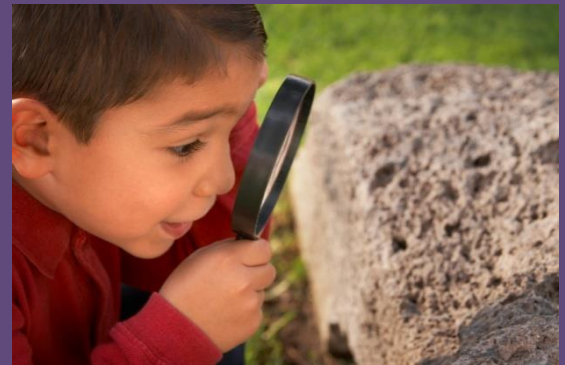


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Early Career Researchers and Developers in the DR K-12 Program: Needs, Supports, and Recommendations



Community for Advancing
Discovery Research in Education

Written for CADRE by:

Policy Studies Associates, Inc.

Derek Riley

Alisha Butler

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The future strength of the National Science Foundation's (NSF) K-12 education research and development efforts depends in part on the development of promising early career researchers and developers—including doctoral students, post-docs, and first time principal investigators (PIs)—who can grow into R&D leaders and form an impactful R&D workforce. Unfortunately, there is little written on the needs and supports related to early career professional growth in the NSF's Discovery Research K-12 program (DR K-12). Early career researchers and developers in the program have not been asked in a systematic way to assess the topics, types, and sources of support they need and receive. Likewise, DR K-12 veterans have not been asked about the supports they provide to early career colleagues or what they think would be most helpful for early career growth.

CADRE¹ staff produced this brief to promote deliberation on how to improve support and guidance for early career researchers and developers in the DR K-12 program, as well as in the broader field of STEM education R&D. While content and technical expertise are essential for a successful R&D career, here we focus on the development of professional R&D capacities that are needed regardless of one's discipline, methods, or institution. The brief is written for consideration by a range of audiences, including the NSF, its resource networks (particularly CADRE), R&D project leaders and mentors, academic advisors, and early career researchers and developers themselves. Data was provided by a sample of individuals who have shown early career promise, as well by veteran PIs who were motivated to respond on this subject. This brief explores early career and veteran perspectives related to the following questions:

1. What topics and types of supports for professional growth do early career researchers and developers need and receive?
2. To what extent have sources of support proven helpful for early career professional growth, and how?
3. How might the support and professional development of early career researchers and developers be improved?

After discussing methods and the professional experience of survey respondents, the brief turns to the topics on which early career respondents said they needed and received support, followed by topics on which veteran PIs provided support. Then, we discuss a variety of sources of early career support, along with their contributions to early career growth. The brief concludes with recommendations for key actors involved with early career professional growth in the DR K-12 program.

¹ The Community Advancing Discovery Research in Education (CADRE) is an NSF-funded resource network that supports and connects researchers and developers in the NSF's Discovery Research K-12 program. More information can be found at <http://www.cadrek12.org>.



Methodology

This brief draws on data collected in spring 2014 through interviews, a survey of early career researchers and developers, and a parallel survey of veteran researchers and developers. The interview respondents not only spoke about their own early career needs and supports, but also provided feedback on survey development and reviewed a draft version of this brief. Contributors who talked with the research team are identified at the end of this document.

- Interviews. The research team interviewed 20 early career researchers and developers individually and in small groups. Respondents were all associated with DR K-12 projects and were recruited through an invitation to all current and former CADRE Fellows² and through targeted invitations to current CAREER³ grantees or first-time PIs who were nominated by NSF program officers or CADRE staff. Interview respondents provided perspectives from a variety of early career stages, from doctoral student through new PI.
- Survey of Early Career DR K-12 Researchers and Developers. The research team invited 81 early career researchers and developers, who comprised the complete sets of current CAREER DR K-12 grantees and current and former CADRE Fellows, to respond to a brief online survey. Fifty of the 81 invitees responded to the survey (62 percent). Survey questions elicited data regarding the respondent's background and affiliations, topics of needed support, and sources of support.
- Survey of Veteran DR K-12 Researchers and Developers. We invited 311 current DR K-12 PIs to complete this survey. This included nearly all current DR K-12 PIs, except for CAREER grantees and those for whom we did not have an active email address. Of the 311, 129 responded (41 percent). For the purpose of this brief, we consider this group of 129 current PIs to be “veteran” researchers and developers, though there is likely wide variation among these respondents in how long they have been R&D professionals. The survey questions for veterans were parallel to questions for early career respondents, but asked for veteran perspectives on early career needs and supports, as well as the topics on which the veterans provided support.

Data from the two surveys are intended to promote discussion on early career supports: They should not be regarded as representative findings for the entire populations of DR K-12's early career researchers and developers or veteran PIs. We report simple frequencies, and in order to highlight response variation and intensity, our analyses focus mostly on the top end of four-point scales (e.g., “to a great extent” and “very important”).

² The NSF-funded CADRE Fellows program, beginning its sixth year in 2014-15, is a competitive cohort fellowship designed to build the capacity of early career DR K-12 researchers and developers, particularly those who are doctoral students or research assistants who have not yet published extensively. More information can be found at <http://cadrek12.org/cadre-fellows>.

³ The NSF-funded Faculty Early Career Development Program (CAREER) is an NSF-wide grant program that offers prestigious awards to promising junior faculty. More information can be found at http://www.nsf.gov/funding/pgm_summ.jsp?id=503214.



Professional Experience of Respondents

The large majority of all respondents reported they were currently affiliated with a college or university. However, early career respondents were more likely to report affiliation with a college or university (84 percent) than were veteran respondents (74 percent). When asked to choose the title that best describes their current position, about half of the early career respondents reported they were either Assistant Professor (34 percent) or Associate Professor (20 percent). Other academic position titles that were reported include Doctoral Student (20 percent) and Post-Doc (4 percent). Sixteen percent of early career respondents reported they were “not in an academic position,” presumably working in non-profit, governmental, or private institutions.

Exhibit 1: Professional Positions Held Thus Far by DR K-12 Survey Respondents

	Early career percent (N=49)	Veteran percent (N=126)
Researcher or developer in the education department/school of a college or university	76	56
Teacher educator or professional developer	65	56
Pre-K-12 educator	61	54
Researcher or developer in a non-education department/school of a college or university	18	31
Position at an informal learning organization	18	14
Researcher or developer in a private, non-academic institution	16	35
Other	8	9
Position in a government agency	6	14

Exhibit reads: Seventy-six percent of early career respondents and 56 percent of veteran respondents have held a position of researcher or developer in the education department/school of a college or university.

Sources: Survey of Early Career DR K-12 Researchers and Developers (N=49); Survey of Veteran DR K-12 Researchers and Developers (N=126); Respondents could select more than one response.

DR K-12 researchers and developers bring a variety of past professional experiences to their current work (Exhibit 1). Early career and veteran respondents reported having held positions outside of academia, particularly as Pre-K-12 educators (61 percent for early career; 54 percent for veteran). Veterans were more likely than early career respondents to have held a position in private, non-academic institution or in a non-education department/school of a college or university (e.g., departments of mathematics, science, engineering, information sciences). Early career respondents were more likely than veteran respondents to have held a position in the education department/school of a college university.



