Supporting Information:

Aligning Graduate Chemistry Training with Diverse Career Paths: Insights from Student Perceptions of Valued Skills

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Section A: Positionality Statements

Jherian Mitchell-Jones', positionality statement: I am a doctoral candidate at the University of Virginia. I have graduate research experience with computational chemistry and chemistry education research. My current research interests focus on graduate student skill development in chemistry doctoral programs to improve student readiness for future career. My position as a graduate student in a chemistry doctoral program allows me to develop a rapport with participants as a peer. As an insider to the chemistry academia community, my understanding of chemistry and program features provides additional understanding for the data captured in this work. However, I do acknowledge that as member of a doctoral program, I hold my own opinions about what the goals of a chemistry doctoral program should be and the experiences that support these goals. I sought to address these biases through utilizing an established theoretical framework 'Socialization Theory' to assess how described experiences aligned and could support student skill development and by engaging fellow researchers in the analysis process.

Brandon J. Yik's positionality statement: I am a postdoctoral research associate with a focus on chemistry education research. I have had previous graduate research experiences in physical and inorganic chemistry, and in chemistry education. My research interests include STEM faculty members' instructional practices, learning in organic chemistry, and the development and evaluation of assessment and grading practices. My many different experiences in chemistry programs as both a graduate student and as a research mentor allowed me to better understand the experiences of the doctoral chemistry student study participants. However, having been a member of multiple chemistry programs, I acknowledge that my experiences shape my views of the professional skills that I value for myself and for my mentees. I aimed to minimize my biases by relying on the research literature on doctoral chemistry education and professional skills, and by engaging with the research team throughout the research process.

Haleigh Machost's positionality statement: I am a doctoral candidate at the University of Virginia with experience in inorganic synthesis and chemistry education research. My doctoral work seeks to elucidate various practices by STEM faculty, including their reflective practices and adoption of pedagogical innovations. My experiences in a synthetic research lab, a qualitative research group, and as a teaching assistant enable me to understand the complex relationships at play in chemistry doctoral programs and the various program elements that are discussed by participants. However, my personal experience has the potential to influence my interpretation of participants' accounts. In particular, my own personal values may be projected onto participants, and my experience studying faculty may affect how I interpret participants' comments concerning their advisors or departments. I aimed to mitigate these biases through relying on the literature for what is captured by the different skill categories and through participating in complete consensus when coding participants' valuation of skills and the associated reasonings.

Marilyne Stains' positionality statement: I am a professor of chemistry with a focus on chemical education research. My research interest has mostly focused on STEM faculty members' instructional practices and ways of thinking about teaching as a means to improve the education experiences of students in STEM classrooms. My experiences as both a graduate student and a research advisor within chemistry doctoral programs allowed me to better understand the experiences and doctoral program features that participants in the study were describing. However, my role as research advisor and

committee member for doctoral students in my department shape my views of the professional skills that I value for my students and students in my department's doctoral program. I attempted to minimize these biases by relying on the professional skills that have been identified in the literature as essential for various sectors of the chemical enterprise.

Section B: Additional participant demographic data

Participant experience, measured in time, in current graduate program did not necessarily correspond with experience with research group (Table S1). The difference in participants' experiences occurred due to one or more of the following reasons: programs policy of when students officially join a research group (end of their first or second year), participants experience with research group as an undergraduate or master's student prior to enrollment in doctoral program, or changes in research group membership during doctoral program.

Table S1: Participants' experience in current chemistry graduate program and research group

Experience	Years Completed			
	2	3	4	5+
In Current Graduate Program	6	13	9	5
In Current Research Group	7	13	7	6

Table S2: Participants' demographics with all provided subcategories

Participants were instructed to select all subcategories that apply. Percentages do not necessarily sum to 100.

