000)	--	1 (2%)	1 (1%)
01-67 (Proposal deadline May 2001)	--	1 (2%)	1 (1%)
02-025 (Proposal deadline May 2002)	1 (8%)	1 (2%)	2 (3%)
02-177 (Proposal deadline Apr 2003)	--	2 (3%)	2 (3%)
03-587 (Proposal deadline Apr 2004)	1 (8%)	2 (3%)	3 (4%)
04-610 (Proposal deadline Feb 2005	--	4 (6%)	4 (5%)
05-623 (Proposal deadline Jan 2006)	--	4 (6%)	4 (5%)
07-511 (Proposal deadline Feb 2007)	--	2 (3%)	2 (3%)
08-527 (Proposal deadline Apr 2008)	3 (23%)	7 (11%)	10 (13%)
09-508 (Proposal deadlines Feb 2009 & Feb 2010)	7 (54%)	9 (14%)	16 (21%)
Unsolicited	--	2 (3%)	2 (3%)
Don’t Know	--	21 (33%)	21 (28%)
Other (please specify)	1 (8%)	5 (8%)	6 (8%)
No Response	--	2 (3%)	2 (3%)
Total Projects	13 (100%)	63 (100%)	76 (100%)

Other responses: for Alliance - *supplemental funds*; for Research & Dissemination – *Don’t Recall*; *can’t remember*; *1-Nov*; *Feb-06*; and *May-08*.

The PIs selected the track in which their project had received funding, by selecting one of eight track options. The most frequently selected tracks were FRI (Focused-Research Initiatives) [solicitations 02- 025 to 08-527] (*n*=22, 29%) and DEI (Demonstration, Enrichment, and Information Dissemination) [solicitations 02-025 to 09-508] (*n*=18, 24%), each selected for approximately one-quarter of projects.

Table 4.02. *Track in Which Project Received Funding*

Response Option	Alliance (n=11)	R & D (n=49)	Total (n=58)
RAD (Solicitations 01-067 to 08-527)	7 (54%)	--	7 (9%)
DEI (Solicitations 02-025 to 09-508)	--	18 (29%)	18 (24%)
FRI (Solicitations 02-025 to 05-527)	--	22 (35%)	22 (29%)
Alliance (Solicitation 09-508)	6 (46%)	--	6 (8%)
Research (Solicitation 09-508)	--	12 (19%)	12 (16%)
DI (Solicitation 00-69)	--	3 (5%)	3 (4%)
ID (Solicitation 00-69)	--	--	--
CB (Solicitation 00-69)	--	1 (2%)	1 (1%)
No Response	--	--	--
Total Projects	13 (100%)	63 (100%)	76 (100%)

Percentages are based on total number of projects, not number of respondents.

Next, the respondents indicated the disability focus of their project by selecting all options that applied from 10 specific disability conditions and “Other” (for which they could specify details). The most frequently selected condition was Learning Disorder (*n*=39, 51%), which was the only condition selected for more than half of the projects. Also frequently selected were the conditions Deaf or Hard of Hearing (D/HoH) (*n*=35, 46%) and Blind or Visual Impairment (*n*=34, 45%). The number of conditions selected for individual projects ranged from 1 to 11 conditions, with an average selection of 3.5 (*SD*=3.9) overall; the median and mode were both 1 for the group of projects overall. When examined separately by project type, the average number of conditions selected for Alliance projects was 8.2 (*SD*=4.1) and for Research & Dissemination projects was 2.6 (*SD*=3.1).

Table 4.03. *Disability Focus of Project*

Response Option	Alliance (n=11)	R & D (n=49)	Total (n=58)
Acquired/ Traumatic Brain Injury	9 (69%)	9 (14%)	18 (24%)
Asperger's Syndrome/ Autism Spectrum Disorder	10 (77%)	10 (16%)	20 (26%)
Attention Deficit Disorder (ADD)/ Attention Deficit Hyperactivity Disorder (ADHD)	10 (77%)	16 (25%)	26 (34%)
Blind/ Visual Impairment	10 (77%)	24 (38%)	34 (45%)
Deaf/ Hard of Hearing	10 (77%)	25 (40%)	35 (46%)
Learning Disorder	10 (77%)	29 (46%)	39 (51%)
Physical Impairment/ Orthopedic/ Mobility Impairment	10 (77%)	14 (22%)	24 (32%)
Psychological/ Psychiatric Condition	10 (77%)	10 (16%)	20 (26%)
Speech Impairment	10 (77%)	7 (11%)	17 (22%)
Systemic Health/ Medical Condition	10 (77%)	8 (13%)	18 (24%)
Other (please specify)	7 (54%)	11 (18%)	18 (24%)
No Response	--	--	--
Total Projects	13 (100%)	63 (100%)	76 (100%)

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.
Percentages are based on total number of projects, not number of respondents.
Other responses: for *Alliance* – all types of disabilities; and American Indian Education; for *Research & Dissemination* – all types of disabilities; all children in Special Education, grades K-4; Developmental Disabilities; and Evaluation.

The survey also requested an indication of the STEM focus of the project and allowed PIs to select all options that applied from the four specific STEM foci and "Other" (for which they could specify details). The most frequently selected STEM focus was Science (*n*=61, 80%), which was selected for over three- quarters of the projects. The next most frequently selected STEM focus was Mathematics (n=50, 66%), which was selected for two-thirds of the projects. The number of foci selected for individual projects ranged from 1 to 5 foci, with an average selection of 2.5 (*SD*=1.5) overall; the median was 2 and the mode was 1 for the group of projects overall. When examined separately by project type, the average number of foci selected for Alliance projects was 3.8 (*SD*=1.3) and for Research & Dissemination projects was 2.3 (*SD*=1.4).

Table 4.04. *STEM Focus of Project*

Response Option	Alliance (n=11)	R & D (n=49)	Total (n=58)
Science	11 (85%)	50 (79%)	61 (80%)
Technology	11 (85%)	29 (46%)	40 (53%)
Engineering	11 (85%)	25 (40%)	36 (47%)
Mathematics	11 (85%)	39 (62%)	50 (66%)
Other (please specify)	5 (39%)	--	5 (7%)
No Response	--	--	--
Total Projects	13 (100%)	63 (100%)	76 (100%)

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.
Percentages are based on total number of projects, not number of respondents. Other responses: for *Alliance* – all; including social sciences as well; and Psychology.

Participants also indicated the target audience(s) of their project by selecting all options that applied from seven specific target audiences and "Other" (for which they could specify details). The most frequently selected target audiences were K-12 Students (*n*=44, 58%) and Higher Education Students (*n*=41, 54%), which were each selected for over half of the projects. The number of audiences selected for individual projects ranged from 1 to 8 audiences, with an average selection of 2.5 (*SD*=2.0) overall; the median was 2 and the mode was 1 for the group of projects overall. When examined separately by project type, the average number of audiences selected for Alliance projects was 3.8 (*SD*=2.5) and for Research & Dissemination projects was 2.2 (*SD*=1.7).

Table 4.05. *Target Audience(s) of Project*

Response Option	Alliance (n=11)	R & D (n=49)	Total (n=58)
K-12	8 (62%)	36 (57%)	44 (58%)
K-12 Faculty/Staff	5 (39%)	23 (37%)	28 (37%)
Higher Education Students	12 (92%)	29 (46%)	41 (54%)
Parents	4 (41%)	9 (14%)	13 (17%)
Community Members	4 (41%)	9 (14%)	13 (17%)
STEM Professionals	5 (39%)	11 (18%)	16 (21%)
Other (please specify)	--	--	--
Total Projects	13 (100%)	63 (100%)	76 (100%)

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.
Percentages are based on total number of projects, not number of respondents.

Other responses: for *Alliance* – HS Students Grades 11-12 only; for *Research & Dissemination* – K-2nd grade; and Publishers, Accessible Instructional materials providers.

The final item in this section listed the project's co-PI(s) and requested an indication of the institution/organization of the co-PI(s) at the time of the project. Co-PI information was provided for a total of 56 projects, including 10 Alliance projects and 46 Research & Dissemination projects.

Across-Project Data

The remaining six sections of the survey asked participants to reflect on their overall experiences related to their funded PPD/RDE project(s). The survey asked these questions only once (rather than for each project separately). The remaining sections were: Activities and Outputs, Outcomes and Impacts, Goals, Evaluation and Dissemination, Suggestions/Best Practices, and Demographics. This section of the report presents these data. Each PI was assigned to one project type category, based on their previous responses to the project-specific questions. As indicated above, two respondents had served as a PI for both Alliance and Research & Dissemination projects. These two PIs were assigned to the Alliance category, for the purposes of the remaining tables. In this section, the percentages in the tables have been calculated based on the number of respondents in that column.

<u>Activities and Outputs</u>. The PIs could select all the types of organizations they primarily collaborated with during their projects from eight specific organization types and "Other" (for which they could specify details). The most frequently selected organization types were 4-year colleges or universities (*n*=33, 57%) and secondary schools (*n*=32, 55%), each selected by over half of respondents. The number of organization types selected ranged from 1 to 9 organizations types, with an average selection of 2.5 (*SD*=2.0) overall; the median was 2 and the mode was 1 for the group. When examined separately by project type, the average number of organization types selected for Alliance projects was 4.5 (*SD*=2.4) and for Research & Dissemination projects was 2.0 (*SD*=1.6).

Table 4.06. *Types of Organizations the Projects Primarily Collaborated With*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Elementary Schools	1 (9%)	9 (19%)	10 (17%)
Secondary Schools	8 (73%)	24 (51%)	32 (55%)
2yr Technical or Community Colleges	10 (91%)	13 (28%)	23 (40%)
4yr Colleges or Universities	11 (100%)	22 (47%)	33 (57%)
Businesses	5 (46%)	3 (6%)	8 (14%)
Community Organizations	4 (36%)	4 (9%)	8 (14%)
Non-Profit Organizations	5 (46%)	9 (19%)	14 (24%)
Research Organizations	3 (27%)	6 (13%)	9 (16%)
Other (please specify)	3 (27%)	3 (6%)	6 (10%)
No Response	--	1 (2%)	1 (2%)

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.

Other responses: for *Alliance* – STEM employers, and Tribal Colleges; for *Research & Dissemination* – AAAS, Professional organizations, and School for the Deaf.

The next item asked participants to indicate the types of products their projects produced by selecting all options that applied from 13 specific product types and "Other" (for which they could specify details). The most frequently selected product types were presentation (n=45, 78%), publication (n=36, 62%), and report (n=31, 53%). The number of product types selected ranged from 0 to 11 product types, with an average selection of 4.8 (*SD*=2.7) overall; the median was 4 and the mode was 3 for the group. When examined separately by project type, the average number of product types selected for Alliance projects was 7.1 (*SD*=2.8) and for Research & Dissemination projects was 4.3 (*SD*=2.3).

Table 4.07. *Types of Products the Projects Produced*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Audio/Video Product	8 (46%)	17 (36%)	22 (38%)
Data/Database	10 (91%)	13 (28%)	23 (40%)
Instrument/Equipment Development	4 (36%)	10 (21%)	14 (24%)
Invention	1 (9%)	4 (9%)	5 (9%)
Newsletter/News Outlet	7 (64%)	7 (15%)	14 (24%)
Presentation	11 (100%)	34 (72%)	45 (78%)
Publication	8 (73%)	28 (60%)	36 (62%)
Recruitment Materials	9 (82%)	9 (19%)	18 (31%)
Report	9 (82%)	22 (47%)	31 (52%)
Software	2 (18%)	14 (30%)	16 (28%)
Teaching Aid	4 (36%)	10 (21%)	14 (24%)
Thesis/Dissertation	1 (9%)	6 (13%)	7 (12%)
Training Materials	7 (64%)	13 (28%)	20 (35%)
Other (please specify)	--	5 (11%)	5 (9%)
No Response	--	2 (4%)	2 (3%)

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.

Other responses: for *Alliance* – See project reports for quantities; for *Research & Dissemination* – future proposal to RDE; I am completing final report and expect to produce many of the products listed above; Developed methodology for analyzing high school transcript, also created a website, and 3 Highlights; Web-based seminar; and Prototype software program.

The survey also provided participants with an opportunity to report the quantity of each product type produced through their projects. Participants were instructed to provide their best guess in the form of a number, rather than entering a range or text. The numbers provided for each product type were summed. By far, the type of product produced most frequently by the RDE projects were training materials (n=5,114). The RDE projects also produced many presentations (n=508) and instruments/equipment (n=332).