Topics on which Support Was Needed and Received

Using two survey questions, we asked the early career respondents to indicate the extent to which they 1) needed and 2) received support on eleven topics relevant to professional growth (Exhibit 2). We discuss survey and interview responses in the following pages. Discussion is organized by topic of support in order of the frequency early career respondents said they needed support on the topic. First, highlights include:

- For all but one topic, early career respondents were more likely to report that they needed support than received support, though the size of the gap was larger for some topics.
- *Developing proposals* was the topic in which support was most frequently needed to a great extent, yet was much less frequently received to a great extent.
- Compared with other topics, support on *networking and collaborating* was both needed and received to a great extent. Opportunities to network depended significantly on institutional affiliation and facilitation by PIs or mentors.
- *Presenting at conferences* was the topic in which support was least frequently needed to a great extent, yet was most frequently received to a great extent. However, opportunities to attend or present at conferences are too limited for many early career researchers and developers.
- Needs varied by early career stage, with doctoral students needing support on identifying an R&D focus and career path, post-docs needing proposal- and networking-related support, and first-time PIs needing guidance on project management.

Developing proposals & Identifying appropriate funding sources. In order to stake out a career in research and development, one must get funded: doing so is a primary concern for early career researchers and developers. Early career respondents most often identified two related topics as their biggest areas of need—*developing proposals* for funding (69 percent to a great extent) and *identifying appropriate funding sources* (59 percent to a great extent). Similarly, when veterans were asked a parallel question about topics in which early career researchers need support, the veterans also chose *developing proposal* most frequently (79 percent to a great extent).

“I am okay with writing publications, but in terms of how to write a proposal, I don’t know where to start.”
- Early career respondent

However, far fewer early career respondents reported receiving support to a great extent on *developing proposals* (20 percent), suggesting early career researchers and developers could use increased support on this topic. Generally, early career interview and survey respondents agreed that they had some support in learning how to write proposals or identify funding sources. However, that support was seen as insufficient for their needs. In interviews, those that did



receive useful support or guidance on proposal writing felt fortunate compared to their peers and regarded the learning opportunities as especially helpful for their career development.

Exhibit 2: Topics on which Early Career Respondents Needed and Received Support

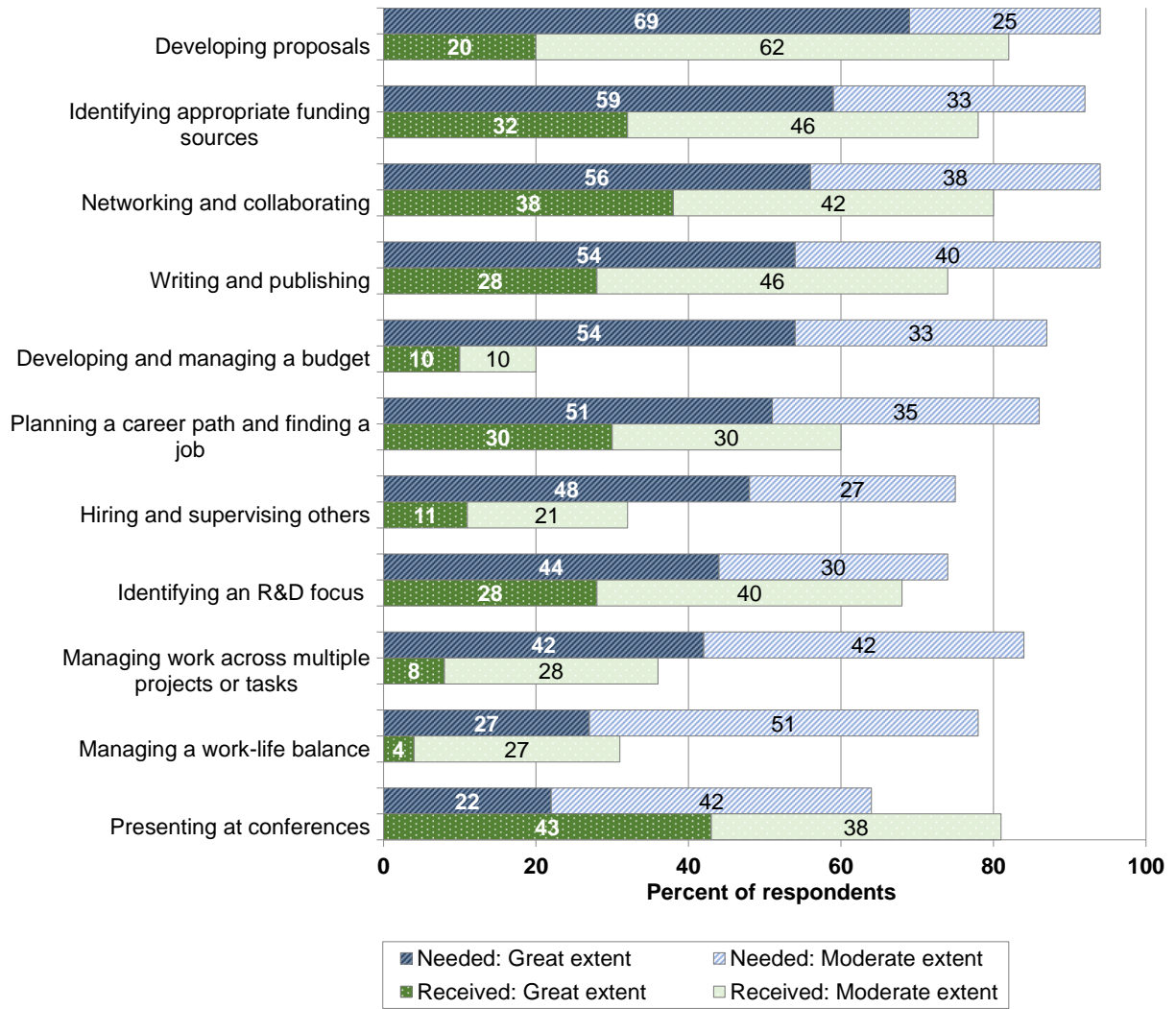


Exhibit reads: On the topic of “Developing proposals,” 69 percent of early career respondents reported that they needed support to a great extent, and 20 percent reported they received support to a great extent.

Source: Survey of Early Career DR K-12 Researchers and Developers (N=50)

Several early career interview respondents spoke highly of their opportunity to serve on a DR K-12 proposal review panel, and their consensus was that there is no substitute for reviewing real proposals alongside real reviewers. Other individuals wanted to serve on a panel but were not asked to and/or were mystified about how to become a candidate.



Respondents pointed to other invaluable types of support for learning about proposal writing—participating in a proposal writing process with an experienced colleague, seeing examples of successful and unsuccessful proposals, and getting feedback on their first proposals from multiple individuals with knowledge of the content, methods, and the proposal process. Formal and informal mentors often provided the respondents with these types of support, though several respondents added that they also looked outside of their institution for this advice, particularly if they were not housed at a large institution with research focus. Webinars and informational sessions were seen as helpful for understanding the basics, such as logistics or proposal requirements.

Lastly, interview respondents pointed to a variety of proposal-related topics for support, including those that looked beyond the nuts and bolts understanding needed to respond to a solicitation. On one hand, they said early career researchers and developers need help developing the project concept and content. But they also highlighted needed guidance in developing and nurturing relationships, such as with R&D collaborators and K-12 partners, and in managing the writing process.