Category	Subcategory	Frequency	Percentage
Gender	Agender	0	0
	Woman	18	55
	Gender fluid	0	0
	Man	14	42
	Transgender	0	0
	Not listed	0	0
	Prefer not to say	1	3
Ethnicity	American Indian or Alaska Native	0	0
	Asian	8	24
	Black or African American	1	3
	Hispanic, Latino, or Spanish origin	1	3
	Native Hawaiian or Pacific Islander	1	3
	White	22	66
	Other: North African	1	3
	Prefer not to say	1	3
Received an education outside of United States	K12 education only	1	3
	Undergraduate education only	1	3
	K12 & Undergraduate education	3	9

Section C: Professional skills value sorting activity

Participants were presented with a Microsoft PowerPoint document listing digital cards of professional skill categories and bulleted component skills (Figure S1). Subsequent PowerPoint slides provided a professional skill value sorting activity scaffold (Figure S2) labeled with the level (department, research group, or personal) being discussed. Activity procedure was as follows:

Here, I have listed a list of skill categories. These are skills that are commonly listed on individualized development plans (IDPs). An IDP is a tool that has been used to help students with personal development and career goals. The skills listed here are what is commonly listed, and they may or may not be important or relevant for your graduate experience. Please read these skill cards and let me know if they are unclear or if you have any questions.

I have a chart where I would like you to sort these skill cards based on the amount of value they have at the [Department, Research group, or personal level] in your program. As you place each skill, I would like you to explain your placement.

Do you believe there are any skills that are not listed/missing from this list that are valuable at the [Department, Research group, or personal level]? If so, please list them.

Participants were giving remote control access via zoom to place professional skill cards on sorting activity scaffold. Card movement and placement was recorded via zoom.

Figure S1: Digital cards of professional skill categories with component skills

Professional skill categories presented to participants for the value sorting activity.

Technical Skills

- Broad based Knowledge of Science
- Knowledge of Specialized Area/ Field of Research
- Techniques related to Research Area

Research Skills

- Plan and execute experiments
- Analysis and Characterization of Data
- Problem Solving

Management Skills

- Time management
- Working independently
- Planning and organizing projects
- Managing people and delegating work

Communication Skills

- Oral Presentations
- Written communications
- Communication with scientists and non-scientists

Interpersonal Skills

- Teaching or training others
- Lead, mentor, or providing guidance
- Seeking advice from advisors and mentors

Collaboration Skills

- Working with or in a team
- Sharing research progress
- Providing Feedback

Other Skills

- Creativity
- Attention to detail
- Flexibility/Adapting to change
- Professionalism

Figure S2: Professional skills value sorting activity scaffold

This scaffold was provided to participants for the value sorting activity of the professional skill. The scaffold was presented three times, once for each perspective level.

Level: Department / Research Group / Personal		
Really Value	**Somewhat Value**	**Do Not Value**

Section D: Codebooks

The professional value skill sorting activity was cross coded for value assignment (Really Value, Somewhat Value, Do Not Value) value rationale (Table S3), level (Department, Research Group, or Personal) and skill category (Figure S1). Experiences described by participants were cross coded for experience type (Table S4) and the context in which they were mentioned (Table S5). If the context of the experience was a value connection or helpfulness, the experience was also cross coded for skill category (Figure S1). When value connection were made, experiences were also cross coded for level at which the value was being placed.

Table S3: Codes for the rationale underscoring participants' value of a skill

Value rationale codes were used to categorize participants' rationale for valuation assignments. Multiple value rationale codes may be used to categorize a single valuation assignment with the exception of Ambiguous Rationale.

