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Insights Gained into the Use of Individual Development Plans as a Framework for Mentoring NIH Postbaccalaureate Research Education Program (PREP) Trainees

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Abstract

This study examines the use of individual development plans (IDPs) in a structured mentoring program as an effective mechanism for reducing identity-related anxiety for underrepresented trainees and increasing their learner agency. Social cognitive theory served to provide the theoretical framework for our implementation of IDPs and our investigation of the effects of completing IDPs on trainees attaining academic goals and subsequent success in enrolling in competitive PhD programs. Results suggest that IDPs are also an effective tool that can allow faculty mentors to provide the social support necessary for trainees to persist in accomplishing their short- and long-term learning goals. Additionally, trainee self-agency, in the use of the IDP and mentoring, seemed to provide an alternative narrative to ability as a sole predictor of STEM achievement. We also found that IDPs helped foster social support networks, providing stability, predictability, and a sense of belonging. Specifically, IDPs helped foster the emotional and informational support necessary for trainees to persist, despite obstacles, as they strived to attain their learning goals.

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IPREP IDP Template can be found at https://scholarworks.iupui.edu/handle/1805/26890 and 10.7912/cdg2-9v16.

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INTRODUCTION

In 2013, The National Institute for Health (NIH) released an announcement encouraging institutions to use individual development plans (IDPs) as a mechanism through which trainees can achieve their career goals (NOT-OD-13–093).[1] This call was based on the recommendations of the Advisory Committee to the NIH Director, seeking out strategies that will attract, retain, and prepare the best and most diverse trainees for a broad biomedical research workforce. The following year, the NIH required funded training programs to institute and report on the use of their IDP to provide structure to the training experience (NOT-OD-14–113). The intent was to utilize the IDP as a mechanism for identifying, planning, and achieving the trainee's career objectives in a more structured manner during the training experience.[2]

IDPs as a Framework for Mentoring

The concept and use of IDPs as a tool to be used by mentors had already been explored quite vigorously in the literature. Vincent et al. (2015) described the IDP as a mechanism for mentors to have regularly scheduled meetings with trainees structured around five specific goals: (1) motivating the trainee through the recognition and celebration of accomplishments; (2) setting short- and long-term goals for both their research projects and career; (3) teaching strategies toward prioritizing tasks and identifying barriers to success; (4) building a rapport and relationship based on productive and constructive criticism; and (5) setting and clarifying bidirectional expectations and miscommunications.[3] Furthermore, they suggest that this process surround a conversation led by the thoughtful exploration and conversation of the trainee, resulting in a strategic plan containing actionable goals. This style of mentoring incorporates a nurturing process designed to promote the trainee's professional and personal development. Many studies suggest that this approach leads to more positive outcomes for the trainee's long-term career goals including better academic performance, resiliency, persistence, networking, and career satisfaction.[3–5]

The use of IDPs in structured mentoring programs represents an effective mechanism for goal-setting and addressing anxiety in trainees in hopes of increasing learner agency.[3,6] Social cognitive theory (SCT), developed by Bandura and others, served to provide the theoretical framework for our implementation of IDPs and our investigation into the effects of completing IDPs on trainees attaining academic goals and subsequent success in enrolling into competitive PhD programs.[7–9] SCT posits that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behavior. According to Bandura (1997), self-efficacy expectations are judgments about how well a person is able to meet a goal or cope effectively with stressful events that may arise.[10] We view SCT as critically important in the examination of trainee success. Self-agency provides an

alternative narrative to ability as a sole predictor of STEM achievement. Bandura (2011) argues that the concept of self-efficacy is foundational to motivation and well-being.[11] Self-efficacy relates to individuals' self-perception of their own ability to perform and "influence events that affect their lives".[12]

Within this learning context, faculty mentors provide the social support necessary for trainees to persist in accomplishing their short- and long-term learning goals. Research has shown that social support networks provide stability, predictability, and positive effect.[13] The positive effect includes a sense of belonging, referring to a students' perceived social support on campus, a feeling or sensation of connectedness, and the experience of mattering or feeling cared about, accepted, respected, and valued by and important to the campus community.[14] When minoritized students worry about belonging and something goes wrong, it may lead to feelings of isolation, overwhelming criticism, or disrespect. This, in turn, can increase stress and undermine students' motivation and engagement.[15] The IDP process provides the structure for faculty mentors to provide the social support (emotional, informational, appraisal, and informational) necessary for trainees to feel supported and persist despite obstacles as they strive to attain their learning goals.[16] Motivation, self-efficacy, and a sense of belonging are malleable and affected by social constructs and interactions. The IDP serves as an effective tool to create safe spaces for trainees to develop science motivation, positive self-efficacy, and a healthy sense of belonging in a space of advocacy and support as they strive to accomplish the challenging goal of gaining acceptance into competitive PhD programs.