Networking and collaborating. The third most frequently cited need was *networking and collaborating*, as reported by both early career (56 percent to a great extent) and veteran respondents (68 percent to a great extent). This was a topic on which early career respondents also said they received support, as it was the second most frequently cited topic of received support (38 percent to a great extent). Many interview respondents described networking as essential for success in the R&D field, and they spoke of the importance of networking with veterans as well as peers.

However, opportunities to network and networking support varied across respondents. Early career interview respondents said it was easier to network and form collaborative relationships when housed at a large research university or affiliated with an R&D center. It was also easier for those that had a PI or mentor who was invested in and capable of facilitating connections with others in their research area. One way PIs supported networking was by supporting conference-going, in terms of funding attendance and working to garner a registration slot, but also by being deliberate in making introductions. Some early career respondents spoke of the lasting positive effect of networking that occurred through participation in major cross-institution programs or centers, such as the now-defunct NSF-funded Centers for Learning and Teaching.

“Networking is everything, though it is the one thing that I’m slow to adapt to.” - *Early career respondent*

In interviews, early career researchers and developers also said they needed guidance on developing and nurturing relationships with K-12 individuals and institutions that could participate as R&D partners or subjects. Several, speaking from project experience, commented that successful implementation of a project often hinged on finding and maintaining productive relationships with K-12 actors. Yet, this is a difficult task, even for experienced PIs and those who have worked in schools as K-12 educators. Respondents pointed out that support was needed on how to build relationships with K-12, as well as in bringing early career researchers and developers into existing relationships.



Writing and publishing. Fifty-four percent of early career researcher and developers reported that they needed support to a great extent in *writing and publishing*. Veteran PIs found this to be an even higher priority for early career support, placing it second in relative order of need (70 percent to a great extent). Many early career interview respondents found assistance from their faculty advisor or PI to be useful, as the respondent progressed from assisting on papers toward lead authorship. Helpful guidance took a variety of forms, from assisting with tone and syntax to identifying appropriate publications to framing findings and methods in a compelling way.

Developing and managing a budget & Hiring and supervising others. These two topics, both project management tasks, were similar in having a substantial gap between needed support and received support. Early career interview respondents who were managing their own projects said that *project budgeting* was an important function they received little help with until they were in the thick of it. While 54 percent of early career survey respondents reported that they needed guidance on budgeting to a great extent, only ten percent said they received this support to a great extent. In interviews, almost no one said they were exposed to budgetary

“I really needed more support in writing budgets and accounting. Some institutions have that support built in, but others don’t.” - *Early career respondent*

decision making or mechanics. Support on this topic tended to come from an advisor or institution budget specialist as a part of a proposal writing process or at a project’s inception. Interview respondents did wonder if there was some type of generalized training or exposure that could be offered earlier in career development.

Forty-eight percent of early career survey respondents said they needed support on *hiring and supervising others* to a great extent, yet just eleven percent received that support to a great extent. Interestingly, of all topics, veteran respondents were least likely to say early career researchers and developers needed support on *hiring and supervising others* (36 percent to a great extent). While managing others is not often a primary responsibility early in one’s career, it is an important skill that could be learned early on by observing effective mentors or receiving feedback when managing a smaller project tasks. Interview respondents who were given management opportunities in their early career were more likely to say they developed skills in this area. Other respondents pointed to the benefits in this area that result from PIs who have frequent project meetings in which they model team management. This is a topic on which *published resources*—more than any other source—contributed meaningful support to early career survey respondents (see Exhibit 6, below).

“Supervising and management is a huge part of this—more than I realized. I was used to working alone as an academic.” - *Early career respondent*

Planning a career path. *Planning a career path* was identified as a middling need by early career survey respondents (51 percent to a great extent), and they said they received support in this area (4th most frequently received topic of support). Interview respondents said that support and guidance on this topic often came from their advisors, as well as from peer networks (these sources of support are discussed in a following section). Several found that a



weakness in support for career planning was that advisors tended to focus on career paths similar to the path they took themselves. For instance, academic pathways were promoted, while non-academic pathways into non-profits or private-sector R&D were not addressed in the support.

Presenting at conferences. *Presenting at conferences* is the only topic for which early career respondents were more likely to have received support to say they needed it (43 percent to a great extent, 22 percent to a great extent,). In fact, this was the most frequently identified topic of received support and the least most frequently needed. Interview respondents that pointed to useful support on this topic said that they received support on developing presentation proposals, identifying the right conferences at which to present, framing the presentation content, and rehearsing presentations. One interview respondent highlighted the difference between a PI's support for presentations that advance the project's agenda versus support for presentations that are driven by the interests and career path of the early career presenter. Supporting presentations that further a junior researcher's own career trajectory may offer less of an incentive for PIs, but that support may lead to greater professional growth and career development.

Different needs at different early career stages. Not surprisingly, some interview respondents emphasized different support needs for different stages of their early career, though needs related to *developing proposals* and *networking and collaborating* were frequently mentioned across all stages. Prominent topics of needed support they identified, by early career stage, include:

- Doctoral students need support on: developing an R&D focus, understanding career paths within and outside of academia, writing for publications, networking
- Post-docs need support on: writing proposals for funding, networking, project budgeting, developing a long-term R&D focus while conducting project work, learning all stages and components of an R&D project, career planning, collaborating with other R&Ders, developing relationships with K-12
- First-time PIs need support on: hiring and managing people, managing multiple work strands within and outside of a project, managing time, reporting to NSF, mentoring others

Topics of Support Provided by Veteran Respondents

Veteran PIs, who supervise early career researchers and developers and sometimes serve as their formal faculty advisors, are a primary source of support and guidance among many sources. In a survey item, we asked veterans to indicate the extent to which they provided support on each of the eleven topics to early career researchers and developers (Exhibit 3). These results are interesting on their own, but it is helpful to compare the veteran responses with needs identified by early career respondents. It is important to note that in their survey, early career respondents identified needs that could be addressed by any source of support, not just by veteran PIs. Some needs might be best addressed by sources other than PIs.



One can draw insights into what PIs may consider continuing or doing differently. For instance, they may consider:

- focusing more support on *developing and managing a budget* and *hiring and supervising others*
- ramping up guidance related to *developing proposals*
- continuing to support *presenting at conferences*, perhaps while determining whether their level and types of support are optimal

On four topics, more than sixty percent of veteran respondents said they provided support and guidance to a great extent:

- *Presenting at conferences* (66 percent to a great extent). While the top topic of support provided by veterans, *presenting at conferences* was not identified as a great need by early career respondents (least frequently identified need; 22 percent to a great extent), nor by veterans themselves (second least frequently identified need).
- *Networking and collaboration* (65 percent to a great extent). This topic was uniformly identified as a major area of needed support by early career and veteran PI respondents (third most frequently identified to a great extent, for both groups).
- *Planning a career path and finding a job* (64 percent to a great extent) and *writing and publishing* (61 percent). A smaller proportion of early career respondents said support on these topics was needed to a great extent, though the differences between early career responses and veteran responses were not great.

Least frequently, veteran PIs reported providing support for the following topics:

- *Developing and managing a budget* (17 percent to a great extent). PIs and their institutions may consider providing or arranging for greater support on this topic, as a much larger proportion of early career respondents said they needed support to a great extent (54 percent).
- *Hiring and supervising others* (25 percent to a great extent). Similarly, there was a relatively large gap between the frequency with which early career respondents identified this as a need and veteran PIs said they provided support.
- *Managing a work-life balance* (30 percent to a great extent). While presumably a difficult balance to strike (and one that is personal and unavoidable), this was not frequently identified as an area of needed or provided support. Unsurprisingly, several interview respondents, particularly those with young children, found this to be a struggle, but there were few suggestions about how veteran PIs could help them navigate it.