Value Rationale	Description	Subcode
Ambiguous Rationale	Participant expresses ambiguity when explaining value assignment. Participant either: did not assign skill value, did not explain skill value assignment, did not know/unsure of skill value, or expressed that the concept of the skill was vague	NA
Development Expectations	Participant describes expectations regarding skill development during graduate program or possession prior to program	• Development Expected • Development Not Expected • Procession Expected
Other's Responsibility	Participant expresses that management of skill formalization is the responsibility of a certain entity	• Research Group Responsibility • Student Responsibility
Others' Engagement with Skill	Participant describes the engagement of others with skill	• Others Engage in Skill • Others Do Not Engage in Skill
Role of Skills in Achieving Success	Participant describes the relevance of skill engagement (learning/practice/use) on success in the doctoral program, future career, or in a task	• No Impact • Helps Success • Hinders Success • Absence Hinders Success
Skill Formalization	Participant describes how a skill's development is formally organized through requirements, teaching, and facilitation (opportunities and guidance for practice)	• Requirement • Facilitated • Taught • Not Required • Not Facilitated • Not Taught
Support of Skill	Participant expressed how student's development of a skill is encouraged or discouraged by another	• Presence of Support • Absence of Support
If Necessary	Participant describes skill value of skill is tied to necessity but is otherwise not valued	NA
Students as a Resource	Participant describes that the skill is valued because students' skills are relied on/needed	NA

	as a resource to help the department function or to establish prestige	
Student Drive	Participant describes use or development of skill as self or student driven	• Student Is Driven • Student is Not Driven • Personal Satisfaction • Student is Not Proficient

Table S4: Codes for the type of experience

Experience type codes were used to categorize student experience that they deemed played a role in the development of a skill. Experience type largely categorizes experiences (i.e. subcodes) by their association with an aspect of a student's academic journey.

Experience type	Description	Subcode
Ambiguous Experience	Experience details are unclear and unable to be sorted into another experience code	NA
Prior Experience	Experience prior to attending graduate school	NA
Program Features	Experience related to program requirements or opportunities provided by the department	• Program exams • Presentation requirements • Department seminars • Teaching assistantship • Training/workshops • Mentorship program • Committee meeting • Coursework • Rotations
Other Opportunities	Experience that occurred during time in doctoral program but not provided by the department	• Internship • Volunteer • Teaching workshop • University clubs and organizations • Career workshop • Library resources • Writing resources • Attending conferences
Research Experiences	Experiences related to conducting research within research group of doctoral program	• Research activities • Group meetings • Individual meetings • Receiving training • Training others • Teaching self • Receiving mentorship • Mentoring others • Collaborations • Writing scientific articles • Reviewing scientific articles • Grant preparation/ fellowship application • Research autonomy
Interpersonal Interactions	Experience that involves participant relationship and communication with another person or group (outside of training or mentorship)	• Advisor • Committee • Faculty • Group members • Peers • Mental healthcare provider • Family members
Qualifiers	Quality of a described experience	• Feedback • Discipline Specific

Table S5: Context in which experiences were described with example quotes

Experience context codes were used to describe the context in which a participant describes an experience as they relate to the targeted research questions during their interview.