To adhere with the goal of using the IDP in a more structured mentoring approach, many NIH funded programs turned to the Science myIDP, a web based application made available in 2012. It guides the trainee through an introspective self-assessment of the interests, skills, experiences, plan, and progress necessary to achieve their career choice and objectives.[6] The questions also lead the trainee to explore and identify potential career pathways that fit their interests and develop goals toward preparing entry into those careers.[17] Trainees are expected to confidentially complete this assessment and then bring the suggested objectives to their regularly scheduled meetings with their mentor as an iterative process.

While a majority of the training programs impacted by this IDP requirement have trainees in biological science departments or programs, ~10% of the funded programs are chemistry, chemical engineering, biochemistry, biophysics, biochemistry/biomedical engineering, and other chemistry-related training programs.[18] Due to the growing need for IDPs in these programs, the American Chemical Society developed ChemIDP, also a web based application for trainees interested in pursuing careers in the chemistry enterprise.[19] ChemIDP guides the trainee through assessing their professional and technical skills, developing strategies to strengthen those skills, and tracking their success in building skills and reaching goals. Like myIDP, ChemIDP provides a platform for exploring and identifying potential career pathways within the chemistry enterprise. This is different from other tools, in that the guidance is built into the tool, and therefore, a specific discussion about progression with mentors is not necessarily required.

Mentoring Frameworks for Underrepresented Trainees

Trainees participating in these training programs are generally provided an experience that includes mentoring from several conceptual frameworks of supportiveness including sponsor-ship, psychosocial, career-related, and research collaboration.[20] All of these aspects align the short and long-term goals with metrics such as research productivity and various other career goal(s). While most mentors have a general sense of methodologies for implementing these types of mentoring concepts, successful implementation when mentoring underrepresented trainees requires what Williams et al. (2017) describes as coaching support, which surrounds the previously described concepts, combined with social support.[16] They describe social support as a framework to address the feelings of "isolation and the negative stereotypes they experience" by enhancing motivation, aiding in the self-development of their scientific identity, and facilitating their sense of belonging within a predominantly white male represented biomedically related research environment. To achieve this goal, they suggest mentors include social supportiveness mentoring practices, such as emotional, informational, appraisal, and instrumental support.

The previously mentioned IDPs, and the framework generally used to develop similar IDP tools, are generally designed with long-term career goals in mind. The tools become a platform for mentors to give coaching support, with the goals and metrics of success being aligned with items, such as scholastic productivity or career stepping stones. This long-term approach often leaves little room for mentors to engage in social support conversations that are more focused on the short-term "wins" necessary for trainees to thrive. This may be especially true for underrepresented students and may require mentors who are culturally responsive with practices and behaviors that allow them to effectively mentor students from different cultural backgrounds.[21,22]

Incorporating Social Support into IDP Frameworks

The work presented here will explore the use of both the myIDP and a new IDP (https://scholarworks.iupui.edu/handle/1805/26890) used with underrepresented trainees in the Indiana University Purdue University Indianapolis (IUPUI) Postbaccalaureate Research Education Program (IPREP). IPREP is a mentored program that guides these participants through a one-year professional development and research experience designed to transition them from being undergraduate to graduate students. Here, we will report on the responses from these diverse trainees, faculty mentors, and executive board on the yearly programmatic evaluation survey questions on the use of that year's IDP and the mentoring experiences. The faculty mentors, by and large, held representation from the majority social groups, but the trainees and executive board groups are typical of groups generally underrepresented in science (i.e., gender, racial/ethnic, and LGBTQ+ groups). While the mentors have participated in several research and culturally aware mentor training experiences over the years at IUPUI, they still reported more goal planning and coaching support in their mentoring approach but hesitated to use the IDP tool without specific interventions, reinforcing the need for more structured use within this population. The executive committee suggested that mentoring constructs need to reflect more emotional and informational support for the trainees. The trainees reported that because of their mentoring relationship, they had more informational, emotional, and instrumental support. This was

further strengthened by programmatic interventions building upon their ability to advocate for their own social support. Finally, we will suggest best practices for using the IPREP IDP as an instrument for short-term coaching and social support mentoring of underrepresented trainees.