PIs are an important, but not singular, source of support to early career researchers and developers. Nevertheless, as a key and proximal resource, PIs may want to have regular, explicit conversations with their early career colleagues about the areas in which they have career development needs and existing supports.

Exhibit 3: Topics on which Early Career Respondents Needed Support and Veteran Respondents Provided Support

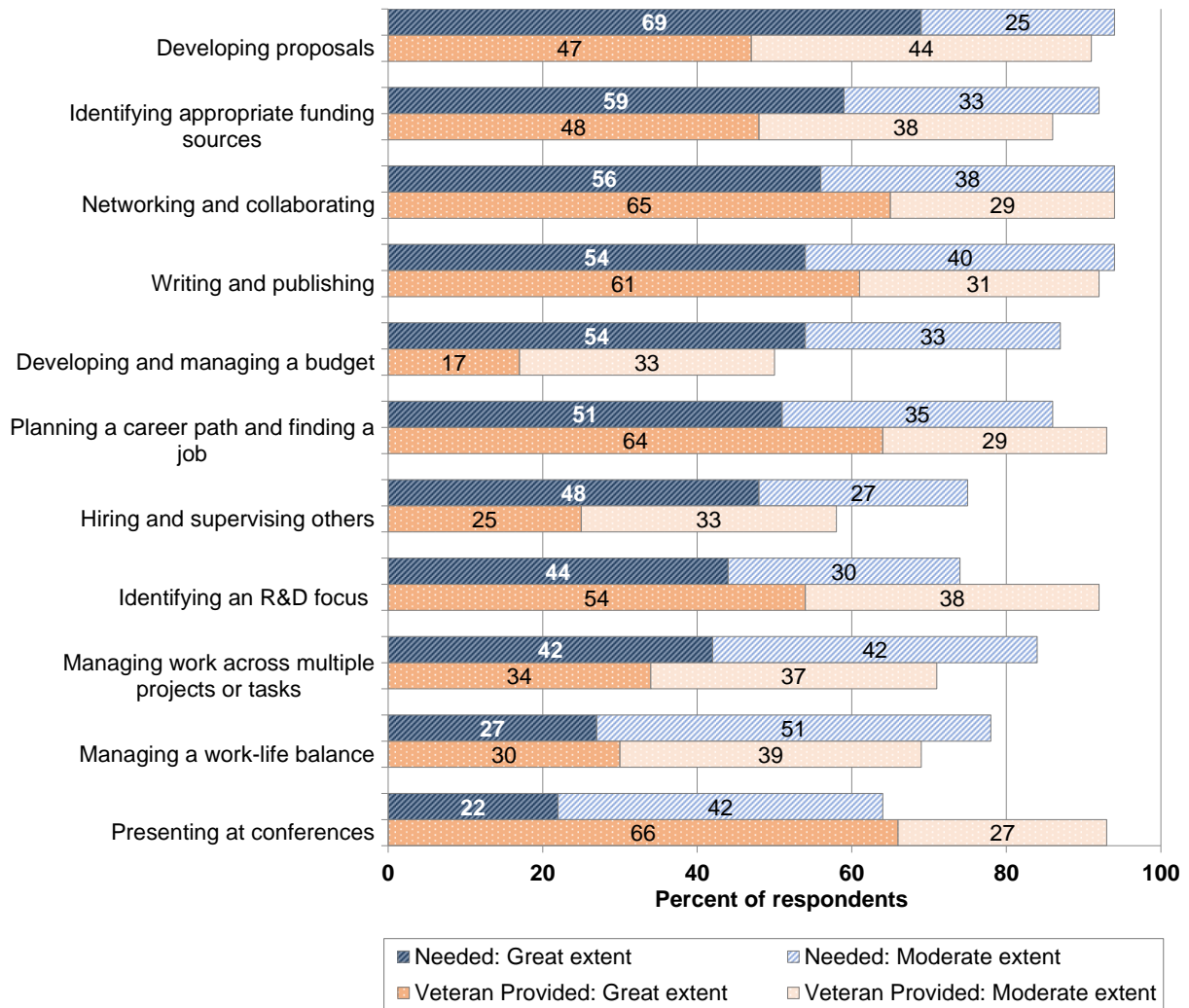


Exhibit reads: On the topic of “Developing proposals,” 69 percent of early career respondents reported that they needed support to a great extent, and 47 percent of veteran respondent reported they provided support to a great extent for early career researchers and developers.

Sources: Survey of Early Career DR K-12 Researchers and Developers (N=50); Survey of Veteran DR K-12 Researchers and Developers (N=121)



Sources and Types of Support

On two parallel survey items, early career respondents and veteran respondents rated the importance of eight sources of support for early career growth. The responses of early career respondents are presented in Exhibit 4. Using a separate survey item, we asked the early career respondents to identify the topics on which each of the sources contributed meaningful support for early career growth. Exhibit 5 highlights the most and least frequently reported topics of meaningful support by source, while Exhibit 6 provides the complete set of frequencies for all sources and topics of meaningful support. Data from these three survey items, as well as from interviews with early career researchers and developers, are discussed in the following section. Highlights include:

- Responses from early career and veteran respondents put three sources of support well ahead of the others in importance, these being *formal advisors or supervisors*, *informal mentors*, and *peers and peer networks*.
- *Formal advisors or supervisors* were the source most frequently identified as very important for eight of eleven topics.
- On the topic of *developing proposals*, *formal advisors or supervisors* were by far the leaders in contributing meaningful support. However, early career interview respondents indicated that participation on DR K-12 proposal review panels was an extremely meaningful learning experience for this topic.
- On the oft-needed topic of *networking and collaborating*, early career respondents most frequently reported that *peers and peer networks* contributed meaningful support. Veterans reported that *peers and peer networks* were the second most important source of support in early career R&D. Interviews indicated that early career researchers and developers wanted even more opportunities to network with peers and veterans, particularly outside of their institution or department.
- While trailing other sources, the NSF was found by early career respondents to contribute meaningful support most often on the topics of *identifying appropriate funding sources*, *developing proposals*, and *networking and collaborating*.

Formal advisors or supervisors & Informal mentors. Early career survey respondents most often identified *formal advisors or supervisors* as very important sources of beneficial support for their professional growth (68 percent). Second most often, they identified *informal mentors* as very important sources (52 percent). In interviews, early career respondents described strong mentoring from formal faculty advisors, but they most often pointed to veterans on their projects or research teams as helping them grow as R&D professionals. These veterans included project PIs and Co-PIs, as well as other experienced researchers and developers who could provide informal mentoring. Along these lines, when veteran respondents were asked to identify which sources of support they thought were important for early career growth, they most frequently said *informal mentors* were very important (75 percent) with *formal advisors and*



supervisors third (61 percent). One way to interpret these data is that informal mentors should be regarded as a core component of early career R&D support—early career researchers and developers could seek out informal mentors, veterans could open themselves up to informal mentoring, and the NSF and host institutions could promote opportunities in which early career and veteran researchers might establish informal mentoring relationships (e.g., conferences, cross-institution R&D centers or events, work groups).