Context of Experience Mentioned	Subcode with description	Example Quote [Participant ID (Experience type; Skill category; level)]
Description: Participant describes an experience without making a connection to the perceived value or development of a skill	NA	"Um, after undergrad I worked for a while. Uh, it was really only supposed to be one year, but then I liked where I worked, and I was making decent money. So, I kept working there for a number of years. And I got a few promotions along the way. Worked my way up from research tech to senior research tech to research associate. And I was pulled aside by my boss one day and she told me that I would be up for another promotion but wouldn't be able to receive it because I didn't have a doctorate. And I'd sort of ascended the ladder as high as I could go, um, without having a PhD. Um, so that kind of pushed me into applying to graduate school." **[GS21 (Prior Experience)]**
Value Connection: Participant describes an experience as rationale for the value or perceived value of a skill	NA	"I would put like this networking probably in somewhat value because [my advisor] does like, um, will send us a lot of like job opportunities and also he'll try to bring in like people from industry to come give a seminar at the university or at least talk in like some form of career seminar. So, he does that a lot. Anything else? Not really." **[GS06 (Interpersonal interactions with advisor; Other Skills; Research group)]**
Helpfulness: Participant describes an experience as it relates to their development of a skill	**Helpful**: Experience was helpful in the development of a skill	"I think the fact that a couple of my professors built in mini grant proposals to their classes was really, really helpful when I had to go help write an actual grant proposal." **[GS28 (Coursework; Communication Skills)]**
	Limited: Experience did not occur, was infrequent, or was limited in assisting the development of a skill	"I was never specifically taught [research skills] and I don't know how well a class could teach those things, but like, I think that there probably could be a way to like, kind of teach people like a little bit more organizational skills in terms of like, in the context of their specific subfields… But I think that like, if they had like an experimental design and like time management and planning and organizing projects for bio-chem, for physical chemistry, for synthetic chemistry, that sort of thing, like the different little subdivisions we have, I think that would be helpful. I don't know how, yeah, I don't know how well actually how well that would be in practice, but I think that there's probably a better way to learn than just kind of like, all right, throw in the deep end, sink or swim." **[GS15 (Training/Workshop; Research Skills)]**
	Not helpful: Experience was not helpful in the development of a skill	"I was supposed to be working with this one guy who knew how to use [a technique] and he was just a complete disaster and never showed up when he was supposed to. Um, and so I was wandering around the lab trying to even find the instrument cause he texted me. He is like, ah, just

		go boot it up, it'll be fine. And I was like on the wrong floor of the building looking at the wrong instrument." **[GS28 (Receiving training; Technical skills)]**
	Ambiguous: Helpfulness of experience for skill development was unclear	"Yeah. Uh, so most of it is like usually postdoc or senior grad student. Um, like usually if you need to learn something you can just ask someone, and they'll show it to you. Um, yeah, that's how it usually breaks down in both groups." **[GS20 (Receiving training; Technical skills)]**

Table S6: Summary of iterative inter-rater reliability for codebook refinement

Codebook Version	Iterations utilized	Summary of codebook refinements
Value Rationale Version 2	Value Rationale IRR Rounds 2 - 4	• Subcodes 'Student responsibility' and 'Research group responsibility' were added to the value reasoning parent code 'Other's responsibility' • Subcode 'Personal satisfaction' added to the value reasoning parent code 'Student driven skill development' • Clarification that value reasoning subcodes 'Requirements' and 'Not required' under 'Skill formalization' does not pertain to in class requirements. • Altered definition of value reasoning parent code 'Impact of skill engagement" to mention connect to skill engagement • Altered definitions across codebook to use participant to refer to interviewee.
Value Rationale Version 3	Value Rationale IRR Rounds 5 - 6	• Instances of code parent code 'flagged reasoning' (used to denote request for inter rater discussion) were negotiated and "flagged reasoning' was removed from codebook • Value reasoning parent code 'Students as a resource' was added • Coding instances of value rationale 'ambiguous' were removed unless it was the only rationale coded
Value Rationale Version 4	Value Rationale IRR Rounds 7 - 16	• Subcode 'Development not expected' was added to the value reasoning parent code 'Expectations' • Subcode 'Others do not engage in skill' added to the value reasoning parent code 'Engagement with skill' • Subcode 'Absence hinders success' added to the value reasoning parent code 'Impact of skill engagement' • Subcode 'Student is not driven added to the value reasoning parent code 'Student driven skill development' • Subcode 'Student is not proficient' added to the value reasoning parent code 'Student driven skill development' • Subcode 'If necessary' added as value reasoning parent code

Value Rationale Version 5	None	• Following codes were renamed for reader clarity following reviewer comments:
		  • 'Impact of Skill Engagement' to 'Role of Skills in Achieving Success
		  • 'Expectations' to 'Development Expectations'

Experience Version 2	Experience IRR Round 2 -	• Clarification that experience subcode 'advisor' under the parent code 'Interpersonal interactions' does not pertain to individual meetings