Table 4.08. *Numbers of Products the Projects Produced*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Audio/Video Product	54	46	100
Data/Database	41	35	76
Instrument/Equipment Development	26	306	332
Invention	5	4	9
Newsletter/News Outlet	49	8	57
Presentation	298	210	508
Publication	62	76	138
Recruitment Materials	43	21	64
Report	101	45	146
Software	2	25	27
Teaching Aid	15	21	36
Thesis/Dissertation	2	5	7
Training Materials	96	5018	5114
Other (please specify)	--	8	8
Total	794	5828	6622

Respondents also selected all options that applied from eight specific types of contributions their projects had to the knowledge base of working with SWDs and "Other" (for which they could specify details). The most frequently selected contribution type was: identified teaching strategies that are effective for SWDs (n=47, 81%). Also selected by over half of respondents were identified strengths/difficulties related to working with students with a specific disability (n=33, 57%) and developed a model for working with SWDs to increase their success in STEM (n=31, 53%). The number of contribution types selected ranged from 1 to 9 types, with an average selection of 3.7 (SD=2.2) overall; the median was 3 and the mode was 2 for the group. When examined separately by project type, the average number of contribution types selected for Alliance projects was 6.3 (SD=2.7) and for Research & Dissemination projects was 3.1 (SD=1.5).

Table 4.09. *Types of Contributions the Projects had to the Knowledge Base of Working with Students with Disabilities*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Identified teaching strategies that are effective for SWD	8 (73%)	39 (83%)	47 (81%)
Identified strengths/difficulties related to working with students with specific disability	8 (73%)	25 (53%)	33 (57%)
Developed a model for working with SWD to increase their success in STEM	10 (91%)	21 (45%)	31 (53%)
Identified factors that increase SWD interest in pursuing STEM	8 (73%)	18 (38%)	26 (45%)
Identified factors that increase SWD success in STEM	9 (82%)	21 (45%)	30 (52%)
Identified factors that assist with transitions of SWD from high school to college	8 (73%)	10 (21%)	18 (31%)
Identified factors that assist with transitions of SWD from college to graduate school	8 (73%)	2 (4%)	10 (17%)
Identified factors that assist with transitions of SWD from college to the work force	8 (73%)	5 (11%)	13 (22%)
Other: (please specify)	2 (18%)	6 (13%)	8 (14%)
No Response	--	--	--

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.
Other responses: for *Alliance* – Strategies to work successfully with American Indian College students; for *Research & Dissemination* – Identified STEM professional with disabilities; how to evaluate these programs; project is not compete yet; Identified software development strategies for Deaf and Hard of Hearing students; Strategies for both science and special education teachers; and Developed technology to enhance access to STEM programs.

The section concluded with an open-ended survey item that asked participants what they consider to be the one greatest achievement or significant accomplishment of their RDE projects. The survey received 52 responses to this item, and the comments were coded for themes. Both groups supported the theme of increased support for SWDs (*n*=21). Another common theme across project types was that of increased collaboration and networking; while the responses from participants in the Alliance group (*n*=2) were focused on collaboration and networking among SWDs, the Research & Dissemination group's responses (*n*=6) noted an increase in collaboration/networking among students as well as STEM educators. Additionally, one participant from each project type (*n*=2) reported that their project(s) had increased support for disabled veterans. Other frequently cited achievements or accomplishments of the project(s) in the Research & Dissemination group include product(s) used to improve teaching and learning (*n*=12), increased information and model sharing (*n*=11), and knowledge gained of SWD (*n*=11). Table 10 presents all themes, and Appendix B contains all verbatim responses.

Table 4.10. *Greatest Achievement or Significant Accomplishment of Projects*

Alliance (n=11)	**Frequency**	**Percent**
Increased support for SWDs in STEM	5	45
Increased collaboration and networking for SWDs	2	18
Increased support for disabled veterans in STEM	1	9
Introduced colleges to Universal Design for Learning	1	9
Tracked participants longitudinally	1	9
Promoted awareness of SWD in STEM	1	9
No Response	1	9

R&D (n=47)	**Frequency**	**Percent**
Increased support for SWD	16	34
Used product(s) to improve teaching and learning	12	26
Increased information and model sharing	11	23
Knowledge gained of SWD	11	23
Increased collaboration and networking for students and STEM educators	6	13
Promoted awareness of challenges, solutions, and resources	4	9
Still in progress	3	6
Identified disabled veteran support strategies	1	2
Increased SWDs STEM success	1	2
No Response	4	9

Respondent comments may have been categorized into more than one theme, so frequencies may sum to more than the total number of participants and percentages may sum to more than 100%.

<u>Outcomes and Impacts</u>. Participants indicated the types of impacts their projects had on their target audiences by selecting all options that applied from 11 specific impacts and "Other" (for which they could specify details). The most frequently selected impacts were increased skills for working with students with disabilities (*n*=34, 59%) and increased confidence related to STEM (*n*=30, 52%), each selected by over half of respondents.

Table 4.11. *Types of Impacts the Projects Had on Target Audiences*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Increased interest in STEM fields/careers	9 (82%)	15 (32%)	24 (41%)
Increased knowledge of STEM fields/careers	9 (82%)	13 (28%)	22 (38%)
Increased awareness of services/opportunities available for SWD	8 (73%)	15 (32%)	23 (40%)
Increased confidence related to STEM	10 (91%)	20 (43%)	30 (52%)
Increased motivation to achieve in STEM	10 (91%)	17 (36%)	27 (47%)
Increased preparedness for college or work force	8 (73%)	15 (32%)	23 (40%)
Increased skills for working with SWD	8 (73%)	26 (55%)	34 (59%)
Increased connections/expanded networks for SWD	9 (82%)	14 (30%)	23 (40%)
Increased number of SWD that enter higher education	7 (64%)	6 (13%)	13 (22%)
Increased number of SWD that enter the STEM work force	8 (73%)	6 (13%)	14 (24%)
Increased STEM competencies for SWD (GPA, study skills)	9 (82%)	14 (30%)	23 (40%)
Other (please specify)	2 (18%)	8 (17%)	10 (17%)
No Response	--	1 (2%)	1 (2%)

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.

Other responses: for *Alliance* – Increase skills for working with American Indian students; for *Research & Dissemination* – Updated Database; Trained people on how to create accessible materials, showed what a mainstream website with access features can do; increased evaluation knowledge base; project is not complete yet; Increased awareness of effective instructional materials for STEM instruction; Increased ability to read and understand reading materials related to science content; Increased resources in math and science; and Increased knowledge base about learning disabilities in STEM.

The PIs also identified the types of challenges they faced within their projects, by selecting all options that applied from 12 specific challenge types and “Other” (for which they could specify details). Each challenge was selected by less than half of respondents. The most frequently selected challenges were evaluation-related (*n*=24, 41%), administrative/staffing (*n*=21, 36%), and recruiting participants (*n*=20, 35%), each selected by over one-third of respondents.

Table 4.12. *Types of Challenges Faced Within the Projects*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Administrative/staffing	5 (46%)	16 (34%)	21 (36%)
Challenges related to participants' disabilities	1 (9%)	7 (15%)	8 (14%)
Coordination/collaboration between sites	2 (18%)	11 (23%)	13 (22%)
Evaluation-related (collecting data, etc.)	7 (64%)	17 (36%)	24 (41%)
Finding collaborators/ partners	--	10 (21%)	10 (17%)
Delayed funding of award	1 (9%)	--	1 (2%)
Insufficient funding for project	3 (27%)	8 (17%)	11 (19%)
Identifying potential participants (e.g., they don't report disability status)	2 (18%)	9 (19%)	11 (19%)
Recruiting participants	4 (36%)	16 (34%)	20 (35%)
Reporting to NSF	6 (55%)	5 (11%)	11 (19%)
Time	4 (36%)	9 (19%)	13 (22%)
Tracking participants	4 (36%)	9 (19%)	13 (22%)
Other (please specify)	1 (9%)	12 (26%)	13 (22%)
No Response	--	--	--

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.

Other responses: for *Alliance* – NSF Staff; for *Research & Dissemination* – Confidentiality Matters; None; inability to continue with project, no future funding; creating content; Getting results from busy software programmers; PDMS Reporting; technical issues; Equipment failure; project is not complete yet; difficulty with NSF program administrator; Getting children's data from school; and Institutional resistance.

This next survey item asked participants, in an open-ended format, to describe any unexpected experiences or outcomes from their projects. Participants submitted 33 comments, and these comments were coded for themes. The only theme appearing among both the Alliance and Research & Dissemination Project PIs was related to the ability of faculty to adapt to working with SWDs (*n*=3). Two Alliance PIs reported having greater participation from community colleges than expected, and the responses of multiple PIs in the Research & Dissemination group supported themes of: funding-related issues (*n*=3), the learning curve when using different types of software/technology (*n*=2), teachers' lack of cooperation (*n*=2), and the wide applicability of products developed (*n*=2). The Research & Dissemination group PIs also reported having had *no* unexpected experiences or outcomes (*n*=4).

Table 4.13. Unexpected Experiences or Outcomes

Alliance (n=11)	Frequency	Percent
Greater participation from community colleges	2	18
Ability of faculty to adapt to working with SWD	1	9
The learning curve for understanding veteran's systems and post-combat challenges	1	9
Formation of student organizations for SWD	1	9
Increase in STEM participation, retention and graduation rates	1	9
Administrative challenges with communication	1	9
Still in progress	1	9
No Response	3	27

R&D (n=47)	Frequency	Percent
None	4	9
Funding-related issues	3	6
Ability/interest of faculty to adapt to working with SWD	2	4
Learning curve when using different types of software/technology	2	4
Teachers' lack of cooperation	2	4
Wide applicability of products developed	2	4
Community college eliminated special training project for persons with disabilities	1	2
Project went very well	1	2
Difficulty motivating students	1	2
External evaluation process was costly and unnecessary	1	2
Faced discrimination as researchers	1	2
Limited means of communication	1	2
Low number of students classified with learning disabilities	1	2
Low understanding of concepts	1	2
Positive impact on project participants	1	2
Scarce resources	1	2
Software adopted by others	1	2
Still in progress	1	2
No Response	21	45

Respondent comments may have been categorized into more than one theme, so frequencies may sum to more than the total number of participants and percentages may sum to more than 100%.

This section concluded with another open-ended survey item asking participants to identify the primary lessons learned from their projects that would assist others conducting projects related to persons with disabilities. The survey received 51 comments, which were then coded for themes. The two groups did not share any common lessons learned. While participants in the Alliance group most frequently cited having learned more about recruitment practices/strategies (*n*=3), respondents in the Research & Dissemination group reported learning about things such as project development (*n*=12), methods for developing useful products or resources (*n*=11), and how to meaningfully integrate SWDs into research and data collection (*n*=11).

Table 4.14. *Primary Lessons Learned from the Projects*

Alliance (n=11)	**Frequency**	**Percent**
Recruitment/strategies	3	27
Difficulty in bureaucratic systems to make change	1	9
Embedded program operations within STEM colleges	1	9
Engage campus disability services	1	9
Importance of mentoring	1	9
Importance of self-advocacy training	1	9
Necessity of multi-faceted interventions	1	9
Tap into existing resources instead of creating duplicates	1	9
Still in progress	1	9
No Response	2	18

R&D (n=47)	**Frequency**	**Percent**
Project development-related ideas	12	26
Appropriate methods for developing useful products and/or resources	11	23
How to meaningfully integrate SWDs into research and data collection	11	23
Professional development and/or training related ideas	11	23
Collaboration/networking	8	17
Buy-in from administration, faculty is important	4	9
Importance of information-sharing	4	9
The impact/lack of awareness of bias	3	6
Project not completed	2	4
Challenges with confidentiality	1	2
Continued funding need	1	2
Outcomes were enlightening and unexpected	1	2
Importance of determination	1	2
STEM SWDs are stronger than non-STEM SWDs in most academic areas	1	2
No Response	4	9

Respondent comments may have been categorized into more than one theme, so frequencies may sum to more than the total number of participants and percentages may sum to more than 100%.

Goals. The PIs next rated the extent to which they achieved 1) their project goals and 2) PPD or RDE program-level goals, by selecting one of five options on the scale (1=None, 2=Few, 3=Some, 4=Most, 5=All).

Table 4.15. *Extent to Which PIs Achieved Project Specific and Program Level Goals*

a. I achieved my project-specific goals.	Alliance (n=11)	R&D (n=47)	Total (n=58)
None	--	--	--
Few	--	2 (4%)	2 (3%)
Some	--	6 (13%)	6 (10%)
Most	6 (55%)	15 (32%)	21 (36%)
All	5 (46%)	23 (49%)	28 (48%)
No Response	--	1 (2%)	1 (2%)
Mean (SD)	4.45 (0.52)	4.28 (0.86)	4.32 (0.81)

a. I achieved PPD/RDE program-level goals.	Alliance (n=11)	R&D (n=47)	Total (n=58)
None	--	1 (2%)	1 (2%)
Few	--	--	--
Some	--	15 (32%)	15 (26%)
Most	5 (46%)	12 (26%)	17 (29%)
All	6 (55%)	14 (30%)	20 (35%)
No Response	--	5 (11%)	5 (9%)
Mean (SD)	4.55 (0.52)	3.90 (0.96)	4.04 (0.92)

Respondents also provided an indication of whether their project goals changed after they received funding. Most respondents selected “No” (n=47, 81%).