Exhibit 4: Sources of Support for Early Career Respondents, by Importance

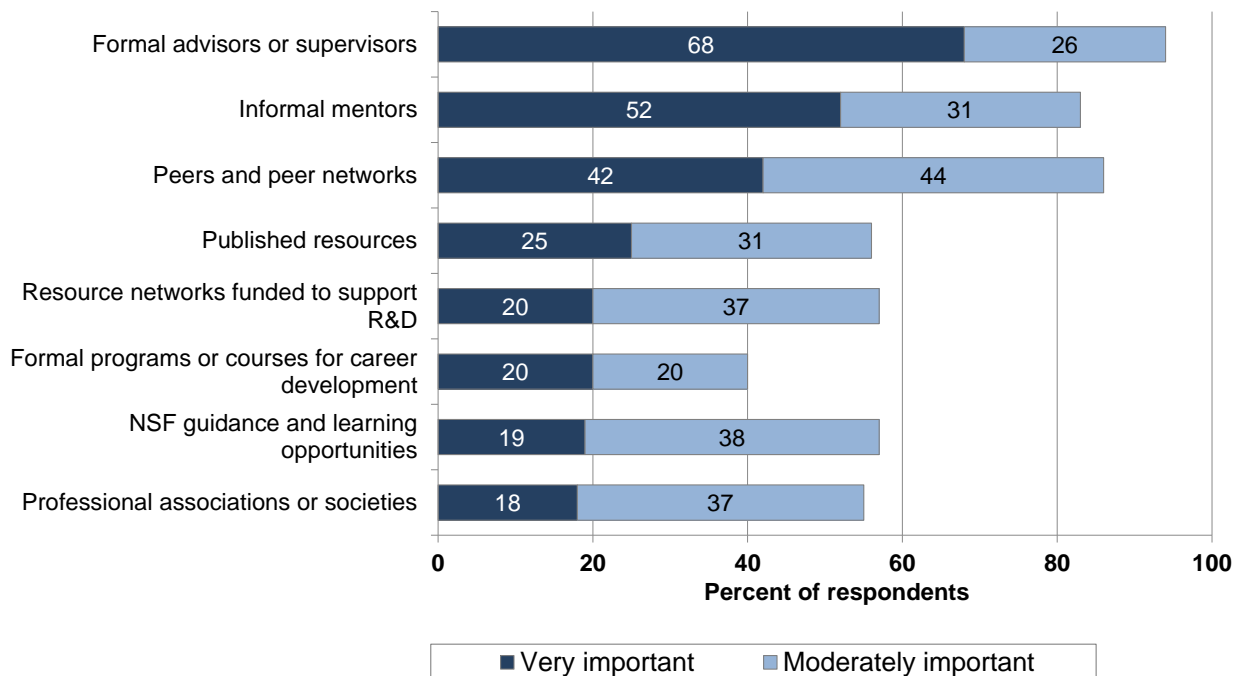


Exhibit reads: Sixty-eight percent of early career respondents reported that “Formal advisors and supervisors” were very important sources of support for their professional growth, and 26 percent reported that this source was moderately important.

Sources: Survey of Early Career DR K-12 Researchers and Developers (N=50)

These two types of sources were seen to contribute meaningful support on different topics, as seen in Exhibit 6. Early career respondents indicated that *formal advisors and supervisors* most often provided meaningful support on *planning a career path and finding a job* (85 percent), *identifying an R&D focus* (73 percent), and *developing proposals* (71 percent), and they were the leading source of support on 8 of the 11 topics. *Informal mentors* most often provided meaningful support on *planning a career path and finding a job* (58 percent), *networking and collaborating* (56 percent), and *writing and publishing* (48 percent). This suggests that early career researchers and developers would do well to develop relationships with *informal mentors*, in addition to those with a more formal role.

Perhaps not surprisingly, early career survey respondents indicated that *formal advisors and supervisors* were the leading sources of support in *planning a career path and finding a job* in



R&D. Interview respondents appreciated mentors or advisors who were intentional in providing career guidance, discrete from guidance that focused on project or academic work. Whether regularly scheduled or ad hoc, the useful guidance included explicit discussion of career paths, planning, and steps to be taken. For instance, mentors provided advice about clarifying an R&D focus that intersects personal interests and needs in the field, or they provided guidance about publishing and presenting that will serve career goals. They were also willing to collaborate on work with their early career colleagues and share their own challenges as R&D professionals.

It should be noted that early career interview respondents said that the usefulness of support varied substantially among those in advisor, supervisor, and mentor roles. They suggested that more could be done to promote consistently good R&D career mentoring, which is discussed more in the section on recommendations for the NSF.

Formal advisors and supervisors are a key source of support on *developing proposals*. As discussed above, early career researchers and developers identify this as a leading area of need, and they also said that formal advisors and supervisors were by far the most likely source to contribute meaningful support on the topic (71 percent). Interview respondents pointed to ways advisors and mentors helped them learn about proposal writing:

- Involved them in proposal discussions and drafting, as well as in the procedural and budgetary aspects of proposal writing
- Advocated for their participation as a DR K-12 proposal panel reviewer
- Shared examples of winning and losing proposals, as well as feedback from reviewers
- Provided generous feedback on their own draft proposals

Project leaders are in a unique position to help career researchers and developers to learn about and take on project management tasks. Interview respondents described benefits in being exposed to all parts and processes of an R&D enterprise. A couple of individuals felt fortunate to have a substantive long-term role on a project, from its proposal through late publishing, affording a complete picture of a project's life. This may provide a greater

opportunity to grow as a professional, at least in terms of understanding project management, than would being pulled onto a project for relatively isolated tasks. Respondents described several examples of ways PIs facilitated their learning of project management:

- Gave substantive responsibility for portions of a project, allowing for discomfort and growth around areas such as work flow management and oversight of a team

"PIs should make decisions collaboratively: involve [early career researchers and developers] in every step of proposal preparation and project management." - *Veteran respondent*



- Involved them in regularly scheduled project meetings that cut across tasks and that may involve partner organizations
- Included them in tasks associated with reporting to or meeting with NSF program officers
- Included them in relationship building and recruitment efforts with K-12 partners and subjects

While *peers* and *professional associations* play a large role in *networking and collaborating*, early career survey respondents also said *formal advisors and supervisors* (58 percent) and *informal mentors* (56 percent) contribute meaningful support on that topic. Interview respondents described benefits of advisors and mentors who draw on their relationships to help them navigate the STEM education R&D social network. Conferences were a good opportunity for mentoring from supervising PIs. Several interview respondents appreciated it when mentors kept them close for portions of a conference to introduce them to key people. A couple of respondents described how their mentors promoted their involvement in cross-institution work or centers.

Peers and peer networks. Third most often, early career survey respondents identified *peers and peer networks* as very important sources of support (42 percent). When asked to identify topics on which *peers and peer networks* contributed meaningful support, early career survey respondents most often identified *networking and collaboration* (69 percent). Note that *peers and peer networks* were also more likely than any other source to contribute meaningful support on this topic. Interview respondents pointed out that peers could link them to veterans and others in their discipline, while also being able provide advice on networking strategies and opportunities from a similar perspective. A theme emerged in interviews that one’s early career peers will become knowledgeable collaborators, leaders, and linkers in future years.