	5	• Subcode 'Poster Sessions' under the experience parent code 'Program Features' was changed to 'Presentation requirements" and definition was altered to include presentations on any type required by the department • Subcodes 'Teaching workshop', "Career workshop', 'Writing resources' and 'Library resources' were added to the experience parent code 'Other opportunities" • Subcode 'Teaching self' added to the experience parent code 'Research"
Experience Version 3	Experience IRR Round 6 - 11	• Subcode 'Faculty' added to the experience parent code 'Interpersonal interactions' • Subcodes 'mental health provider' and 'family member' were added to experience parent code 'Interpersonal interactions'
Experience Version 4	Experience IRR Round 13 -22	• Subcode 'Candidacy exams' under the experience parent code 'Program features' was changed to 'Program exams' and definition was altered to include all program exam types • Subcodes 'Training/Workshop', 'Mentorship program', and 'Committee meeting' were added to the experience parent code 'Program features' • Subcode 'Reviewing scientific articles' added to experience parent code 'Research' • Subcode 'Rotations' added to experience parent code 'Program feature'

Table S7: Examples of coding application for valuation perceptions

Quotes representing examples of the three value assignments (Really Value, Somewhat Value, and Do Not Value) are provided. Value assignment and skill category were determined based on participants' placement of digital skill category card on the provided activity scaffold (Figure S2). The level assignment was determined based on perspective level being sorted. Value rationale was determined through rater consensus.

Quote (Participant ID)	Value Assignment	Level	Skill Category	Value Rationale
"I would rank communication skills in really valuable. I think oral and written communication are skills that are like, they take a long time to develop. So, like the earlier you start developing those skills, the better you'll get in the future. I'm not really great at giving the oral presentations, so I try to practice that even though I don't like it. Just trying to find opportunities to give presentations. So, like poster sessions. I haven't done it yet, but I'm hoping to go to ACS fall or spring… So, just looking for opportunities where I can give presentations." (GS06)	Really Value	Personal	Communication Skills	Student Drive: Student is Driven
"And say research skills. [My chemistry advisor is] quite hands off. So a lot of these things, like to plan experiments and analyze/characterize the data, falls onto yourself. Like she's not gonna be there and be like 'you should do that	Somewhat Value	Research Group	Research Skills	Other's Responsibility: Student Responsibility

experiment' per se. So, a lot of it is like your own judgment and talk to other people in the group." (GS20)				
"Management skills. I'll just say this is something we do not value. And to be honest, you can also feel that many professors do not have management skills. So, I'll just say it is something we do not value. And also you can see from our daily management that our chemistry department doesn't run in the most smooth way. Like reimbursements, sometimes they get delayed. And the seminars, sometimes there's a confusion. I just feel like the management is not really up there and it is not something we appreciate in the department." (37)	Do Not Value	Department	Management Skills	Others' Engagement with Skill: Others Do Not Engage in Skill

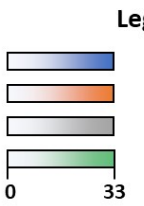
Table S8: Examples of coding application for development experiences

Quotes representing examples of each experience context (Description, Value Connection, and Helpfulness) are provided. Application of experience context, Experience type, and skill category was determined through rater consensus.

Quote (Participant ID)	Experience Context	Experience Type	Skill Category; Level (if applicable)
"Um, after undergrad I worked for a while. Uh, it was really only supposed to be one year, but then I liked where I worked, and I was making decent money. So, I kept working there for a number of years. And I got a few promotions along the way. Worked my way up from research tech to senior research tech to research associate. And I was pulled aside by my boss one day and she told me that I would be up for another promotion but wouldn't be able to receive it because I didn't have a doctorate. And I'd sort of ascended the ladder as high as I could go, um, without having a PhD. Um, so that kind of pushed me into applying to graduate school." (GS21)	Description	Prior Experience	*not applicable*
"I would put like this networking probably in somewhat value because [my advisor] does like, um, will send us a lot of like job opportunities and also he'll try to bring in like people from industry to come give a seminar at the university or at least talk in like some form of career seminar. So, he does that a lot. Anything else? Not really." (GS06)	Value Connection	Interpersonal interactions: Advisor	Other Skills; Research Group
"I think the fact that a couple of my professors built in mini grant proposals to their classes was really, really helpful when I had to go help write an actual grant proposal." (GS28)	Helpfulness: Helpful	Program Features: Coursework	Communication Skills