IPREP Program Description

Trainees come to the IPREP program with varying levels of research experience including participating in laboratory courses, summer experiences, and year-long research experiences. Each year, trainees are accepted into the program within 36 months of graduating with their baccalaureate degree and begin the program in June. Mentors and trainees are first exposed to the IDP and are encouraged to use the IDP as a part of their relationship building during the orientation session held with all program associates the first week of the program. During the first two months of the program, trainees participate in several professional development modules. Most modules are derived from the *Entering Research* curricula and training materials, introducing trainees to the culture of research environments and increasing their self-efficacy in research skills (coaching support).[23,24] In addition to research skills, there are modules designed to provide the trainees with social support. Such support is designed to increase their ability to discern mentoring styles, effectively communicate, align expectations, and navigate anxiety and feedback with their mentors. The trainees are introduced to the IDP concept and the mechanics of using an IDP to frame their conversations about their skills, short-term goals (graduate school, research interests), and strengths/weaknesses with their mentor throughout the course of the program. During the fall semester, trainees are reintroduced to the IDP as a tool for long-term self-discovery and career building. The mentors meet with the executive committee bimonthly until the end of the program to give updates on the trainee's progress toward their graduate school, professional development, and research goals.

Since the start of the program, the evaluations were used to determine areas that needed improvement. As a result, several interventions were implemented, including the following items related to the use of the IDP, which reinforce programmatic components with lower familiarity or comfortability, and evidence based practices toward building success in underrepresented trainees (Figure 1). As detailed in Figure 1, the program consistently underwent revisions informed by the needs reported in the yearly evaluation as well as those suggested in real time in the literature. While the impact of the changes may be studied with small participant groups, the responses consistently given by the trainees, faculty, and executive committee within the evaluation process suggest trends that should be considered when using IDPs as a tool to support inclusive mentoring in STEM.

METHODS

Procedures and Instruments

We conducted a qualitative content analysis in order to determine the presence of certain words, themes, and concepts. We employed a combination of conceptual and relational analyses, as we examined the occurrence of selected terms in the data (e.g., IDP, goal, motivation, accomplishment, mentor, and social support) and explored relationships

between concepts. These techniques allowed us to explore affect (capture the emotional or psychological state of the respondent) and cognition (the meaning of text and underlying the motivations and thought processes of the respondent). Using these techniques, we were able to capture trainees' voices and gain a more in-depth understanding of their thoughts, sentiments, and experiences as they reflected on their pre-IPREP program and post-IPREP program goals and accomplishments. The data analysis allowed for an understanding of trainees' experiences with the IPD in the mentoring process, as well as the faculty mentors' and executive committee members' perspectives of IDP as an effective tool.

Trainees, faculty mentors, and executive committee members were asked to respond to a series of self-report questionnaires designed to assess their perceptions of overall IPREP program effectiveness, as well as aspects of the program, such as the IDP process, mentoring relationships, social activities, structured academic support sessions, lab rotations, trainee learning goals and accomplishments, barriers to trainee success, and more. Trainees responded to a series of prepost program questions designed to understand their expectations of mentoring relationships, learning goals, learning accomplishments, their individual strengths, and the overall benefits of the IPREP program. Trainee alumni are also asked to participate in an annual questionnaire to track their experiences and accomplishments over the next survey for the next 10 years.

Participants

Among the trainees, 32.5% were male, 67.5% were female, 2.7% were Asian American, 56.8% were African American, 8.1% were White, 8.1% were more than one race, and 24.3% were Latinx. There were 37 trainees who completed prepost questionnaires.

Participants also included 35 trainee faculty mentors who responded to the questions and 8 executive committee members who completed questionnaires (their responses were anonymous with no accompanying demographic information in an effort to preserve anonymity).

Table 1 contains the items and the strategy used for coding the qualitative responses that were analyzed for this work. The following definitions based on Williams et al. (2017) were used for the purposes of coding social support mentoring comments.[16]

1. Emotional support: listening to other's concerns, sharing common life experiences, providing supportive environmental networks with common life experiences
2. Informational support: advice, guidance, and the provision of instructional or other informational resources when trying to complete tasks that are crucial for reaching goals and career milestones
3. Appraisal support: providing constructive and honest feedback to build and foster the ability to self-assess and validate performance
4. Instrumental support: providing tangible services or materials goods to ensure the emotional, mental, financial, and physical well-being

RESULTS

Mentor Use of IDP

To examine the use of individual development plans (IDPs) as an effective mechanism for reducing identity-related anxiety for underrepresented trainees, the aforementioned methods were applied to this study. We initially asked mentors to describe how effective the IDPs were in helping to provide guidance to their trainee. The mentor comments were used to determine the usage rate.