One concern expressed by early career interview respondents was that there were too few opportunities to develop peer relationships outside of their program or institution, particularly for those at small universities or unaffiliated with research centers or networks. While developing a peer network is ultimately an individual pursuit, some have fewer opportunities to do so and there may be long-term benefits to the field if such opportunities were expanded or facilitated.

Conferences. While not presented on the survey as a source of support, early career interview respondents valued conferences as an essential opportunity to network and learn professional behaviors and skills. Interview respondents pointed to conferences as being particularly crucial for those new to the field and without a broad professional network. In addition to showcasing content and technical knowledge, conferences afford early career researchers and developers with opportunities to meet leaders in the field, potential employers, future collaborators, and

“Conferences and meetings have been extremely important for networking and learning from others.” - *Veteran respondent*



like-minded peers. They provide an opportunity to improve how they present their work and map their R&D focus onto the broader field. It can also be a rare opportunity to meet program officers or hear the priorities of funders.

However, many early career respondents said there were too few opportunities to attend conferences. Outside of project budgets and the support of their PIs, there were few funding opportunities to finance travel and participation in conferences. Some desirable conferences, like the DR K-12 PI meeting, had few available registration slots for early career researchers and developers.

Exhibit 5: Topics on which Sources Provided Meaningful Support for Early Career Growth

	Most frequently reported topics of meaningful support	Least frequently reported topics of meaningful support
Formal advisors or supervisors	Planning a career path and finding a job	Hiring and supervising others
	Identifying an R&D focus	Managing a work-life balance
Informal mentors	Planning a career path and finding a job	Developing and managing a budget
	Networking and collaborating	Hiring and supervising others
Peers and peer networks	Networking and collaborating	Developing and managing a budget
	Managing a work-life balance	Hiring and supervising others
Professional associations or societies	Presenting at conferences	Developing proposals
		Managing work across multiple projects or tasks
	Networking and collaborating	Hiring and supervising others
Formal programs or courses for career development	Planning a career path and finding a job	Managing work across multiple projects or tasks
	Developing proposals	Hiring and supervising others
NSF guidance or learning opportunities	Developing proposals	Managing work across multiple projects or tasks
	Identifying appropriate funding sources	Hiring and supervising others
Resource networks funded to support R&D	Identifying appropriate funding sources	Managing work across multiple projects or tasks
	Networking and collaborating	Managing a work-life balance
Published resources	Identifying and R&D focus	Presenting at conferences
	Hiring and supervising others	Developing and managing a budget

Exhibit reads: Early career respondents reported that “Formal advisors or supervisors” most frequently provided them with meaningful support on the topics of “Planning a career path and finding a job” and “Identifying an R&D focus.” They reported that “Formal advisors or supervisors” least frequently provided them meaningful support on “Hiring and supervising others” and “Managing a work-life balance.”

Source: Survey of Early Career DR K-12 Researchers and Developers (N=48)



Proposal review panels. Though not addressed in the survey, proposal review panel participation stood out as a landmark source of early career learning. Several interview respondents described proposal review panels as the best way to learn how to write a successful

“What helped me most was being a panel reviewer because you hear what the judges say when it comes to what matters most.” - *Early career respondent*

proposal and referred to the opportunity as one of the most valuable career development experiences they had. Those that served on a panel wanted to do so again, and several respondents said they had tried unsuccessfully to get selected to review. Former panelists described benefits of serving on proposal review panels as:

- Seeing a range of complete proposal examples, varying in topic, approach, and quality
- Applying authentic review criteria and discussing specific strengths and weaknesses as measured by the criteria
- Learning first-hand who reviewers are, how their perspectives and preferences differ, how they talk about criteria, and how group rating decisions are made
- Considering how one’s future work can be proposed with the right scope, level of ambition, and methods

Published resources. On the survey, early career respondents most often identified three topics for which they turned to *published resources*—*identifying an R&D focus, hiring and supervising others*, and *writing and publishing*. In fact, *published resources* was the most frequent contributor of meaningful support on *hiring and supervising others* (35 percent), suggesting that other sources of support overlook this topic. Several interview respondents added that they turned to publications for guidance on project and time management strategies, as well as for R&D career planning.

NSF guidance & Resource networks. *NSF guidance* and *resource networks funded to support R&D* were both sources that 57 percent of early career researchers and developers found to be important and about one-fifth found to be very important. Surveys and interviews suggested that each were useful for particular needs, with the top three topics for which they contributed meaningful support being *identifying appropriate funding sources, developing proposals*, and *networking and collaborating*. A couple notable findings are below, though recommendations are reported in the next section.

- The CADRE Fellows program got high marks from interview respondents for providing opportunities for networking, and for some cohorts, for exposure to proposal writing.
- The NSF webinars on proposals were mentioned as helpful. However, more was wanted in terms of additional NSF guidance on proposals, such as more advanced



proposal writing webinars, the availability of example proposals, and basic feedback or technical assistance on draft proposals.

- For the most part, early career interview respondents regarded NSF and CADRE (outside of the Fellows program) as resources that are only available when you have an NSF grant or are on a DR K-12 project. The NSF program officers are perceived to be primarily charged with managing existing projects, rather than being available to those who hope to one day propose, so some early career respondents had not felt comfortable contacting them. As mentioned previously, respondents pointed to the scarcity of registration slots for early career folks at NSF-sponsored conferences/meetings.



Exhibit 6: Topics on which Sources Provided Meaningful Support for Early Career Growth, in Percents

	Formal advisors or supervisors	Informal mentors	Peers and peer networks	Professional associations or societies	Formal programs or courses for career development	NSF guidance or learning opportunities	Resource networks funded to support R&D	Published resources
Planning a career path and finding a job	85	58	40	10	10	6	8	19
Identifying an R&D focus	73	46	33	13	6	13	6	38
Developing proposals	71	40	15	0	15	29	13	19
Writing and publishing	69	48	48	13	8	2	10	31
Identifying appropriate funding sources	67	33	25	19	8	38	16	18
Presenting at conferences	67	25	48	31	4	4	4	8
Networking and collaborating	58	56	69	52	6	25	19	15
Managing work across multiple projects or tasks	42	31	27	0	2	2	0	10
Developing and managing a budget	35	21	13	0	4	8	4	4
Hiring and supervising others	33	19	13	0	2	0	4	35
Managing a work-life balance	25	33	52	2	4	4	0	15

Exhibit reads: Eighty-five percent of early career survey respondents reported that formal advisors or supervisors provided meaningful support on the topic of planning a career path and finding a job.

Source: Survey of Early Career DR K-12 Researchers and Developers (N=48)



Recommendations

Interviews and surveys asked respondents to offer recommendations for supporting the professional growth and career development of early career researchers and developers, particularly those in the DR K-12 program. These recommendations may be useful for consideration by 1) the NSF and NSF-supported resources networks (particularly CADRE), 2) PIs, advisors, and other mentors, and 3) early career researchers and developers themselves. Many of the recommendations centered on promoting networking and collaboration, improving mentoring, and increasing early career opportunities to learn the most needed skills, such as proposal writing. Respondents frequently recommended that early career researchers and developers be proactive about their career planning and seek out sources that can contribute to their growth as R&D professionals.

One global recommendation for all sources of early career support is to use Exhibit 6 as a tool for reflection. While data in Exhibit 6 should not be considered representative of all early career researchers and developers, the data may help a source consider whether its support lives up to its intentions for particular topics.