Section E: Additional Results

Figure S3: Participant use of value rationale by level and value assignment with child codes



Value Rationale	Subcode	Total Participants	Value Assignment by Perspective Level											
			All Values			Really			Somewhat			Do Not		
			Department	Research Group	Personal	Department	Research Group	Personal	Department	Research Group	Personal	Department	Research Group	Personal
Ambiguous Rationale		**29**	10	19	21	5	12	16	4	4	8	2	4	0
Skill Formalization	Facilitated	**32**	19	30	2	12	26	0	16	15	2	2	2	0
	Requirement	**29**	29	7	0	22	5	0	20	2	0	3	1	0
	Taught	**9**	9	1	0	4	1	0	7	0	0	0	0	0
	Not Facilitated	**25**	20	18	1	0	3	0	11	14	1	11	5	0
	Not a Requirement	**13**	10	6	0	0	1	0	9	3	0	3	2	0
	Not Taught	**21**	16	10	0	0	2	0	12	6	0	4	3	0
Role of Skills in Achieving Success	Helps Success	**33**	12	18	32	9	16	32	5	5	10	0	0	1
	Hinders Success	**5**	2	2	1	0	0	0	1	2	1	1	0	0
	Absence Hinders Success	**13**	5	9	1	1	3	1	4	5	0	1	1	0
	No Impact	**19**	6	6	14	0	1	3	4	4	12	3	2	2
Student Drive	Student Driven	**24**	3	6	18	0	2	16	2	4	3	1	1	0
	Student is Not Driven	**13**	0	1	13	0	0	0	0	0	11	0	1	4
	Student Not Proficient	**7**	0	0	7	0	0	0	0	0	6	0	0	1
	Personal Satisfaction	**10**	0	0	10	0	0	7	0	0	3	0	0	0
Development Expectations	Possession Expected	**14**	5	8	3	2	5	1	2	2	2	2	1	0
	Development Expected	**28**	13	18	13	10	15	10	7	3	3	1	1	0
	Development Not Expected	**8**	1	3	5	0	0	0	0	2	5	1	1	1
Others' Engagement with Skill	Others Engage in Skill	**25**	11	23	4	7	19	3	4	6	1	0	1	0
	Others Do Not Engage in Skill	**13**	10	7	1	1	0	0	2	4	1	8	4	0
Other's Responsibility	Student Responsibility	**15**	5	12	0	0	3	0	5	8	0	2	2	0
	Research Group Responsibility	**17**	17	0	0	2	0	0	10	0	0	9	0	0
Support of Skill	Presence of Support	**15**	8	8	1	5	6	1	3	2	0	0	0	0
	Absence of Support	**10**	5	8	0	0	2	0	3	5	0	3	3	0
Students as a Resource		**8**	7	4	0	7	3	0	0	2	0	1	0	0
If Necessary		**5**	2	2	3	0	0	0	1	1	3	1	1	0
Value Assignment														
Really Value		**33**	33	33	33									
Somewhat Value		**33**	33	28	28									
Do Not Value		**25**	24	13	5									

Figure S4: Types of experiences that participants related to the development of a skill category