In Figure 2, we see the usage rate has varied since 2015, where we saw 40% of mentors using the IDP. An increase in usage followed from 2016 to 2018, when in 2018, less than 20% of mentors reported that they were not using the IDP. This time period coincides with the introduction of the new IPREP IDP and the institution of the NRMN trainee curriculum that included modules on using IDPs and collaborative goal-setting with the mentor. However, this trend was not sustained with future cohorts. Therefore, we looked more closely at the mentor comments as to the type of mentoring that was occurring.

Mentor Satisfaction with the IDP Instrument

In Figure 3, we analyzed the mentor comments for their overall satisfaction with the instrument. Approximately 55% of mentors surveyed made comments on finding the IDP satisfactory for use and found it helpful overall. These results vary over the years, with mentors from 2018 and 2019 finding the IDPs most helpful and satisfactory. This was an interesting result considering that the use of the instrument had begun to decline. We then looked for trends in the comments as to why the mentors decided not to use the IDP.

Figure 4A summarizes the mentors' reasons for why they did or did not use the IDP and mentor meetings. With mentors who did not use the IDP, some used other planning sources, informal goal planning, and communication with mentees. A small percentage of mentors stated that they were unaware that they should be using an IDP with their mentees. Of the mentors that did use the IDP, most stated that they utilized goal planning and communication, and this was more likely to be trainee specific. Figure 4 shows the results of the phenomenological study on their responses for the activities and support that the mentors were able to do when they used the IDP.

In general, mentors who used the IDP found it helpful in goal planning, career support, appraisal support, and communication. However, those that found the IDP useful were also more likely to make comments that showed a role for appraisal, career, and goal planning support in their interactions with their trainee. Table 2 contains examples of mentor comments toward their choice to use/not use the IDP, and use of mentor meetings.

In short, we found the following trends in how mentors approached the IDP:

- Mentors that used the IDP generally found more benefit toward coaching short-term goal planning and long-term career support.
- All mentors equally commented on finding regular times to communicate about the progress of their projects.

- Mentors that used the IDP generally found the tool to be helpful in their mentoring of the trainee.

Executive Committee Views toward Mentoring

Executive committee members were asked what aspects of the program were going well or not well and were asked for suggestions for improving the program for future mentoring cohorts. We have extracted the comments of executive committee members (Figure 5). Most executive committee members centered around perceptions of the mentor/mentee interaction and how mentees progressed through the program. Executive committee members felt that communication with trainees was strong and that the program provided a good amount of support for mentees, particularly emotional support.

Both the mentors and executive committee made comments toward the IDP being used to facilitate communication between the mentor and trainees, a trend that led to the implementation of the new IDP tool. However, there was a significant trend that the executive committee suggested a need for the mentoring approach to include more emotional and informational support and less instrumental and career support as the program progressed. Additionally, on two separate occasions, (2016 and 2019), executive board members provided additional comments and specifically mentioned the use of IDPs as aspects of the program that needed improving.

> In 2016, “We had significant problems this year in some mentor-mentee relationships. The IDP process is not working (again this year). Parts of the summer program were not well received by the Trainees.”

> In 2019, “I think we still need more feedback on how well the IDP is working for students and mentors. We need to ensure mentors offer options to trainees beyond IUPUI for research presentations and skill development (when possible). We need to assess where on campus the trainees have been most successful (schools/mentors).”

Impact on Trainee Mentoring

At the end of the program, trainees were asked about the mentoring that they received and their perceptions of the greatest benefit of the program. In Figure 6, we examined the data from IPREP trainees to determine the benefits of mentoring that mirror the content of an IDP.