Recommendations for the NSF and NSF-supported research networks

Interview and survey respondents provided recommendations for the NSF and NSF-supported research networks (e.g., CADRE) to consider when looking to improve supports for early career R&D professional growth.

- ***Increase opportunities to learn about writing proposals for funding.*** Survey and interview respondents highlighted gaps in the early career support provided on proposal writing. NSF and its resource networks could expand opportunities for early career researchers to participate in proposal reviews, training, and technical assistance. Opportunities to serve on proposal review panels – even mock panels – can help early career researchers understand how funding decisions are made and, in turn, promote the development of better proposals. Existing NSF and CADRE webinars were appreciated, but respondents advocated for greater outreach and the development of more advanced and participatory trainings. Many expressed an interest in seeing examples of winning proposals (and if possible, unfunded proposals), as this exposure is currently quite limited if you are not a veteran PI or have not served on a review panel. There were also suggestions that early career proposers get more detailed feedback from panel reviewers or follow-up guidance on drafts from program officers.
- ***Increase opportunities for early career researchers and developers to network with each other and with veterans.*** Early career and veteran respondents agreed that networking and collaborating are important for a successful R&D career, though opportunities to do so were too limited for many early in their career. Some suggested promoting or funding conference participation, whether at the



DR K-12 PI meeting or conferences held by professional associations/communities. Existing funds for this purpose were seen as limited or difficult to secure. NSF-sponsored conferences could build in opportunities for early career researchers and developers to present, receive targeted support, meet with program officers, or network as group. At other major conferences, program officers or resource network staff could host networking and workshop events specifically for DR K-12 early career researchers. While these exist now, further investment may be warranted.

The NSF could also support early career networking by building it into the designs of research centers and grant solicitations. Past and current Fellows, pointed to the CADRE Fellows program as a model for early career networking. Solicitations for future resource network solicitations could explicitly call for implementation of similar programs and networking opportunities. The NSF could also look at the CADRE Fellows and similar programs to draw lessons that can be specified and promoted for broader implementation. For example, respondents highlighted the usefulness of Fellows program face-to-face meetings, participation in the PI meeting, and collaborative learning opportunities focused on professional skills such as proposal writing.

Similarly, the Centers for Learning and Teaching (CLT) program was singled out by several participants for promoting collaboration among graduate and post-doctoral students, who evolved into a network of emerging leaders and an R&D workforce. Indeed, in a 2005 evaluation of the CLTs, CLT doctoral students said participation led to “development of a broader professional community than they would have developed on their campus alone...[and that] they have more opportunities to interact with faculty and students at other institutions than their non-CLT peers.”⁴ Also, in the DR K-12 grant solicitation, the NSF could be more explicit about expectations for supporting early career networking.

- ***Offer guidance or infrastructure for effective mentoring.*** To improve the quality of mentoring provided by PIs and supervisors, the NSF and associated resource networks can offer guidance, clear expectations, and resources to those in formal and informal mentoring roles. A guide to mentoring could establish a common understanding about NSF-related mentoring and provide practical tips and examples. Some suggested mentoring workshops. Regardless, many pointed to uneven mentoring in the DR K-12 program and said more could be done to improve mentoring quality.

“Some mentors are too hands off, others micromanage... Not everyone knows how to be a good mentor, so more training is needed.” - *Early career respondent*

“The NSF should hold PI’s accountable for following through on Post-doctoral Plans in proposals.” - *Veteran respondent*

⁴ See page six of the 2005 Centers for Learning and Teaching evaluation report at http://csted.sri.com/sites/default/files/reports/CLT_FINAL_REPORT_Executive_Summary.pdf.



One theme was to formalize mentoring guidelines in grant solicitations. For instance, several people pointed to the DR K-12 solicitation requirement of a post-doc mentoring plan, saying it was a good start that should go further.⁵ There is little guidance about what the post-doc mentoring plan should look like, how to budget its activities, and how much weight the plan has in proposal review or progress reports. Exemplary examples of post-doc mentoring plans could be shared. Two interview respondents suggested that the post-doc mentoring plan could be broadened to include graduate students as well.

Several suggested that the NSF develop a vehicle for matching early career researchers with mentors who are not at their institution. This might include a cadre of willing mentors on stipend, or perhaps a more formal program managed by the NSF. The NSF might also encourage partners in collaborative grants or multi-institution grants to do cross-institution mentoring. An approach along these lines could be particularly helpful for those at small institutions or who otherwise have limited access to good mentors in their discipline.

- ***Continue or increase grants specifically for early career researchers and developers.*** Both early career and veteran survey respondents recommended continued funding of grants specifically for early career researchers and developers, including those from institutions that do not have a strong tradition of receiving research grants. Examples include CAREER grants, smaller exploratory grants that carry minor investment risk, early career grants to build off work associated with major funded projects, and funds dedicated for early career participation in conferences and research center events. Small short-term grants could enable early career researchers and developers conduct work that would inform proposals for larger grants, while providing management experience. Funds might also be targeted toward releasing early career faculty from instructional duties so they can pursue approved R&D activities, or for providing incentives for senior researchers to include early career researchers and developers on grants. It should also be mentioned that many veterans and early career respondents advocated for continued funding of the CADRE Fellows program.

“Make it easier for early career researchers to get their first award.” - *Veteran respondent*

“The CAREER program is great, although it only serves the tip of the iceberg.” - *Veteran respondent*

“The NSF should have a separate RFP for first-time PIs so that they are not competing with the ‘big guns’.” - *Veteran respondent*

⁵ The 2014 DR K-12 grant solicitation can be found at <http://www.nsf.gov/pubs/2013/nsf13601/nsf13601.htm>. This solicitation links to a general Grant Proposal Guide that includes guidance on the Postdoctoral Researcher Mentoring Plan and can be found at http://www.nsf.gov/pubs/policydocs/pappguide/nsf14001/gpg_2.jsp#IIC2j.



- ***Develop an online resource space that aggregates resources on R&D professional capacities and career development.*** While resources for early career researchers and developers exist on the CADRE and other NSF-funded websites, some early career respondents wished for an organized and maintained set of resources and information that would meet practical needs for developing as an R&D professional. Content could address project management capacities, funding opportunities, proposal writing guidance and examples, conference and publication information, career planning resources, formal networks and networking opportunities, and so on. It could archive webinars and other presentations related to career development or the R&D profession. For one early career respondent, the goal is “to make the implicit, explicit—what you do as a researcher, focus on that explicitly.”
- ***Develop or enhance replicable trainings for early career researchers and developers.*** Respondents identified useful learning opportunities developed or delivered with NSF funds, but these could evolve into a fuller and more organized program of offerings. Topics could include project management and career development topics discussed in this report, and they could be codified into trainings or a curricula that could be replicated. These early career learning opportunities could take the form of webinars (archived for asynchronous viewing), workshops at conferences, curricula for use by granted institutions, or a summer institute (not unlike summer research institutes hosted by the Institute for Education Sciences).

“The NSF could provide more workshops at professional or academic conferences. Reach out to constituencies to see what they need.”
- *Veteran respondent*

Recommendations for PIs, supervisors, and mentors

Recommendations for PIs, supervisors, and mentors focused on strategies to expose early career researchers to project planning and management processes, diverse career paths, and networking opportunities.