Helpfulness	Experience Type	Skill Category: Research	Technical	Communication	Management	Interpersonal	Collaboration	Other	Ambiguous	Total Participants
Helpful	Ambiguous Experience	0	0	2	1	0	0	1	0	**4**
	Research Experiences	2	4	5	2	2	0	2	1	**11**
	Program Features	10	15	18	4	9	3	2	4	**31**
	Interpersonal Interactions	0	2	19	4	4	2	8	2	**21**
	Other Opportunities	23	24	23	13	14	10	4	6	**33**
	Prior Experience	14	16	17	4	13	12	12	12	**29**
	Qualifier: Feedback	3	4	8	1	2	4	2	4	**16**
	Qualifier: Discipline Specific	0	0	0	0	0	0	0	0	**0**
	Total Participants	**27**	**30**	**31**	**20**	**24**	**20**	**18**	**18**	
Limited	Ambiguous Experience	0	0	4	1	0	0	2	0	**7**
	Research Experiences	0	14	4	1	2	1	0	0	**18**
	Program Features	1	6	14	8	7	2	5	6	**24**
	Interpersonal Interactions	0	0	8	0	1	0	7	1	**13**
	Other Opportunities	2	8	14	10	7	12	3	6	**29**
	Prior Experience	5	3	5	2	4	2	1	17	**26**
	Qualifier: Feedback	0	0	8	0	0	2	0	5	**12**
	Qualifier: Discipline Specific	0	0	2	0	0	0	1	1	**4**
	Total Participants	**8**	**19**	**27**	**18**	**14**	**14**	**14**	**24**	
Not Helpful	Ambiguous Experience	1	0	0	0	0	1	0	2	**3**
	Research Experiences	0	2	0	0	0	0	0	1	**3**
	Program Features	0	3	6	0	2	0	0	13	**16**
	Interpersonal Interactions	0	0	3	0	0	0	2	1	**6**
	Other Opportunities	1	4	2	1	1	3	1	5	**11**
	Prior Experience	0	0	4	2	0	0	3	5	**10**
	Qualifier: Feedback	0	0	0	0	0	1	1	1	**3**
	Qualifier: Discipline Specific	0	0	0	0	0	0	1	0	**1**
	Total Participants	**2**	**7**	**10**	**3**	**3**	**4**	**6**	**19**	
Ambiguous	Ambiguous Experience	0	0	2	1	0	1	1	0	**5**
	Research Experiences	3	17	7	2	3	0	1	0	**24**
	Program Features	4	9	8	1	3	1	2	1	**18**
	Interpersonal Interactions	0	0	3	0	1	1	4	1	**8**
	Other Opportunities	10	25	11	8	7	2	6	4	**33**
	Prior Experience	7	14	10	1	6	1	3	5	**25**
	Qualifier: Feedback	1	0	11	0	0	1	1	1	**13**
	Qualifier: Discipline Specific	0	0	0	0	0	0	0	0	**0**
	Total Participants	**18**	**31**	**20**	**12**	**14**	**4**	**13**	**8**	