Trainees reported feeling that there was a higher level of informational support regarding research studies (35%), with lower levels of support indicated for emotional, instrumental, and career support. Notably, the program mentees indicated a lower level of communication than suggested by mentors. Overall, mentors primarily supplied informational support for trainees from 2015 to 2020, with some level of emotional and instrumental support. At the height of the use of the IDP, trainees reported the greatest amount of informational support from their mentors. The introduction of the IPREP IDP coincided with the trainees reporting that they were able to receive more emotional, career, and goal planning support. On two separate occasions (2015 and 2020), the trainees provided additional comments that

specifically mentioned the use of IDPs that correlates with the inclusion of a structured programmatic use of the IDP:

> In 2015, “In IPREP, I learned how to develop a thorough independent research projects. I also learned to be more honest about my career choices. Initially I was set to pursue a PhD…, but I realized that it was not the best route for me. It was a tough decision, but when I came to the realization, it was very much relieving. The IDP analysis played a significant role in my decision. most of the questions helped me gain a better understanding of my strengths and weaknesses.”
>
> In 2020, “I know how to set SMART goals with my mentor and build relationships outside of my department. I have also learned how to find support mechanisms within whatever university I attend both culturally and professionally. For instance, I know how to receive institutional support for grants I may write during my doctoral program. I also know how to find minority-serving programs for graduate students within my institution.”

These comments demonstrate the utility of enlisting the IDP, as well as providing a concrete structure for trainees to understand how to the use the tool with their mentor as they navigate a program to reach their career goals. One of our early alumni provided this quote that further demonstrates the need to incorporate training for not only the mentor, but also the trainee on how to use the tool as they develop self-advocacy and agency in the training process:

> “I do feel as though there should be a more structured GRE prep class and an emphasis on why certain assignments are required. We had to do an independent goal sheet [IDP] and had to revisit it every few months, but no one emphasized what that should look like. Some of the meetings I had with my PIs felt pointless. It’s important to know why we needed to write everything down. I understand now, and actually write down all of my goals, however, I think it’s important to talk to students about the advantages of doing so. Sometimes, you need to voice what you need and want in order to make it happen.”

In summary, we report the following mentoring trends:

- There was an unsustained reporting of mentors using and finding the IDP helpful after implementation of the new IDP, regardless of the reinforcement by EC meetings and mentor training.
- Career support follows the same yearly trend, as those mentors who said the IDP was helpful.
- Informational support followed a similar yearly trend as those mentors who said the IDP was not helpful.
- On the basis of the trainee comments, mentors consistently focused more on informational support with the least amount of attention to appraisal support.

Impact on Trainees' Persistence in Accomplishing Their Learning Goals, Academic Attainments, and Successful Admission to Competitive PhD Programs

We employed a series of analyses to examine if incorporating IDPs in a supportive mentoring and learning context helped trainees attain their academic goals and gain successful admission in competitive PhD programs. The program has witnessed a 91% (31/34) success rate in terms of the number of students who have been successfully admitted to competitive PhD programs in biomedical and behavioral science fields. We also employed a series of paired sample tests to determine if the IDPs allow faculty mentors to provide the social support necessary for trainees to persist in accomplishing their short- and long-term social and academic learning goals. Our investigation examined if the IDP helped trainees persist, despite obstacles in attaining their academic goals and gaining admission into competitive PhD programs. At the beginning of the IPREP program, trainees were asked to respond to a series of items asking them to report their self-efficacy levels in the several domains including research skills, resiliency, persistence, establishment of positive mentoring relationships, and career attainment. Trainees were asked to report their level of confidence using the following scale: very low level = 1, low level = 2, slightly low level = 3, slightly high level = 4, high level = 5, and very high level = 6. Table 3 contains the results of the analyses indicating significant gains or differences between the pre- and postprogram items.

In an effort to gather more in-depth information about how the use of IDPs in the structured mentoring program helped increase trainees' self-efficacy, learner agency, and attainment of intended learning goals, we examined trainees' accomplishment of learning goals pre- and postprogram using open-ended items. At the beginning of the IPREP program, trainees were asked what learning goals they hoped to achieve, and at the end of the program, they were asked what learning goals they actually attained. Table 4 suggests that trainees found that the IDP was an effective mechanism for reducing identity-related anxiety and increasing learner agency. Trainees accomplished their learning goals and gained skills related to designing and implementing effective research, presentations, effective communication, ethics in research, preparing manuscripts, overcoming setbacks, learning to cope with stress, and gaining acceptance into graduate school.