- ***Involve early career researchers in project planning and management.*** Respondents recommended that PIs and supervisors involve early career researchers and developers in all aspects of project implementation, or at the very least, make project management decisions visible. Senior researchers could become more intentional discussing project management issues, which are often overlooked among pressing academic and task-oriented priorities.

“PIs should get early career researchers authentically involved in the process; I have learned more sitting in on meetings and phone calls, than I would have in other ways.” -
Early career respondent



There were suggestions that PIs should do more to enlist early career researchers in project planning, such as by having them participate in discussions or activities associated with proposal writing. PIs could expose early career team members to decision making and tasks in an ongoing way by including them in team meetings that address management and in interactions with partners and clients. Where possible, PIs might orchestrate opportunities for junior team members to take responsibility for tasks, where they will learn professional and managerial skills first hand. They could involve early career staff in pursuing future funding opportunities that will continue the work.

- ***Have frequent discussions focused explicitly on career development and growth as a professional.*** Often PIs or supervisors meet with their early career colleagues to discuss and provide mentoring on project- or dissertation-related work; however, interview respondents said that it was rarer that these talks would

“[My PI and I] met frequently to talk about my career. I’ve talked with other post-docs who had a different experience; they did not get that career-based information.” - *Early career respondent*

turn to career development. Respondents who received it, appreciated time set aside to discuss their professional needs and available supports. A couple of respondents advocated for helping early career researchers and developers to develop an Individual Development Plan and

revisit it frequently. Mentors and mentees could periodically review an R&D core competency checklist, such as the one developed by the National Postdoctoral Association. A core role a mentor can have is helping junior researchers discover where their passions lie and putting a plan in motion.

- ***Support networking and collaboration among early career researchers and established researchers.*** Early career and veteran researchers highlighted the importance of networking as part of professional development. PIs, supervisors, and mentors can help connect early career researchers to professional

communities, particularly those that extend beyond their institution and that can lead to R&D collaboration or career development. Early career respondents found great value in

“Mentors should work tirelessly to bring them ‘into the fold’ in terms of networking.” - *Veteran respondent*

attending conferences, so PIs might consider budgeting early on to support these activities and assisting in ways to make conference participation meaningful. Supervisors and mentors could be intentional about regularly introducing early career colleagues to others in the field, including those that could serve in a mentoring capacity or as a future employer. While a regular part of veteran work, early career researchers could benefit from participating in project-related communication with research and K-12 partners, as well as with NSF.



- Help early career researchers explore diverse career paths.** Both early career and veteran respondents, particularly those outside of academia, recommended that mentors help and encourage early career researchers to explore a range of career paths. Since PIs are most familiar with their own career paths, they can connect early career researchers and developers with veteran colleagues who have taken different paths, or they can push early career folks to actively seek out other mentors and information with insights to varied career paths. For instance, early career DR K-12 professionals might have goals and interests that will take them into non-profit R&D, advocacy, private curriculum development, district or state research management, informal education settings, consulting, and so on.

“I went to an R-1 institution, so I was groomed for a similar academic institution... But, it’s nice to know about the array of options.” - *Early career respondent*

“Tenured faculty only have that experience and can’t share beyond that.” - *Early career respondent*

Recommendations for early career researchers and developers

Recommendations for early career researchers from veterans and early career researchers themselves highlighted the importance of being proactive to support one’s professional development. Other recommendations for early career researchers included:

- Seek multiple mentors who can support your career development.** Very often, respondents recommended that early career researchers and researchers be self-directed in seeking and connecting with mentors who share their research interests and can support their professional development. It is worth noting again that veteran PI survey respondents reported that informal mentors were the most important source of support for early career researchers and developers. Having multiple mentors provides access to broader range of specialized knowledge and insights for career development. Several interview respondents suggested one’s assigned mentors or formal supervisors may not always be the best sources of support, and informal mentors may be a better fit.

Often helpful mentors were at other institutions, so early career researcher and developers should consider developing relationships with mentors through shared interests or by having PIs provide introductions. Early career researchers and developers should not be afraid of reaching out to senior researchers doing similar work and asking them for feedback and should not get discouraged when some say they are unable to

“Seek out colleagues and senior researchers who seem good at a particular aspect of research and find ways to work with these people.”- *Veteran respondent*



help. Early career folks should engage with mentors collegially, and look for opportunities to collaborate with them or recruit them as advisory board members.

- ***Seek opportunities to learn practical R&D career skills, such as proposal writing and project management.*** Early career researchers and developers can support their own development by directly asking their supervisors about where they can contribute and how they can burnish specific capacities. For instance, to learn about proposal writing, they might offer to pitch in on proposal development or ask a supervisor to nominate them to serve on a proposal review panel. They may also want to find smaller grant opportunities to develop a proposal; even if it is not awarded, the feedback and experience will be instructive for future efforts. One respondent suggested that early career researchers and developers evaluate their own professional capacities by using a core competency checklist, such as one promoted by the National Postdoctoral Association.
- ***Find opportunities to network within and outside of your institution, with peers and more experienced researchers.*** Both early career researchers and veterans suggested that early career researchers and developers should be deliberate about networking and build their professional networks by attending conferences, joining professional organizations, and regularly engaging in conversations with researchers within and outside of their institutions. Sometimes these opportunities are available by participating on large or multi-institution projects, or by seeking out non-project-related responsibilities that bring them in contact with like-minded peers (e.g., work groups, association SIGs, conference panels, reviews for journals and meetings). Early career researchers and developers should strive to be perpetually proactive about networking, especially with senior researchers, and they should work toward creating their own networks. They should also strive to share and advocate for their own work while networking, even though this may feel difficult or distasteful.

“Get involved. In my experience, it’s been okay to be a little pushy; it means that you get your foot in the door and force some good conversation about what the work of research is really like.” - *Early career respondent*
- ***Develop and hone a clear R&D focus and organize work around it.*** Drawing on the advice of mentors and peers, early career researchers and developers should identify a specific need in the knowledgebase that they can passionately pursue. It helps to learn about the research interest by reading papers, but it is also essential to know who is doing what on the topic currently. In this way, one can identify a niche and opportunities to complement or collaborate on other important work being done. To the extent possible, project work, networking, publishing, mentor relationships, and proposal writing can be organized around a well-defined R&D focus.



Contributors to this Brief

While referred to as “interview respondents” in this brief, the following individuals did more than share their early career experiences and perspectives, having also given helpful feedback on survey development and the draft brief. CADRE appreciates their assistance.

Cory Buxton, University of Georgia Research Foundation
Jason Chen, College of William and Mary
Cynthia D’Angelo, SRI International
Rick Gaston, KCP Technologies
Jana Craig Hare, University of Kansas
Jonathan Hertel, Museum of Science, Boston
Susan Kowalski, Biological Sciences Curriculum Study
Carlos Mejia, Texas State University
Jamie Mikeska, Educational Testing Service
Emily Moore, University of Colorado-Boulder
Brian O’Connell, Tufts University
Ashley Lewis Presser, Education Development Center, Inc.
Sarah Rand, University of Chicago
Gloriana Gonzalez Rivera, University of Illinois at Urbana-Champaign
Laurie Rubel, City University of New York-Brooklyn College
Leigh S. Arino de la Rubia, California Charter Schools Association
M. Alejandra Sorto, Texas State University
Dung Tran, North Carolina State University
Andrea Weinberg, Colorado State University
Kristen Wendell, University of Massachusetts-Boston