Table 4.16. *Change of Project Goals After Receiving Funding*

Response Option	Alliance (n=11)	R&D (n=47)	Total (n=58)
Yes	4 (36%)	6 (13%)	10 (17%)
No	7 (64%)	40 (85%)	47 (81%)
Don’t Know	--	1 (2%)	1 (2%)
No Response	--	--	--

The survey presented the 10 respondents that selected “Yes” to the previous question (that their project goals changed after they received funding) with two follow-up questions about those changes. The first question asked these respondents to describe the reasons for the change in their project goals. The second follow-up question asked them to describe how the changes impacted their ability to achieve their project goals. All 10 participants responded to both questions, and the responses were coded for themes.

Two Alliance project PIs reported that the need to adapt to using new technologies led to a change in project goals. A participant from this group indicated that alliances were no longer a goal (*n*=1), and another PI indicated being advised by the project office to change goals (*n*=1). Project goals changed for projects in the Research & Dissemination group because the data suggested new directions (*n*=2), they desired to meet additional goals (*n*=2), or the project took longer than expected because of technology issues (*n*=2).

Table 4.17. *Reasons for the Change in Project Goals*

Alliance (n=4)	**Frequency**	**Percent**
Adapt to use of new technologies	2	50
Alliances were out as a goal	1	25
Guidance from project officer	1	25
No Response	--	--

R&D (n=6)	**Frequency**	**Percent**
Data suggested new directions	2	33
Desired to meet additional goals	2	33
Project took longer than expected because of technology issues	2	33
Transitioned to adult life rather than just STEM	1	17
No Response	--	--

Respondent comments may have been categorized into more than one theme, so frequencies may sum to more than the total number of participants and percentages may sum to more than 100%.

These changes in project goals seemed to only somewhat impact the ability of the project(s) to achieve their goals. Only one response indicated the change in project goals made it more difficult to achieve the project goals (*n*=1). Some reflected that the ability to achieve the goals was not impacted (*n*=1) or merely described having to take a somewhat different approach (*n*=3), and some reported the goal changes enhanced their ability to achieve project goals (*n*=4).

Table 4.18. *How Changes to Project Goals Impacted Ability to Achieve Project Goals*

Alliance (n=4)	**Frequency**	**Percent**
A different approach was required for goal achievement	3	75
Did not impact goal achievement	1	25
No Response	--	--

R&D (n=6)	**Frequency**	**Percent**
Positively impacted goal achievement	5	83
Negatively impacted goal achievement	1	17
No Response	--	--

Respondent comments may have been categorized into more than one theme, so frequencies may sum to more than the total number of participants and percentages may sum to more than 100%.

Evaluation and Dissemination. Participants identified the types of metrics used to evaluate their projects by selecting all options that applied from nine specific metric types and "Other" (for which they could specify details). The most frequently selected metric types were "improved knowledge" (*n*=39, 67%), which was selected by two-thirds of respondents. Also frequently selected were "improved attitudes" (*n*=36, 62%), "increased awareness" (*n*=30, 52%), and "number of student participants" (*n*=30, 52%), each selected by over half of respondents.

Table 4.19. *Types of Metrics Used to Evaluate Projects*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Number of Student Participants	10 (91%)	20 (43%)	30 (52%)
Number of student participant transitions	10 (91%)	4 (9%)	14 (24%)
Number of faculty/staff participants	8 (73%)	15 (32%)	23 (40%)
Increased student participant success in STEM	10 (91%)	13 (28%)	23 (40%)
Increased awareness	9 (82%)	21 (45%)	30 (52%)
Improved knowledge	9 (82%)	30 (64%)	39 (67%)
Improved attitudes	11 (100%)	25 (53%)	36 (62%)
Increased intentions	8 (73%)	12 (26%)	20 (35%)
Behavioral changes	6 (55%)	8 (17%)	14 (24%)
Other (please specify)	2 (18%)	13 (28%)	15 (26%)
No Response	--	1 (2%)	1 (2%)

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.

Other responses: for *Alliance* – Retention rate in college and major, increased participation in internships and outside class STEM activities; for *Research & Dissemination* – Number of individuals listed in directory; Product functioned successfully as an accommodation; Attainment of goals and objectives;

evaluation practices; math proficiency (skills); evaluation is not complete; Improved reading strategies for informational text; Increased access to instruction in math for students with LD; improved lab equipment; Time playing with program; Test subjects test scores on presented material; increased reading ability; and increased interest.

Respondents selected all the methods used to disseminate their project findings from 12 specific methods and "Other" (for which they could specify details). By far, the most frequently selected method was conference presentation (*n*=52, 90%). Also selected by at least half of respondents were website (*n*=34, 59%), college/university/departmental presentation (*n*=30, 52%), and peer-reviewed publication (*n*=29, 50%).

Table 4.20. *Methods Used to Disseminate Project Findings*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Blog	2 (18%)	1 (2%)	3 (5%)
College/University/Departmental Presentation	10 (91%)	20 (43%)	30 (52%)
Conference Exhibit/Booth	8 (73%)	19 (40%)	27 (47%)
Conference Presentation	10 (91%)	42 (89%)	52 (90%)
Email List/List serve	6 (55%)	14 (30%)	20 (35%)
News Release	5 (46%)	13 (28%)	18 (31%)
Newsletter	6 (55%)	11 (23%)	17 (29%)
Non Peer-Reviewed Publication	5 (46%)	15 (32%)	20 (35%)
Peer-Reviewed Publication	8 (73%)	21 (45%)	29 (50%)
Promotional Materials/Brochure	9 (82%)	15 (32%)	24 (41%)
Social Networking Community	5 (46%)	4 (9%)	9 (16%)
Website	8 (73%)	26 (55%)	34 (59%)
Other (please specify)	1 (9%)	10 (21%)	11 (19%)
No Response	--	--	--

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.

Other responses: for *Research & Dissemination* – Reports in PDF format on website; project not yet completed; CDs, mp3; evaluation is not complete; NSF Highlights; web-based seminar; workshop offered; Pictionary of signs; books; and publication in preparation.

<u>Suggestions/Best Practices</u>. This section consisted of two open-ended questions. The first question presented a list of three specific challenges of RDE projects that the RDE-SP team frequently encountered during their research efforts (obtaining student disability data from the institution, reporting, and recruiting participants), and it asked participants to describe any best practices or strategies that they may have identified for overcoming these obstacles. Forty-three participants entered a

comment, and these comments were coded for themes. PIs of both project groups mentioned the development of effective or alternative recruitment practices/strategies (*n*=16). The Alliance group also referenced the importance of engaging the Office of Disability Services (*n*=4) and building relationships with the students as well as the institutional staff (*n*=2). Additional best practices or strategies identified by the Research & Dissemination group include networking and collaborating (*n*=19), identifying alternative data collection and entry strategies (*n*=4), and the importance of reporting/dissemination (*n*=3).

Table 4.21. *Best Practices or Strategies Identified for Overcoming Common Obstacles*

Alliance (n=11)	**Frequency**	**Percent**
Developed effective recruitment practices/ strategies	7	64
Engaged office of disability service	4	36
Built relationships with students and institutional staff	2	18
Obtained administration approval to recruit students	1	9
Created OSAA scholar's database	1	9
Persisted in efforts with students and institutional staff	1	9
No Response	1	9

R&D (n=47)	**Frequency**	**Percent**
Networked and collaborated	19	40
Identified alternative recruitment strategies	9	19
None or N/A	4	9
Identified alternative data collection/ entry strategies	4	9
Recognized the importance of reporting/ dissemination	3	6
Used inclusive science strategies	2	4
Increased awareness that SWDs can succeed	1	2
Utilized resources	1	2
Still in progress	1	2
No Response	13	28

Respondent comments may have been categorized into more than one theme, so frequencies may sum to more than the total number of participants and percentages may sum to more than 100%.

The second item in this section provided a space for participants to enter any additional comments about their RDE experience that they would like captured in the synthesis effort. Twenty-seven participants entered a comment in this section. Overall the responses were positive and focused on project success, administrative support from NSF and the program officers, and the importance of focusing on persons with disabilities. Selected representative comments are captured below.

> *"This program [RDE] has been a great resource not purely in terms of research funding, but primarily in terms of creating a community of*

researchers focused on supporting the needs of students with disabilities. As the NSF moves beyond the RDE program, I hope the RDE community is able to persist."

"*Our project has resulted in some useful products and findings. We began with a small group of teachers in an action research format. I regret that similar funding opportunities do not seem to be available currently."*

"We think that RDE should still exist at NSF as a separate program—it is a disservice for it to have been integrated away."

"I truly appreciated the patience of the NSF staff and the flexibility they showed when I was not able to collect data exactly as I originally intended."

The responses also included challenges related to PDMS data collection challenges, project evaluation focus for research projects, as well as a noticed shift in funding priorities within the RDE program. Selected representative comments from this section are captured below.

"*Please note the need of these efforts to produce data that will build well-documented evidence-based practices for effective and efficient future implementations. An integrated implementation-applied research emphasis is needed to make progress toward a strong STEM workforce and full inclusion of people with disabilities."*

"The evaluation process (not the evaluator we wrote into our proposal, but the external RDE Community of Practice evaluator) has been the most difficult to work with."

Demographics. The final set of items collected five pieces of demographic data.

There was a fairly even split of female PIs (*n*=30, 52%) and male PIs (*n*=25, 43%), among the group of survey respondents.

Table 4.22. *Gender*

Response Option	**Alliance (n=11)**	**R&D (n=47)**	**Total (n=58)**
Male	4 (36%)	21 (45%)	25 (43%)
Female	5 (46%)	25 (53%)	30 (52%)
I prefer not to respond.	1 (9%)	--	1 (2%)
No Response	1 (9%)	1 (2%)	2 (3%)

The vast majority of respondents selected "NOT Hispanic/Latino" for their ethnicity (*n*=52, 90%).

Table 4.23. *Ethnicity*

Response Option	**Alliance (n=11)**	**R&D (n=47)**	**Total (n=58)**
Hispanic/Latino	--	1 (2%)	1 (2%)
NOT Hispanic/Latino	8 (73%)	44 (94%)	52 (90%)
I prefer not to respond.	2 (18%)	1 (2%)	3 (5%)
No Response	1 (9%)	1 (2%)	2 (3%)

PIs indicated their race by selecting all options that applied from five specific race options, "I prefer not to respond", and "Other" (for which they could specify details). Only one respondent selected more than one option. The most frequently selected race was "White" (*n*=49, 85%).

Table 4.24. *Race*

Response Option	**Alliance (n=11)**	**R&D (n=47)**	**Total (n=58)**
American Indian/Alaska Native	1 (9%)	1 (2%)	2 (3%)
Asian	1 (9%)	--	1 (2%)
Black/ African American	1 (9%)	1 (2%)	2 (3%)
Native Hawaiian/Other Pacific Islander	--	--	--
White	6 (55%)	43 (92%)	49 (85%)
I prefer not to respond.	1 (9%)	1 (2%)	2 (3%)
Other (please specify)	--	1 (2%)	1 (2%)
No Response	1 (9%)	1 (2%)	2 (3%)

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.
Other responses: for *Research & Dissemination* –Circassian/Arab.

The participants also indicated the organization type in which they were employed during their PPD/RDE project(s) by selecting all options that applied from four specific organization type options, "I prefer not to respond", and "Other" (for which they could specify details). Only one respondent selected more than one option. The most frequently selected organization type was Higher Education Institution. This option was selected by over three-quarters of respondents (*n*=44, 76%).

Table 4.25. *Organization Type Where PI was Employed During PPD/RDE Projects*

Response Option	Alliance (n=11)	R&D (n=47)	Total (n=58)
Foundation	--	--	--
Higher Education Institution	9 (82%)	35 (75%)	44 (76%)
Industry/Business	--	1 (2%)	1 (2%)
Research Corporation/Organization	--	3 (6%)	3 (5%)
I prefer not to respond.	--	--	--
No Response	1 (9%)	1 (2%)	2 (3%)

Respondents could select all applicable response options, so percentages in a column may sum to more than 100%.

Other responses: for *Alliance* – Tribal College; for *Research & Dissemination* – non-profit organization; Non-profit research organization; Scientific Society; Public Radio; and Quasi-Govt. Educational Inst.

The final survey item listed the 10 disability conditions collected through the RDE PDMS reporting system and asked respondents to indicate whether or not they have one or more of the conditions. About two-thirds of respondents indicated “I do not have any of these conditions” (*n*=39, 67%), while approximately a fifth of respondents selected “I have one or more of these conditions” (*n*=13, 22%).

Table 4.26. *Disability Condition*

Response Option	Alliance (n=11)	R&D (n=47)	Total (n=58)
I have one or more of these conditions.	3 (27%)	10 (21%)	13 (22%)
I do not have any of these conditions.	7 (64%)	32 (68%)	39 (67%)
I prefer not to respond.	--	4 (9%)	4 (7%)
No Response	1 (9%)	1 (2%)	2 (3%)

Note. The item listed all conditions collected about project personnel through PDMS: Asperger's Syndrome/Autism Spectrum Disorder, Attention Deficit Disorder (ADD)/Attention Deficit Hyperactivity Disorder (ADHD), Deaf or Hard of Hearing (D/HoH), physical impairment/orthopedic/mobility impairment, systemic health/medical condition, psychological/psychiatric condition, learning disorder, Blind or visual impairment, speech impairment, and acquired/traumatic brain injury.