Figure S5: Common experiences related to the development of a skill category

Helpfulness	Experience Type: Common Subcode (> 35% of participants)	Skill Category: Research	Technical	Communication	Management	Interpersonal	Collaboration	Other	Ambiguous	Total Participants
Helpful	**Research Experiences**: Group Meetings	4	5	19	1	3	4	2	2	**23**
	Interpersonal Interactions: Group Members	6	11	6	2	5	6	3	4	**22**
	Program Features: Coursework	8	14	9	2	1	2	0	0	**20**
	Research Experiences: Receiving Training	6	17	2	0	1	0	1	0	**20**
	Interpersonal Interactions: Advisor	7	7	10	4	7	3	7	5	**20**
	Research Experiences: Research Activities	14	10	1	6	0	0	2	2	**19**
	Qualifier: Feedback	3	4	8	1	2	4	2	4	**16**
	Other Opportunities: Attending Conferences	0	1	14	0	0	0	5	1	**15**
Limited	**Prior Experience**	0	14	4	1	2	1	0	0	**18**
	Program Features: Training/Workshop	1	0	5	8	5	1	4	3	**15**
	Interpersonal Interactions: Committee	2	2	2	0	1	0	0	11	**15**
	Research Experiences: Receiving Training	1	5	3	3	4	2	1	0	**14**
	Program Features: Coursework	0	6	6	2	0	0	0	2	**13**
	Interpersonal Interactions: Advisor	1	0	4	2	2	0	1	5	**13**
	Qualifier: Feedback	0	0	8	0	0	2	0	5	**12**
Not Helpful	**Program Features:** Coursework	0	3	2	0	0	0	0	9	**12**
Ambiguous	**Prior Experiance**	3	17	7	2	3	0	1	0	**24**
	Research Experiences: Research Activities	9	10	0	4	0	0	4	1	**20**
	Research Experiences: Receiving Training	1	20	0	0	0	0	0	0	**20**
	Interpersonal Interactions: Advisor	5	5	5	0	2	0	2	5	**18**
	Research Experiences: Teaching self	1	14	1	0	1	0	1	1	**16**
	Interpersonal Interactions: Group Members	4	11	5	0	4	1	1	1	**15**
	Program Features: Coursework	4	9	5	0	0	1	2	1	**14**
	Research Experiences: Group Meetings	2	1	10	0	0	1	1	1	**14**
	Qualifier: Feedback	1	0	11	0	0	1	1	1	**13**

Figure S6: Helpfulness of mentioned experiences

Experience Type	Subcode	Helpfulness				
		Helpful	Limited	Not Helpful	Ambiguous	Total Participants
Ambiguous Experience		4	7	3	5	**14**
Research Experiences	Research Activities	19	2	2	20	**29**
	Group Meetings	23	6	4	14	**29**
	Individual Meetings	2	2	1	1	**6**
	Receiving Training	20	14	3	20	**29**
	Training Others	5	1	1	4	**9**
	Teaching Self	7	0	2	16	**19**
	Receiving Mentorship	10	5	0	4	**14**
	Mentoring Others	10	5	0	3	**16**
	Collaborations	10	7	2	3	**19**
	Reviewing Scientific Articles	2	0	0	0	**2**
	Writing Scientific Articles	3	6	0	2	**11**
	Grant Preparation/ Fellowship Application	6	9	0	2	**15**
	Research Autonomy	2	3	0	2	**5**
Program Features	Program Exam	10	1	3	1	**12**
	Presentation Requirements	7	6	0	3	**13**
	Teaching Assistantship	8	2	2	3	**14**
	Coursework	20	13	12	14	**27**
	Training/Workshop	2	15	0	1	**17**
	Committee Meetings	3	2	2	0	**6**
	Department Seminars	1	2	1	0	**4**
	Rotations	1	1	2	1	**4**
	Mentorship Program	0	0	0	1	**1**
Interpersonal Interactions	Committee Meember	9	15	3	3	**24**
	Group Members	22	6	3	15	**28**
	Advisor	20	13	5	18	**31**
	Collaborators	6	1	2	4	**12**
	Peers	5	3	1	1	**9**
	Mental Heath Provider	1	0	0	1	**2**
	Family Members	1	0	0	0	**1**
	Faculty	7	2	1	1	**10**
Other Opportunities	Internship	0	2	1	1	**4**
	Univeristy Clubs and Organizations	7	0	0	4	**10**
	Volunteer	1	0	0	0	**1**
	Teaching Workshop	0	1	0	1	**2**
	Career Workshop	3	0	1	1	**4**
	Library Resources	1	0	0	0	**1**
	Writing Resources	1	1	2	1	**4**
	Attending Conferences	15	9	2	3	**22**
Prior Experience		11	18	3	24	**31**
Qualifier	Feedback	16	12	3	13	**25**
	Discipline Specific	0	4	1	0	**4**
Total Participants		**33**	**33**	**27**	**33**	