Summary

In spring 2013, the RDE-SP team administered the *2001-2011 RDE Principal Investigator Survey* to gain more complete information about the 2001-2011 PPD/RDE-funded projects, such as their contributions, impacts, challenges, best practices, and lessons learned. This valuable information should facilitate the process for other PIs conducting research in disabilities education. Highlights from this data collection effort are provided in the bulleted lists below.

Participants

- Fifty-eight of the 87 PIs (67%) to which a survey invitation was sent participated in the survey.
- PIs included 30 females (52%) and 25 males (43%).
- The most frequently selected race was White (*n*=49, 85%), and the majority of PIs reported not being of Hispanic/Latino ethnicity (*n*=52, 90%).
- Most PIs were employed by Higher Education Institutions during their project(s) (*n*=44, 76%).
- Around one-fifth of PIs reported having one or more disability conditions (*n*=13, 22%). Two- thirds of PIs reported not having a disability condition (*n*=39, 67%).

Project-Specific Background Data

- PIs provided background data related to 76 projects.
- The most frequently selected funding tracks were FRI (Focused-Research Initiatives) (*n*=22, 29%) and DEI (Demonstration, Enrichment, and Information Dissemination) (*n*=18, 24%).
- The disabilities most frequently cited as the project focus were Learning Disorder (*n*=39, 51%), Deaf or Hard of Hearing (D/HoH) (*n*=35, 46%), and Blind or Visual Impairment (*n*=34, 45%). PIs selected 3.5 disability conditions on average for a project;
- Science (*n*=61, 80%) was the most often cited STEM focus, followed by Math (*n*=50, 66%). PIs selected an average of 2.5 STEM foci for a project.
- The most frequently selected primary target audiences were K-12 Students (*n*=44, 58%) and Higher Education Students (*n*=41, 54%).

Across-Project Data

Activities and Outputs

- Over half of PIs selected four-year colleges or universities (*n*=33, 57%) and/or secondary schools (*n*=32, 55%) as collaborating organizations.
- The most frequently identified product types produced by projects were presentation (*n*=45, 78%), publication (*n*=36, 62%), and report (*n*=31, 53%). On average, PIs selected 4.8 product types; Alliance PIs selected more product types than Research & Dissemination project PIs. Alliance project PIs reported

having produced 794 total products, and Research & Dissemination project PIs reported 5,828 total products; thus, together this group of PIs produced a total of 6,622 products.

- Over half of the respondents identified their project(s) had contributed to the knowledge base of working with SWDs in the following ways: identified teaching strategies that are effective for SWDs (*n*=47, 81%), identified strengths/difficulties related to working with students with a specific disability (*n*=33, 57%), and developed a model for working with SWDs to increase their success in STEM (*n*=31, 53%). On average, PIs selected 3.7 contribution types.
- When asked to consider the greatest achievement or significant accomplishment of their RDE project(s), participants from both groups cited increased support for SWDs (*n*=21, 36%).

Outcomes and Impacts

- The most frequently selected target audience impacts were increased skills for working with students with disabilities (*n*=34, 59%) and increased confidence related to STEM (*n*=30, 52%).
- Over one-third of PIs reported challenges related to evaluation (*n*=24, 41%), administrative/staffing (*n*=21, 36%), and recruiting participants (*n*=20, 35%).
- An unexpected project experience or outcome identified by both groups was the ability of faculty to adapt to working with SWDs (*n*=3, 5%).

Goals

- On average, the group of PIs indicated that they achieved most of their project-specific goals (*M*=4.32) and most of the PPD/RDE program-level goals (*M*=4.04). The Alliance PIs' and Research & Dissemination PIs' ratings related to achievement of project-specific goals were similar; however, Alliance PIs rated their achievement of PPD/RDE program-level goals higher than did the Research & Dissemination PIs.
- Most PIs reported that their project goals did not change after receiving funding (*n*=47, 81%).
- Of the 10 PIs who indicated their project goals changed, four reported that the change enhanced their ability to achieve the overall project goals (*n*=4, 40%). One PI indicated that achieving project goals was more difficult after the change (*n*=1, 10%).

Evaluation and Dissemination

- The metrics most often used to evaluate the PIs' projects were those related to improved knowledge (*n*=39, 67%), improved attitudes (*n*=36, 62%), increased awareness (*n*=30, 52%), and the number of student participants (*n*=30, 52%).
- The most frequently reported methods of dissemination were conference presentation (*n*=52, 90%), followed by website (*n*=34, 59%), college/university/departmental presentation (*n*=30, 52%), and peer-reviewed publication (*n*=29, 50%). PIs selected an average of 5.1 dissemination methods.

Suggestions/Best Practices

- When asked to describe any best practices or strategies used to overcome common RDE obstacles, PIs from both groups identified the development of effective or alternative recruitment practices/strategies (*n*=16, 28%).
- PIs' additional comments described program challenges (*n*=10, 17%), program strengths (*n*=8, 14%), and suggestions for RDE (*n*=4, 7%).

Chapter 5 – Citation Analysis

Background

This chapter reports on the citation research the RDE-SP team conducted on the published works of Principal Investigators (PIs) of projects funded through the RDE program (formerly Program for Persons with Disabilities - PPD) 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; using the number of times their published work had been cited as evidence. The citation research and analysis supplemented other data collection efforts, allowing a more complete picture of the RDE project portfolio.

Citation analysis utilizes 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 RDE-SP 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.

Researchers pursuing citation analysis must make several decisions in order to set the parameters of their study before starting their citation research. Such decisions will influence the amount of work to be conducted, so budget and reporting timelines are key factors in making the decisions. Some questions the RDE-SP team considered when setting the parameters of our study include:

- Which individuals will be included in the analysis?
    - Do you include PIs only or co-PIs as well?
    - If the original PI left the project, do you include that original PI or include the PI who replaced them (or both)?
- What publications will be included in the analysis?
    - Do you include all publications that you find through your research or a subset? The subset could be based on;
- Publication type (e.g., journal articles, books, conference proceedings)
- Topic (e.g., disability, education, evaluation)
- Date range (e.g., 2001-2011)
- Where will you locate the list of publications?
    - Do you directly ask the researcher to provide a list of their publications, or

do you conduct Internet research to locate them?
    - If you receive a low response rate when directly requesting a publication list from the researcher, do you supplement with Internet research?
- What is your timeframe for conducting this citation research?
    - You need time to factor in time to collect and verify data as well as complete the analysis and create any desired graphics.

The next section of this report presents the methodology used for the RDE-SP citation research, including the parameters set by the research team. The results of the citation analysis appear next, followed by a synthesis and summary of the citation research efforts, which includes a brief examination of lessons learned.

Population Parameters

The population of individuals included in the citation research was the 97 original RDE PIs of the 117 projects funded through RDE/PPD Division of Human Resource Development (HRD) between 2001 and 2011. Replacement PIs (i.e., PIs that took over the project when an original PI stepped down) were not included in the analysis, nor were any of the projects' co-PIs. The research team wanted to include one individual that was representative of each project that was most likely to be an author on grant products, and the team considered the original PI as the best representative. Choosing one representative lessened the likelihood of including duplicate publications.

Types of PIs' original publications included in the analysis were books, journal articles, and other dated published materials/resources. Conference presentations/proceedings were not included as original publications because they are not necessarily polished products (i.e., may contain preliminary findings) and are infrequently cited by others.

The date range of PIs' original publications was limited to 2001 (the first year of the decade of interest) to 2012 (the last full year prior to the research study). Publications labeled "in press" or "in preparation" were excluded. Publication date ranges were not set for each individual PI based on their award date(s) due to the possibility that the PIs had similar funding prior to 2001.

Topics of PIs' original publications were limited to disability, education, and evaluation. Decisions for inclusion were based on information in the publication title and abstract as well as the journal title.

Any citing works available were included in this analysis. The citations could be undated, any type of product, or any topic.

Methodology

Preparing the Data File

The RDE-SP team sought to compile a list of publications authored by RDE/PPD PIs within the study parameters. The team created a spreadsheet labeled according to the type of information to be entered. There were columns for PI name, PI organization and state, PI's publication citation, abstract, citing work citation, and database source(s). The spreadsheet contained a separate tab for each of the 97 PIs, and the tabs were divided among multiple files to allow multiple research assistants to complete research and data entry simultaneously.

Internet Search for CVs/Biographies

The first data collection step involved searching the Internet for each PI's curriculum vitae (CV) or biography; typical sources were PIs' institution/organization and project websites. Research assistants located CVs or biographies for 52 PIs during this step. The team saved the CVs and biographies and then entered each PI's 2001-2012 bibliographic citations into the Excel spreadsheet. During the data entry process, RDE-SP team members decided which publications fell outside of the study parameters (e.g., based on year, type, and topic) and excluded them from the list.

Citation Database Research

Next, research assistants began searching for each PI and their publications in three citation databases: Scopus (2013), Web of Science (Reuters, 2013), and Google Scholar (2013). Each database allows searching by author name, publication name, and year published. Research assistants first completed searches for each of the 52 PIs for which a CV/biography had been located. Each search for a PI's name results in a list of potential matches for authors. Selecting an author from the list then presents a list of publications authored by that individual, including a number indicating how many times each publication has been cited. Clicking on that number brings up a list of that publication's citing works.

For each publication on the PI's list, the research assistants recorded full reference information for the citing works; each citing work was entered as a separate row in the data file. If any publications found in the CVs/biographies did not appear as a search result, the research assistant then tried searching for the publication by name and the year it was published. Publications and citing works were listed once in the file even if found in multiple databases. Multiple "source" columns within the spreadsheet served to record the database(s) in which each citing work had been found (No=0, Yes=1), to facilitate the data verification process.

In some instances, search results included additional PI publications that had not been on the original list gained through the CV/biography search. Research assistants entered the bibliographic citations for these additional publications into a separate spreadsheet. RDE-SP team members then decided whether each publication fell within the study's parameters. Research assistants continued with the process of recording the citing works for the publications that did.

The research assistants also conducted database searches for publications authored by the PIs for which a CV/biography was not available. They searched all three databases for each PI's name, and recorded the publications and citing works that could be linked to these PIs. RDE-SP team members confirmed the relevancy of each publication to the study. Publications for 35 of the 45 PIs for which a CV/biography was not available were located this way. Possible reasons for not locating publications for 10 PIs include that 1) the author was located in the databases but their publication list included none within the study parameters or 2) the author was not able to be located in the databases. Implications are highlighted in the Limitations section of this report.

Data collection, including entry and verification, took approximately 10 months. At its completion, the data files were combined into a master file to prepare for the analysis phase.

Analysis

The RDE-SP team conducted descriptive analyses on the original publications and citing works, producing counts overall and by variables of interest (e.g., year, PI), as well as means, medians, and standard deviations.

Additionally, the research team assigned GIS coordinates to each RDE PI. The PIs who had a single project during the decade were assigned coordinates based on the institution at which they were located when they received the RDE funding. The PIs who had multiple projects funded during the decade were assigned coordinates based on the institution at which they were located when they received funding for their most recent project. It was necessary to assign PIs to one location because the project examined their publications as a whole (rather than attempting to match individual publications to specific grant funding). A GIS map of the United States was produced to geographically represent the RDE PIs' publications as a function of state and institution.

The RDE-SP team also conducted network analyses by identifying instances within the RDE PI publication sample in which RDE PIs cited other RDE PIs. The team produced an infographic to depict these connections, which represent the influence of RDE PIs' work on other RDE PIs.

Data analysis was completed in approximately one month.

Results

The study's parameters (see page 2) should be kept in mind when interpreting the results (i.e., counts and means). PIs' publications are not represented in their entirety. Only publications related to education, disabilities, or evaluation published between 2001 and 2012 have been included in the analysis.

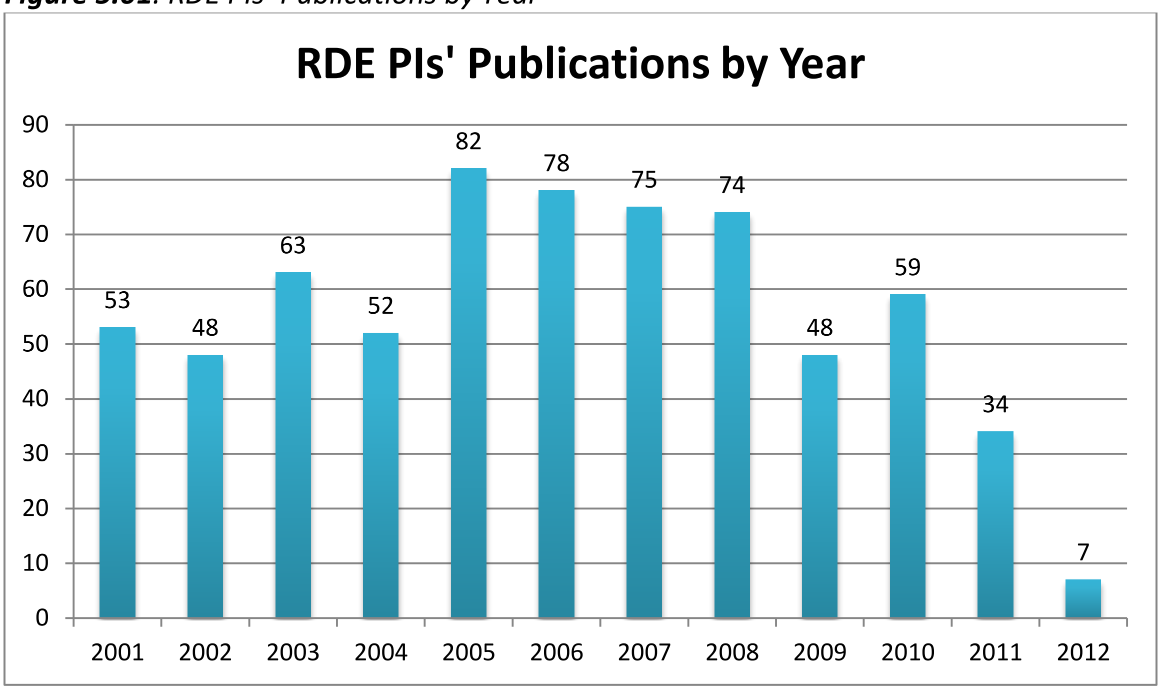
Descriptives

<u>Publications Overall</u>. The group of RDE PIs produced a total of 673 publications within the study's parameters.

<u>Publications by PI</u>. PIs produced an average of about 7 publications (M = 6.94, SD = 11.45) and a median of 3 publications. Individual PIs produced between 0 and 78 publications. Twenty-six PIs had no publications within the study's parameters.

<u>Publications by Year</u>. An average of about 56 publications were produced each year (M = 56.08, SD = 21.19). The median was 56 publications and the range was 7 - 82 publications, per year. Figure 5.01 presents the publications by year.

Figure 5.01. *RDE PIs' Publications by Year*



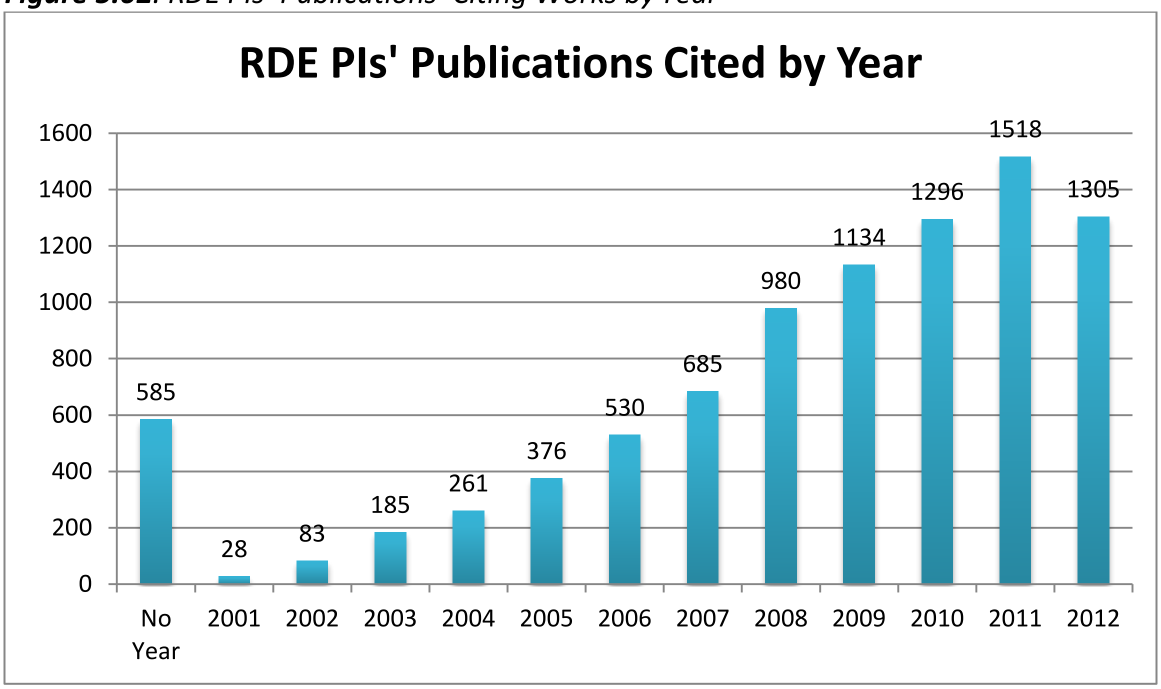
Citing Works Overall. The RDE PIs' publications had a total of 8,966 citing works identified through this research.

Citing Works by Publication. Publications had an average of about 13 citing works (*M* = 13.32, *SD* = 29.84) and a median of 3 citing works. Individual publications had between 0 and 414 citing works. About 30% of the publications had 0 citing works (207, 30.8%).

Citing Works by PI. Individual PIs had an average of about 92 citing works (*M* = 92.43, *SD* = 195.23) and a median of 10 citing works. Counts of citing works for individual PIs ranged from 0 to 990. In addition to the 26 PIs who did not have publications contributing to this analysis, another eight PIs had no citing works for their publications.

Citing Works by Year. There was an average of about 690 citing works each year (*M* = 689.69, *SD* = 507.71). The median was 585 citing works, and it ranged between 28 and 1,518 citing works, per year. Given that some citing works did not have a year assigned, statistics were calculated based on having 13 "years" ("No Year" was counted as the 13th year). Figure 5.02 presents the citing works by year.

Figure 5.02. *RDE PIs' Publications' Citing Works by Year*



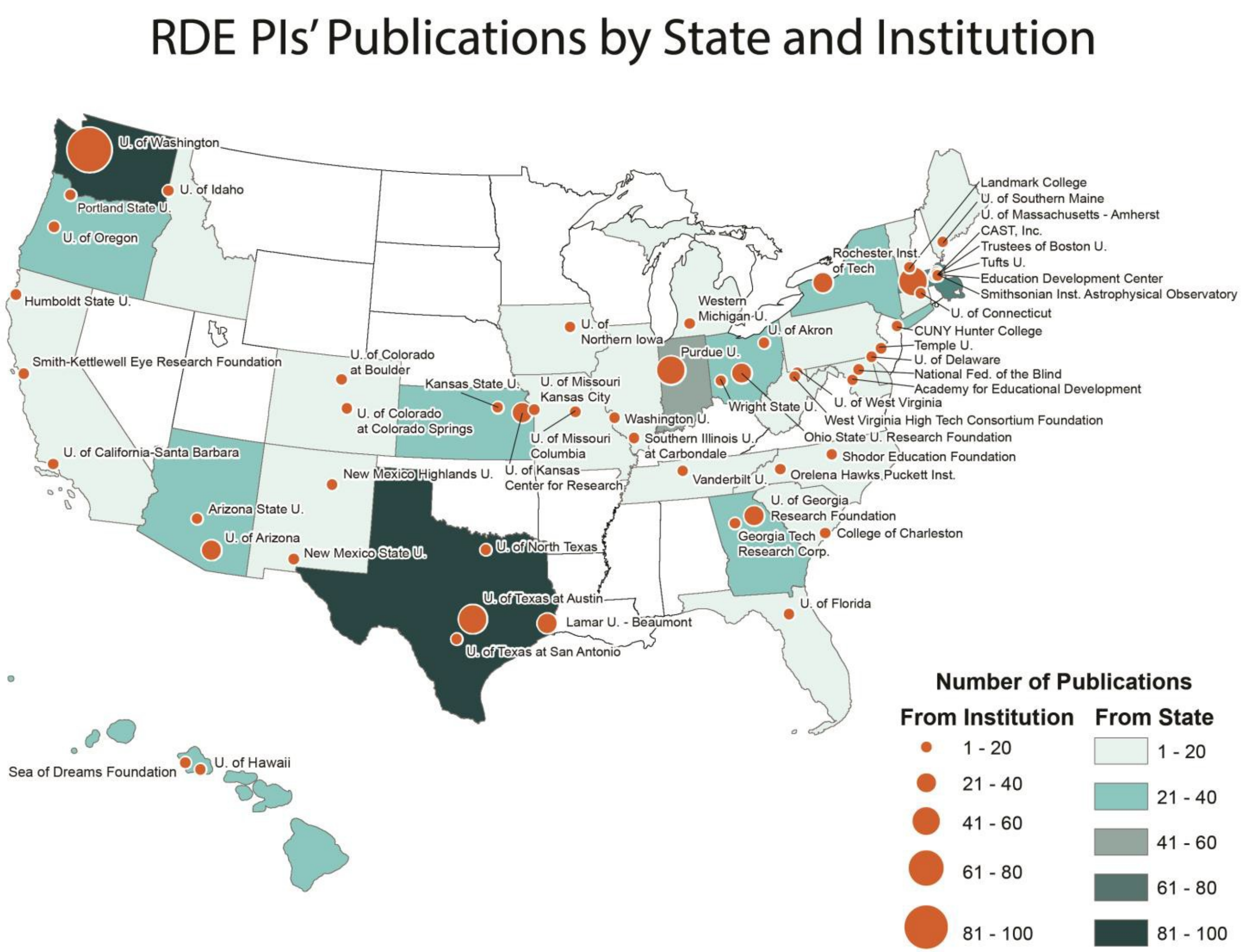
Appendix E presents the counts for publications and citing works for each PI contributing to the analysis.

Geographic Information Systems Mapping

The RDE-SP team created a GIS map that displays the RDE PIs' publications by the location in which they were employed when receiving their RDE award. This information is represented both as a function of state and institution. Refer to Figure 5.03 for the GIS map.

At the state level, a state is either not shaded or has some level of blue shading. A state with no shading indicates none of the RDE PI publications originated in the state. Some level of blue shading indicates one or more of the RDE PI publications originated in that state. The shades of blue represent different number ranges of publications, with darker shading indicating a higher number of publications originating in that state. At the institution level, each contributing institution is marked on the map with an orange dot. The dots sizes represent different number ranges of publications, with a larger dot signifying a higher number of publications originating from that institution.

Figure 5.03. *PIs' Publications by Institution and State*



Contributing States. The PI publications originated in 30 states and the District of Columbia (31 total areas). Therefore, 20 states did not contribute any publications in this study.

Contributing States by Levels of Shading. Only two states had the darkest level of blue shading (having between 81 and 100 publications); they are Texas (99 publications) and Washington (96 publications). Only one state had the second darkest level of shading (having between 61 and 80 publications); it was Massachusetts, with 76 publications. Only one state had the mid-level of shading (having between 41 and 60 publications); it was Indiana, with 45 publications.

Seven states have the second lightest level of shading (having between 21 and 40 publications). Most contributing states (20) have the lightest level of shading (having between 1 and 20 publications).

Contributing Institutions. There are a total of 59 PI institutions contributing to the publications.

Contributing Institutions by State. Most states have one institution (15 states) or two institutions (10 states) contributing to the publications. Many fewer states have three institutions (4 states – CA, DC, MO, OH), four institutions (1 state - TX), or eight institutions (1 state - MA) contributing.

Contributing PIs by State. By far, the state of Massachusetts has the most contributing PIs, with 11 PIs in that state. Next in line are New York (6 PIs) and Texas (5 PIs). All other states had three (6 states), two (9 states), or one (13 states) PIs contributing to its publications.

Appendix B lists each contributing state along with the total number of publications originating from the state and the numbers of institutions and PIs corresponding to that state.

Network Analyses

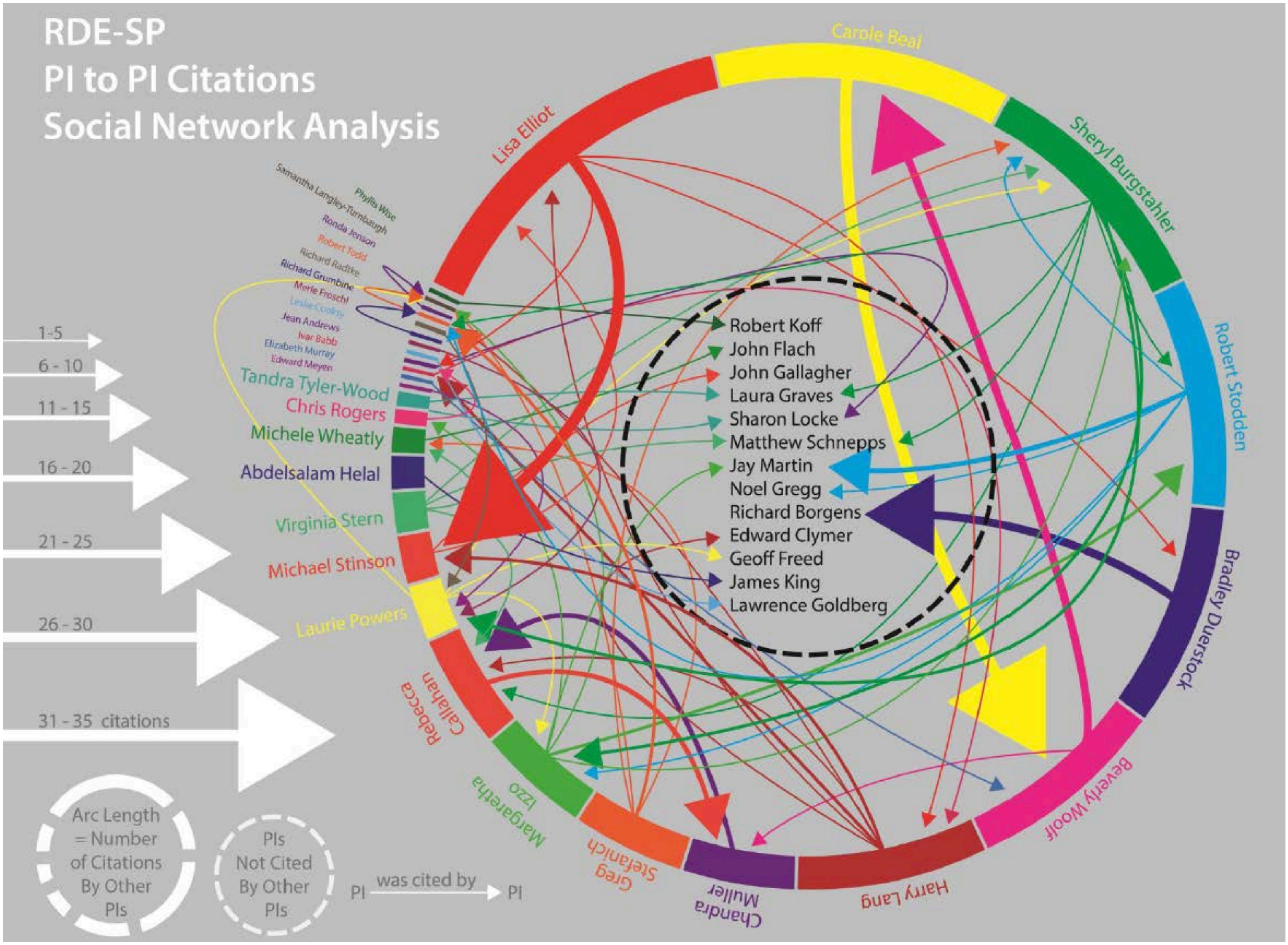
The research team conducted network analyses to identify interactions among the RDE PIs in terms of citing each other's publications. These analyses provide an opportunity to summarize how PIs' work has influenced other PIs' work. The infographic in Figure 5.04 displays results summarizing which PIs cited other PIs within our 97 RDE PI population, and Appendix C provides the supporting data. Please note that the network data, included in the infographic and appendix, do not represent all of the PI publications included in this study, just the publications cited by other PIs.

The names of 43 RDE PIs appear in the infographic. The names of 30 PIs appear around the outside of the colorful circle. The length of the arc corresponding to each of these PIs indicates the total number of citations from other PIs, with a longer arc indicating more citations. The positions of PIs' names are ordered from most cited to least cited, starting with PI Lisa Elliot, in red in the upper left corner. Thirteen PIs appear in the center of the infographic in an inner circle; these PIs' work was not cited by the other PIs.

Citations between PIs are represented by arrows. The arrow points from the PI whose work is being cited toward the PI who cited that first PI's work. Therefore, it points from the influencing PI to the PI whose work was influenced. PIs with many arrows coming out of their arc (e.g., Harry Lang, in dark red along the bottom) influenced many other PIs' work. Also, PIs with many arrows pointing toward their arc (e.g., Sheryl Burgstahler, in green at the upper right corner) were influenced by many other PIs' work. Arrows pointing back and forth between two PIs indicates they cited each other (e.g., Carole Beale, in yellow at the top, and Beverly Woolf, in pink in the lower right corner). Note that the PIs listed in the inner circle have arrows pointing toward them but not away from them, showing that their work cited the work of other PIs, but other PIs did not cite their work.

The thickness of the arrow represents the amount of citing from one PI to the other PI; there are seven thickness options representing different ranges of citations, with a thicker arrow signifying more citations. For example, consider the arrows between Lisa Elliot (in red at the upper left corner) and Michael Stinson (also in red at the left side). These two PIs have cited each other's work. However, the arrow pointing from Elliot to Stinson is thicker than the arrow pointing from Stinson to Elliot; this indicates that Stinson cited Elliot more frequently than Elliot cited Stinson.

Figure 5.04. *PI to PI Citations*



Summary

As part of the RDE-SP synthesis efforts, the RDE-SP team conducted citation research on the published works of the 97 original Principal Investigators (PIs) of the 117 projects funded through the RDE (formerly PPD) program from 2001 to 2011. The purpose of the citation research was to gather information related to the RDE PIs' publications in order to identify the collective influence or reach of these RDE PIs in the field using the number of times their published work had been cited as evidence. A list of publications and citing works were located through Internet searches for PIs' CVs/biographies and citation database research. Publications of interest included books, journal articles, and other dated published materials/resources related to the topics of disability, education, and evaluation. Highlights of the findings from this data collection effort include:

- The research located a total of 673 publications authored by 71 PIs. The remaining 26 PIs had no publications located within the study's parameters.
- An average of about 56 publications were produced each year, with PIs producing an average of 7 publications within the decade.
- The study identified a total of 8,966 citing works for 466 of the RDE PIs' publications. The other 207 publications had no citing works.
- Individual PIs had an average of about 92 citing works, with publications averaging approximately 13 citing works apiece.
- On average, there were about 690 citing works each year.
- The 673 PI publications originated from 59 institutions in 31 geographical areas in the United States (i.e., 30 states and the District of Columbia).
- The states of Texas and Washington contributed the largest number of publications (99 and 96 publications, respectively).
- The states with the most PIs contributing publications to the study include Massachusetts (11 PIs), New York (6 PIs), and Texas (5 PIs).
- The top five PIs cited most frequently by other RDE PIs were: Lisa Elliot (42 citations), Carole Beal (34 citations), Sheryl Burgstahler (28 citations), Robert Stodden (26 citations), and Bradley Duerstock (25 citations).

Limitations

Goals of this research study included compiling a list of RDE PIs' published works related to the RDE projects and identifying these publications' collective influence on others' works. It is possible that not all products/disseminated works of the RDE projects were located through this research study, and it is likely that products that were not a direct result of the RDE-funded projects were included in the study.

The study was limited by setting parameters at its outset. For example, the team conducted research to identify publications of the 97 original PIs of the RDE projects, allowing each project to be represented by only one individual. Including multiple representatives of each project would have increased the likelihood of including publications in the study more than once (as well as repeats of citing works) given that PIs and co-PIs frequently publish project findings together. However, replacement PIs or co-PIs could have published works that did not include the original PI as an author; this was likely to have occurred in instances where the original PI was deceased. In such cases, the project products would not have been located and included in our study.

Other factors also may have contributed to the research team not locating existing publications that fall within our study parameters. Various factors complicated the identification of PIs in the database. If a PI could not confidently be identified in the databases, no publications could be recorded for that PI. For example, it was more difficult to identify the correct author within the database search results of PIs for whom the team did not have a CV/ biography, compared to those for whom it was available. With the searches for PIs for with a CV/biography, when the databases brought up a long list of authors to choose from, it was possible to identify the correct author by searching which author had the publications on the list compiled from the CV/biography. This additional search option was not available for those PIs whom we did not have a compiled publication list. Another search option was to search for the author's name along with institution affiliation. In some cases, the databases did not have an author affiliated with the institution on file for that PI at NSF. Within the database, some authors did not have an institution affiliation at all. Identifying the correct author was further complicated if the PI had a common name. The research team recorded publications and citing works for only the PIs who could be confidently identified through the databases. Thus, it is possible that some of the PIs for whom we did not locate publications actually have publications within the study parameters and we were just not able to identify them.

It is probable that some PI publications were included more than once in our analysis, but we limited our population of interest to one representative per project to minimize the potential for this to happen. It is possible, however, that PIs of separately funded RDE projects collaborated on their research and published papers together. For example, Alliance project PIs may have published together. In effect, the overall count of publications may not necessarily represent unique publications. The overall count represents the sum of each PI's publication count.

Additionally, publications that were not a direct result of an RDE project may have been included in the study. Each publication was included based on its applicability to the date range, type, and topic parameters. Given that the publications were not tied directly to an RDE-funded project, the publication list merely represents publications related to disabilities research, education, and evaluation published by the RDE PIs during the decade.

Other limitations based on setting parameters include the type and topic of PI publications. The team excluded several works based on these parameters. When interpreting the results, it is important to keep in mind that the list of PIs' publications compiled through this study is not comprehensive of all their published works during the decade; such a comprehensive list was not of interest for this study.

The study was also limited by the search results gained both through the CV/biography search and the citation database search phases. Frequently, the CVs/biographies were not up-to-date. Further, it is likely that the citation databases did not contain comprehensive lists of PI publications. Scopus and Web of Science are updated periodically (i.e., quarterly) and do not necessarily contain the most recent publications at any given time. Google Scholar is updated more frequently (i.e., daily) but appears to have additional limitations in that publications disappear during these updates as well.

The team completed verifications during the data collection processes, to ensure that the database search results were recorded accurately in the data file. However, the research team recognized the limited accuracy of the data because it was not feasible to verify the data in each database's records. During the verification process it became evident that the citation databases contained some inaccurate information. The team's compiled publication list included seven citing works dated with the year 2000. Having a citing work from 2000 should not be possible given that the earliest original publications of interest were published in 2001. However, those citing works appeared in the database with a date of 2000, thus they were entered in the data file and later verified as 2000. Through an additional verification step, the team discovered that sometimes the database had the wrong date recorded (in these cases, the team updated the date in our data file). Other times, the citing work had correctly been dated 2000. Given that it should not be possible to have 2000 citing works, these citing works were deleted from our data file. While it was possible to identify and verify these anomalies dated outside our date range parameter, it was not feasible to verify the dates of all citing works due to time constraints. Thus, it is possible there are still instances of incorrect dates (or other information) recorded in the citation database and therefore in our data file as well. The research team's verification processes ensured that the data file reflects what is recorded in the citation databases.

Future Directions

The current analysis focused on the number of original publications produced by the RDE PIs, the number of times these publications were cited, the locations (institutions) where publications originated, and the incidences of RDE PIs' publications citing other RDE PIs' publications. The analysis plan was limited by budgetary restrictions. There are additional ways these data, including both the original publications and citing works, could be examined under future grants.

The analysis related to the citing works could also be expanded. As with the original publications, the citing works also could be coded for content in terms of topics, type, and impact. A GIS map could be produced based on locations that could be tied to the citing works to see the geographic reach of these publications as well. Considering the number of citing works (*n*=8,966) compared to original publications, the coding process would take significantly longer. Unlike with the original publications, abstracts of citing works were not captured in the research. Coding these citing works would have to be based on information contained in their citations only, or additional research would be necessary.

Conclusion

The RDE-SP team conducted a citation research study to supplement other efforts at synthesizing a decade of impact of the RDE program. The study identified 673 relevant publications authored by the RDE PIs, and 8,966 citing works, indicating the reach of these PIs in disseminating their work and their influence on other researchers in the field. The team prepared graphic representations for portions of the data, including geographic locations associated with the publications and the influence of RDE PIs within the RDE PI population.

Chapter 6 – Lessons Learned

The sixth chapter of this report addresses the two final questions investigated by the RDE Synthesis 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 funded projects?

To answer these questions, the researchers examined a variety of project information. Data sources included materials submitted by project PIs such as annual reports and evaluation reports, publications by PIs and Co-PIs, materials on the DO-IT/RDE site funded by RDE for dissemination of information about RDE projects, and qualitative and quantitative survey data. These data were synthesized to produce the following answers to the project's final two questions. Data are augmented by current literature in the field. This chapter has several sections: Common challenges; successful and potential solutions to challenges; and lessons learned. This chapter will not reiterate the findings of the research done by individual projects, although those could be considered "lessons learned".

Challenges

An examination of the current literature and data from the RDE-SP team suggest several challenges to successfully including students with disabilities in STEM post-secondary 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. *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* from administrators, faculty, and staff (Beilke, 1999; Deshler, Ellis, & Lenz, 1996; Vogel et al. 2008; Demirel, Baydas, Yilmaz, & Goktas, 2013.) Some PI's reported challenges with the program operations within the university; 36% of the PI's reported administrative and staffing challenges. Cheatham, Smith, Elliott, & Friedline (2013) 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* (Lowe, D., Newcombe, & Stumpers, 2012; Supalo, Isaacson, & Lombardi, 2014).
- *Knowledge and skills of faculty and staff* (Aaberg, 2012). For example, 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.

Researchers (e.g. Kurth & Mellard, 2006; Lehman, et al., 2000; Shigaki, Anderson, Howald, et. al., 2012) found lack of faculty knowledge and skills for accommodating and working with students with disabilities. PIs described these challenges in their annual reports, publications and survey responses.

- 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.
- *Measurement, evaluation and tracking participants* were reported as challenges 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 in college 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.

> "*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."
>
> RDE PI

Successful and Potential Solutions to Common Challenges

Practices or strategies to solve or prevent common challenges were reported by PIs and suggested in their reports, publications and survey responses. General, summarized suggestions and practices are listed in Table 6.01.

Table 6.01. *Best practices and strategies to overcome obstacles.*

Best Practices and Strategies to Overcome Obstacles	
Build trusting and respectful relationships with students and institutional staff	Recognize the importance of reporting and dissemination early on
Develop effective recruitment strategies and practices	Engage office of disability services at your institution
Identify alternative data collection and entry strategies	Increase awareness that SWDs can succeed
Network, collaborate, and utilize all resources available	Obtain administrative approval to recruit students
Persist in efforts with students and institutional staff	Use inclusive strategies

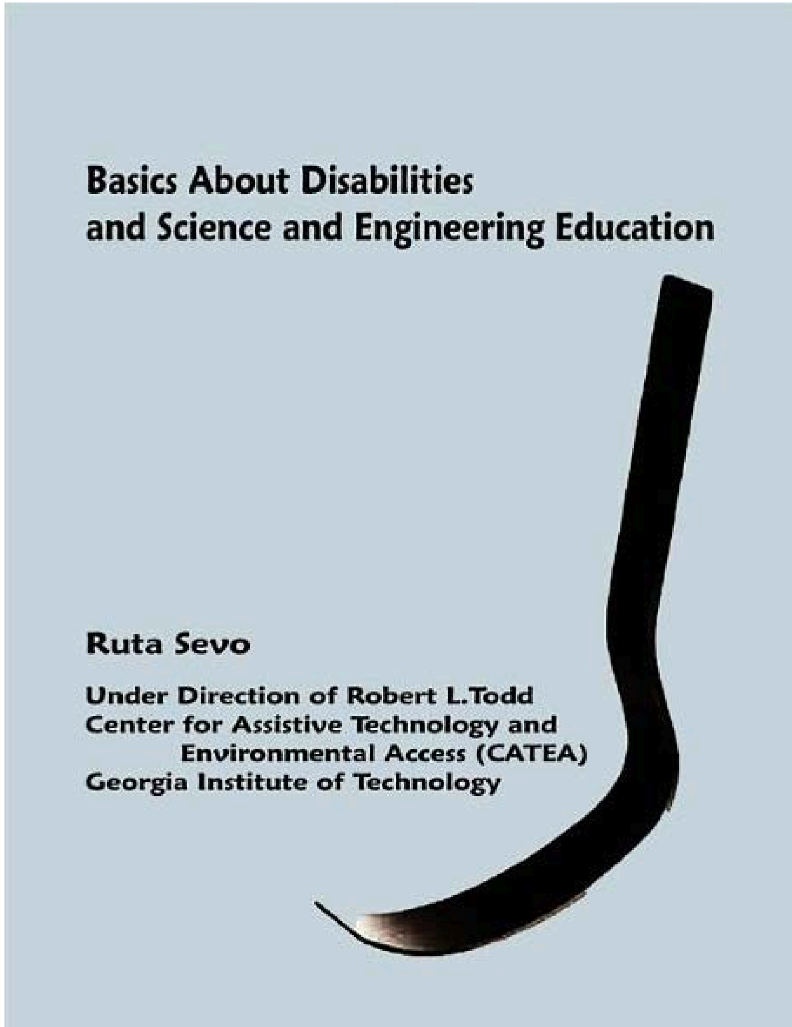
Solutions Start with a Culture Shift

Underlying most of the challenges is an understanding of disability beyond history, language and stereotype. This will take a cultural shift. Faculty and staff in post-secondary STEM programs need to understand that disability is a socio-cultural concept. Sullivan (2009) looks 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 says, 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 (Figure 6.01), *Basics About Disabilities and Science and Engineering Education*, (Sevo, 2011) contains materials, a slide show, and activities, and is free to download from Amazon.com or www.lulu.com. The book was written to facilitate the cultural shift necessary for success of SWD in STEM postsecondary programs.

Figure 6.01. *Basics about disabilities and science and engineering education.*



Several RDE-funded dissemination projects also aimed at providing understanding, insight, and information. The WAMC Northeast Public Radio station (2015) is one such dissemination project, which hosted a public relations series with the input of Glenn Busby airing 2006-2011. The topics focused primarily on women in STEM and had numerous guest speakers and women in STEM fields to provide their experiences first hand Figure 6.02 provides a list of the shows with the link.

Table 6.02. *WAMC Northeast Public Radio – Women in STEM*

Title	**Airing Date**	**Hyperlink**
The Best of Our Knowledge #815	2006 May 1	http://wamc.org/post/best-our-knowledge-815
The Best of Our Knowledge #838	2006 October 9	http://wamc.org/post/best-our-knowledge-838
The Best of Our Knowledge #840	2006 October 23	http://wamc.org/post/best-our-knowledge-840
The Best of Our Knowledge #896	2007 November 19	http://wamc.org/post/best-our-knowledge-896
The Best of Our Knowledge #908	2008 February 11	http://wamc.org/post/best-our-knowledge-908
51% Show #1010	2008 November 20	http://wamc.org/post/51-show-1010
Out Loud: Women in Physics	2009 March 27	http://wamc.org/post/out-loud-women-physics
The Best of Our Knowledge #968	2009 April 6	http://wamc.org/post/best-our-knowledge-968
The Best of Our Knowledge #997	2009 October 26	http://wamc.org/post/best-our-knowledge-997
The Best of Our Knowledge #1015	2010 March 1	http://wamc.org/post/best-our-knowledge-1015
The Best of Our Knowledge #1030	2010 June 14	http://wamc.org/post/best-our-knowledge-1030
The Best of Our Knowledge #1031	2010 June 21	http://wamc.org/post/best-our-knowledge-1031
The Best of Our Knowledge # 1105	2011 November 23	http://wamc.org/post/best-our-knowledge-1105

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

> *“This program has been a great resource not purely in terms of research funding but primarily in terms of creating a community of researchers focused on supporting the needs of students with disabilities.”*
>
> RDE PI

Successful Practices

RDE PIs have addressed the problems identified in the literature and in their own work with their research and alliance projects. These successful practices have been described many of the project PIs.

1. Engage campus disability services. All campuses have services for IWD's "it's the law, it's the right thing to do". Of course, this varies greatly – from one-person shop that also deal with non-traditional students, veterans, and affirmative action issues, to Access Centers with specialist in various forms of impairments and various academic content areas. The NCES report found that 92% of all institutions did one-one work to assist faculty and staff make accommodations for IWDs. Types of accommodations 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 – ours recently moved from Disabled Student Services to Students Access Center. Many staff members of these centers are active in the professional organization, AHEAD, Association for Higher Education and Disabilities.
2. Use existing resources; don't develop new ones.
3. Use multi-faceted interventions / programs. Alliances found the multi-element approach successful for SWD in STEM postsecondary education. The common strategies they used 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, they provided a variety of academic and social supports for their students after they were recruited. 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 indicates that recruited students 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

students learning communities to be a successful recruitment strategy: Izzo, M. V., Murray, A., Priest, S., McArrell, B. (2011). Using student learning communities to recruit STEM students with disabilities. *Journal of Postsecondary Education and Disability, 24*(4), 301-316.

5. Develop or adopt quality mentoring programs. Several Alliance PIs have written about mentoring: Leake, D., Burgstahler, S., & Vreeburg Izzo, M. (2011). Promoting transition success for culturally and linguistically diverse students with disabilities: The value of mentors. *Creative Education, 2*(2), 121-129; Martin, J. K., Stumbo, N. J., Martin, L. G., Collins, K. D., Hedrick, B. N., Nordstrom, D., & Peterson, M. (2011), Recruitment of students with disabilities: Exploration of science, technology, engineering, and mathematics. *Journal of Postsecondary Education and Disability, 24*(4), 285-299; and Stumbo, N. J., Martin, J. K., Nordstrom, D., et. al. (2011/2010). Evidence-based practices in mentoring students with disabilities: Four case Studies. *Journal of Science Education for Students with Disabilities, 14*(1), 33-54.
6. Provide self-advocacy training for students. “Self-advocacy training is key. Students need to understand their disability, learning style and STEM interests and strengths,” wrote one PI. The Kansas City Alliance team wrote about self-efficacy in their article, Jenson, R., Petri, A. N., Day, A. D., Truman, K. Z., & Duffy, K. (2011). Perceptions of self-efficacy among STEM students with disabilities. *Journal of Postsecondary Education and Disability, 24*(4) 269-283.
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 possible regardless of age, ability or situation. The approach began with architecture and was parent to a philosophy and set of principles of Universal Design for Learning. 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). Universal design is based on the socio-cultural theory of disability, as discussed earlier. The premise of universal design recognizes barriers to access can be imposed/ increased, by the environment. Additionally, this premise also recognizes that disability is a natural part of humanity rather than a special or unique occurrence requiring specialized design. PIs have written about specific Universal Design applications for STEM (e.g. Thompson, T. (2008). Universal design of computing labs. In S. Burgstahler & R. Cory (Eds.), *Universal design in higher education: From principles to practice* (pp. 235-244). Cambridge, MA: Harvard Education Press.)

Lessons Learned

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. Examples are unavailability of adaptive aids, inaccessible buildings and grounds, and lack of other accommodations; and lack of adequate services to assist with academic and nonacademic responsibilities. 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 necessary environment and supports for SWD takes much 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
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. A nation-wide community of practice among the RDE PIs was developed and grew as they met at conferences, participated in conference calls together, shared successes and failures, and published and presented together. This reduced the "isolation" sometimes felt by PIs and their teams who were possibly the only ones at their institutions with a mission of improving STEM outcomes for SWD.
8. Success is possible. And success is likely, when best practices, collaborations, and multiple program elements are in place for faculty and students.

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, but a decade of RDE-funded projects has brought us closer. There are more disability service practitioners who know more about STEM education and careers (e.g. presentations at the AHEAD conference by PIs, publication in the AHEAD journal by PIs, a special edition of the AHEAD journal featuring PIs and edited by Burgstahler, collaborations in many projects between access centers and RDE projects). There are more STEM postsecondary faculty, which have experience with and have a better understanding of SWD and UDL strategies (e.g. faculty training and partnerships with student access centers). There are more lay people who see that individuals with disabilities can and do achieve success in STEM education and careers (e.g. dissemination projects). There are more universities and STEM programs that are providing welcoming environments and quality programming for SWD (e.g. UDL and faculty training). There is more research about effective practices, technological tools, student characteristics, and mentoring related to SWD and STEM education and careers. There are more resources for faculty, staff, students, parents and advocates.

Chapter 7 – Summary of Findings Related to Research Questions

The purpose of this technical report of the RDE-Synthesis Project at Kansas State University is to provide an overview of the 2001-2011 decade of RDE projects and to suggest lessons learned through the 10 years of awards aimed at for broadening the participation of SWD in STEM. The project aimed to answer these general questions:

1. How can the RDE project portfolio from 2001-2011 be described as a whole?
2. How has RDE-funded research informed the education of SWD in STEM or contributed to the knowledge base of STEM education of SWD?
3. How have RDE projects influenced the field of STEM education?

The previous chapters of this report have provided the background and context for the RDE program and the data for this endeavor to synthesize the work of the projects funded during the 2001-2011 decade. Chapters 1 and 2 provided a historical perspective of the program and an analysis of the changes in the program as viewed through lens of the program solicitations. These chapters set the stage for the rest of the report.

Chapter 3 addresses the first question, "How can the RDE project portfolio from 2001-2011 be described as a whole?" and provides an overview of the projects and their products and publications. Questions about the influence of the RDE projects on the field of STEM education and the types of resources provided to the field are addressed in the next two chapters. Chapter 4 describes the citation and social network analysis study that was designed to describe influences and resources. Chapter 5 describes the PI survey study in which a decade of RDE PIs provided their thoughts about influences, resources, lessons learned, and problems and issues they faced. The sixth chapter synthesizes lessons learned by the projects, using their survey responses, their publications, and other materials available for analysis. This, the seventh and final chapter, will list each of the six research questions and summarize the findings for each. We will also discuss the limitations of this research as a whole and make recommendations for future synthesis studies.

Question #1: How can the RDE project portfolio from 2001-2011 be described as a whole?

The NSF RDE program was initiated to increase the participation of individuals with disabilities in STEM education and careers. It began as the Program for Persons with Disabilities (PPD) and became the Research in Disabilities Education (RDE) program in 2002. One hundred seventeen PPD/RDE awards were made between the dates of January 1, 2001 and December 31, 2011. By track, there were 10 Demonstration and Intervention (DI) awards, 3 Capacity Building (CB) awards, 2 Information Dissemination (ID) awards, 20 Alliance (formerly RAD) awards, 41 Demonstration, Enrichment, and Information Dissemination (DEI) awards, 40 Research (including FRI) awards, and 1 Innovation through Institutional Integration (I3) award. The largest amount of funding was for the RAD/Alliance track, at approximately $35.5 million. The total amount funded was $58,695,385.

There were a total of 97 PIs funded during the decade studied. Awards went to institutions in 34 states and the District of Columbia. Massachusetts, New York, the District of Columbia, and Texas received the highest number of awards.

Question #2: How has RDE-funded research informed the education of SWD in STEM or contributed to the knowledge base of STEM education of SWD?

There are several mechanisms to inform the field of practitioners and researchers involved in STEM education for students with disabilities. First, the RDE-SP team looked at publications from 2001 – 2015 (April), considering that publications in peer-reviewed journals or publications accessible to the public were contributing to the knowledge base in the field. A total of 1,095 publications were located in academic search databases for the 97 PIs during the decade studied and the two preceding years. Publications came from funded institutions in 30 states and the District of Columbia. The most prolific authors were in Texas and Washington.

The researchers also considered citations of publications by RDE PIs to be evidence of informing the field. During the decade in question, 466 publications were cited 8,966 times, or about 690 citing works per year during the decade.

The PI survey study asked PIs to identify the contributions they thought their projects had made to the “knowledge base of working with students with disabilities”. Table 7.01, also found in Chapter 4, shows their responses coded by type.

Table 7.01. *Types of Contributions the Projects had to the Knowledge Base of Working with Students with Disabilities*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Identified teaching strategies that are effective for SWD	8 (73%)	39 (83%)	47 (81%)
Identified strengths/difficulties related to working with students with specific disability	8 (73%)	25 (53%)	33 (57%)
Developed a model for working with SWD to increase their success in STEM	10 (91%)	21 (45%)	31 (53%)
Identified factors that increase SWD interest in pursuing STEM	8 (73%)	18 (38%)	26 (45%)
Identified factors that increase SWD success in STEM	9 (82%)	21 (45%)	30 (52%)
Identified factors that assist with transitions of SWD from high school to college	8 (73%)	10 (21%)	18 (31%)
Identified factors that assist with transitions of SWD from college to graduate school	8 (73%)	2 (4%)	10 (17%)
Identified factors that assist with transitions of SWD from college to the work force	8 (73%)	5 (11%)	13 (22%)
Other: (please specify)	2 (18%)	6 (13%)	8 (14%)
No Response	--	--	--

Question #3: How have RDE projects influenced the field of STEM education?

In terms of influencing the field, beyond the publications, presentations and products listed above, the researchers asked PIs in the RDE-SP PI Survey to describe the greatest achievement or most significant accomplishments of their projects. The projects reported increased support for SWDs (36% of survey respondents) as a greatest achievement and identifying effective teaching strategies for SWDs (81%) as a key contribution to the field. Projects reported that target audiences gained skills for working with SWDs (59%). Projects, especially the Alliances, believed they benefitted their institutions by contributing to the growing awareness of the needs and potential of students with disabilities in STEM. Alliances increased STEM faculty understanding and use of UDL principles, provided opportunities and supports for STEM faculty to engage with students with disabilities in STEM activities, and supported positive interactions between them. They believed that faculty in there institutions were developing greater awareness, understanding, and responsibility for students with disabilities in their courses. Other faculty and staff impacts reported by PIs were: more open-mindedness about the potential of students with disabilities in STEM; more engagement in advising and mentoring students with disabilities; and regular reflection about effective teaching and learning strategies that they could employ in their classes. PIs of Alliances speculated that project collaboration across campus and among partners strengthened and augmented services and resources for

SWD, providing accommodations and supports for students in STEM promoted success. In many cases, PIs felt that the interventions provided by the Alliances substantially expanded the capabilities of the Disability Services Office to develop and nurture STEM talent in students with disabilities. PIs reported that they were able to influence the education of SWD in STEM education by their collaborative efforts with elementary schools (17% reported this collaborative partner), secondary schools (55%), 2-year colleges of technical schools (40%, and 4-year colleges and universities (57%).

PIs also reported influences on SWD in their projects. These influences on students are reported in Table 7.02 below.

Table 7.02. *Types of Impacts the Projects Had on Target Audiences*

Response Option	**Alliance (n=11)**	**R & D (n=47)**	**Total (n=58)**
Increased interest in STEM fields/careers	9 (82%)	15 (32%)	24 (41%)
Increased knowledge of STEM fields/careers	9 (82%)	13 (28%)	22 (38%)
Increased awareness of services/opportunities available for SWD	8 (73%)	15 (32%)	23 (40%)
Increased confidence related to STEM	10 (91%)	20 (43%)	30 (52%)
Increased motivation to achieve in STEM	10 (91%)	17 (36%)	27 (47%)
Increased preparedness for college or work force	8 (73%)	15 (32%)	23 (40%)
Increased skills for working with SWD	8 (73%)	26 (55%)	34 (59%)
Increased connections/expanded networks for SWD	9 (82%)	14 (30%)	23 (40%)
Increased number of SWD that enter higher education	7 (64%)	6 (13%)	13 (22%)
Increased number of SWD that enter the STEM work force	8 (73%)	6 (13%)	14 (24%)
Increased STEM competencies for SWD (GPA, study skills)	9 (82%)	14 (30%)	23 (40%)
Other (please specify)	2 (18%)	8 (17%)	10 (17%)
No Response	--	1 (2%)	1 (2%)

Question #4: In what ways have the RDE projects provided resources to the STEM education community?

In addition to publications and collaborations, the products developed by RDE projects provide resources to the STEM education community. These products, 6,622 in total, were primarily training materials (5,114), presentations (508), instrumentation (332), reports (146) and publications (138). These resources have been placed on project and university websites and many are found on the RDE dissemination website at the University of Washington.

Question # 5: What are the primary lessons learned from the decade of funded projects?

Chapter 6 lists seven lessons learned beyond the tools, practices and resources developed by individual projects. These lessons were extrapolated from PI publications, presentations, and from specific questions on the PI survey conducted by the researchers. Lessons relate both to surprising challenges and successful solutions. In general, these lessons are:

1. Identification of students with disabilities is problematic
2. Faculty and staff may have stereotypes about students with disabilities, their interest and capacity to do STEM work.
3. In general, there is a paucity of resources for students with disabilities.
4. Faculty and staff are often willing to make changes in their approaches to promote successful educational and social experiences for SWD.
5. Collaboration and teamwork are essential.
6. Data collection is difficult; many measures are not validated on students with disabilities.
7. The community of other PIs and colleagues was important to PIs and project staff.
8. Success is possible.

Appendix F contains information about lessons learned and categorized them to apply and appeal to various types of institutions and personnel roles in the STEM education of students with disabilities.

Question #6: What are common problems/issues and what suggestions for solutions have come from RDE projects?

Chapter 6 outlines common problems faced by RDE projects across the decade and describes solutions and common strategies used by the RDE projects. Most of the challenges written about by PIs and reflected in the PI survey are similar to those found in the literature. These challenges are:

1. Underprepared students, which may reflect the expectations, coursework and lack of access of students with disabilities in K-12 settings.
2. Lack of understanding and cooperation from administrators, faculty and staff, especially in high school and postsecondary settings.
3. Lack of accommodations; accessible buildings, classrooms and labs; and unavailability of adaptions beyond those required by ADA.
4. Knowledge and skills of faculty and staff related the strengths and needs of students with disabilities.
5. Identifying and recruiting students with disabilities for special programs or for differentiated instruction.
6. Relatedly, the tracking of students in programs and the measurement and evaluation of program impacts on SWD.

RDE projects found potentially successful solutions to these problems, but admitted that many could not be solved without more collaboration and collective work with higher-level decision-makers than project PIs. Table 7.03, from chapter 6, summarizes practices and strategies PIs reported as helpful in overcoming the challenges listed above.

Table 7.03. *Best practices and strategies to overcome obstacles.*

Best Practices and Strategies to Overcome Obstacles	
Build trusting and respectful relationships with students and institutional staff	Recognize the importance of reporting and dissemination early on
Develop effective recruitment strategies and practices	Engage office of disability services at your institution
Identify alternative data collection and entry strategies	Increase awareness that SWDs can succeed
Network, collaborate, and utilize all resources available	Obtain administrative approval to recruit students
Persist in efforts with students and institutional staff	Use inclusive strategies

Limitations

A number of limitations impacted the synthesis research team over the project period. These included challenges in accessing data, identifying and compiling data sets, and reporting comprehensive results from all of the RDE projects funded from 2001-2011. These limitations are described in further detail below.

Accessing Data: In the original proposal, the project team planned to have access to data from NSF for each of the 117 RDE awards made from 2001-2011. This would have included annual reports and PDMS data, which would have allowed the team to examine and synthesize the findings from all of the projects. However, due to restrictions from the agency, NSF was not able to release these data. Instead, the research team had to try to contact each of the project PIs to request their participation on the project. This included having the PIs submit available reports, as well as responding to a survey to collect additional data on the projects.
In attempting to contact the 96 project PIs, not counting the RDE Synthesis project, the research team found that a number of these individuals were not available to participate in the study:

- Three of the PIs had retired
- Five of the PIs had passed away
- Three individuals were contacted, but declined to participate in the study

As a result, these projects were not included in the synthesis if other contacts were not available. In the first year of the project, 43 of these PIs submitted documents for the synthesis. These 43 individuals, representing 51 awards, submitted a total of 164 documents, including annual reports, evaluation reports and other project materials.

Identifying and compiling data sets: Upon receiving the reports and project documents from the PIs, the synthesis team created an index to help manage the data. The documents were then reviewed to identify common themes in successes, challenges and lessons learned that were reported by the projects. Because less than half of the PIs submitted documents, the synthesis team developed a survey to collect additional information. The synthesis team used the themes identified in the document review to help develop an online survey. As described previously in this report, the survey was launched in spring of 2013 to 87 PIs. Fifty-eight of these individuals completed the survey for a 66.7% response rate. However, when you add the number of PIs that submitted documents, but did not respond to the survey (15), the research team was able to receive some form of data from 73 of the 87 PIs.

While that does capture most of the PIs and projects, it also represented a challenge the synthesis team had to address. Given the variety of documents received from the PIs, it was difficult to compile a concrete data set. When the team developed the survey, the intent was to use these responses as the main data set for the synthesis. However, based on the response rate, the team realized that it may be necessary to pull some data from the document review to get a more comprehensive view of the results across projects.

The challenge was then to conduct the synthesis using multiple data sources, knowing that some projects were represented in both the survey data and document review, while others were only in one or the other. As a result, the research team decided to use the survey responses as the primary data set, conducting this analysis and compiling a summary report of responses. Then, as a supplement to these findings, the research team went back to the document analysis data to capture other themes or trends that may not have been found in the survey responses, and identify supporting evidence.

Reporting comprehensive results: As noted previously, the synthesis only included projects that responded to the research team's request for participation. The results reported do not capture all of the contributions from the RDE funded projects between 2001 and 2011. Particularly in data such as the number of products developed, or total number of students served. The totals presented do not reflect the full scope of the RDE projects.
Despite these limitations, the team was able to identify lessons learned through the 10 years of RDE awards aimed at broadening the participation of students with disabilities in STEM.

Conclusions

A decade of RDE funding, from 2001 to 2011, has produced a significant number of publications, products, and findings that inform the STEM education field. In addition, a decade of funding of RDE alliances has built capacity at the post-secondary level of STEM education and increased the number of students with disabilities in STEM postsecondary education and the number who have completed degrees in STEM. Despite the limitations of this synthesis project, which include limited access to project reports and project data, this study has been able to describe the history of the program, the solicitations, and the funded proposals during the past decade. We have also documented publications of PIs funded in this decade, publications from 2001 to 2015 (April). These publications were analyzed by topical areas and by type, and they show a significant contribution to the field. The citation analysis demonstrates that these publications are being read and cited. It also demonstrates that a community of scholars has been developed among and across the RDE PIs of the decade. In summary, when considering the goals of the RDE program when it was established (increasing the knowledge base of research related to the success of students with disabilities in STEM postsecondary education; increasing the number and quality of students with disabilities successfully completing associate, undergraduate, and graduate degrees in STEM; increasing the number of students with disabilities entering the professional STEM workforce; and disseminating information about research and evaluation findings related to postsecondary educational success of students with disabilities in STEM and the STEM workforce), this project can attest, with documentation provided in this report, that the first and fourth goals have definitely been met (increasing the knowledge base of research related to the success of students with disabilities in STEM postsecondary education, and disseminating information about research and evaluation findings related to postsecondary educational success of students with disabilities in STEM and the STEM workforce). There are indications from the information available to the researchers that the other two goals have been met or approached. Those goals are increasing the number and quality of students with disabilities successfully completing associate, undergraduate, and graduate degrees in STEM and increasing the number of students with disabilities entering the professional STEM workforce. From the work of the researchers on this synthesis project, it appears that the investment of NSF in the RDE program has been a productive use of NSF funding for the purpose of increasing the diversity of the STEM education population as well as the STEM workforce and for the purpose of providing access, opportunity and success for students with disabilities in STEM education and careers.

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