We then compared the results of our program with those known for other PREP programs. NIH program outcomes for PREP success are that 75% of each cohort matriculates into a PhD or MD/PhD, with a 75% completion rate.[25,26] Hall et al. (2015) evaluated the educational and career outcomes of PREP at 41 institutions.[25] Although they found overall positive outcomes, the success metrics determined by the NIH were not met. Of the PREP Scholars, 65% entered PhD programs, and of those who started one, about 63% completed it. Of the PREP scholars that graduated, about 50% received postdoctoral training, and 79% were actively doing research or were engaged in science-related nonresearch work. When compared to the results of Hall et al. (2015), our program exceeded those benchmarks. Of the 33 Scholars who have completed the program, 97% have been admitted to graduate degree programs (MS or PhD), and 85% are in PhD or MD/PhD programs at prestigious R1 universities. The differences in these success metrics may in part be explained by the more extensive IDP and mentoring model the IPREP employs with our trainees.

DISCUSSION AND IMPLICATIONS FOR PRACTICE

Results suggest that IDPs allow faculty mentors to engage in more meaningful relationships with trainees and promote thoughtful conversations with trainees around developing strategic plans containing actionable goals. This style of mentoring incorporates a nurturing process designed to promote a trainee's sense of belonging, as well as professional and personal development. Our findings support the use of other investigations that showed this methodology of using IDPs promotes more positive outcomes for the trainees' self-efficacy levels related to academic performance, resiliency, persistence, relationship building, and career attainment.[3–5] Moreover, our findings suggest that the use of IDPs in structured mentoring programs represents of an effective mechanism for reducing identity-related anxiety for trainees and increasing learner agency and can even allow for trainees to persist, despite obstacles, and attain their short- and longer-term goals.

Incorporating IDPs in a supportive mentoring and learning context helped trainees attain their academic goals and gain successful admission in competitive PhD programs. Aligned with SCT, we found that trainee self-efficacy expectations and judgments about how well they can perform to meet a goal or cope effectively with stressful events were enhanced by the use of IDPs in the mentoring process. Within this learning context, faculty mentors provided the social support necessary for trainees to persist in accomplishing their short- and long-term learning goals. With programmatic support, the IDP process seemed to provide trainees with the additional structure they need to have conversations with faculty mentors, providing the social support (emotional, informational) necessary for trainees to feel supported and persist despite obstacles as they strive to attain their learning goals. Training programs should see the IDP as an opportunity for mentors to create emotional and scientific safe spaces for their diverse trainees to develop science motivation, positive self-efficacy, and a sense of belonging in a space of advocacy and support.

Suggested Best Practices for IDP Based Mentoring Strategies

- Make IDP simple to fill out, follow and access by the mentor and trainee.
  - Set scheduled times throughout the program dedicated to follow up on the IDP.
  - All parties should understand that the IDP is not just a career tools but they are also designed to help trainees with social and self-efficacy expectations.
  - Provide mechanisms for supervising teams (e.g. executive or advising committee) to provide feedback on the mentoring based on the IDP use.
- Train mentors and remind mentor to use the IDP on regular basis.
  - Explain to mentors the importance of IDP and require documenting informal conversations as a follow-up to the IDP goals.
- Train trainees on the use of the IDP for setting short/long-term goals and framing conversations with their mentor.

LIMITATIONS

There are some limitations to this study. Although the IDP contributes to the mentoring relationship, there are several other factors (e.g., lab rotations, peer networks of support, required projects and presentations) in the IPREP program that may have also contributed to the trainees' goal accomplishment. It is difficult to isolate the sole effects of the IDP. Additionally, the small sample size and single institution limit the generalizability of the results. The study also relied on a qualitative investigation of trainees, faculty mentors, and executive committee members' perspectives, thoughts, sentiments, and events that they were able to recall. It is possible that our data do not reflect the comprehensive and complete mentor and trainee experience. Furthermore, this study did not analyze the results within the context of any reports of the sentiment about the mentor–trainee relationship. Therefore, the smaller sample size may be unduly influenced by the mentor perceptions of the trainee capabilities, and the trainee perception of the willingness/desire to mentor them.

CONCLUSION

In conclusion, our results indicate that the use of individual development plans (IDPs) in a structured mentoring program appear to be an effective mechanism for increasing trainees' self-efficacy levels in several domains, including research skills, resiliency, persistence, establishing positive mentoring relationships, and career attainment. Our results suggest that IDPs allow faculty mentors to provide the social support necessary for trainees to persist in accomplishing their short- and long-term learning goals. More specifically, the IDP process helped mentors provide the emotional and informational support necessary for trainees to persist despite obstacles as they strived to attain their learning goals, including the most challenging goal of gaining admission into competitive PhD programs.

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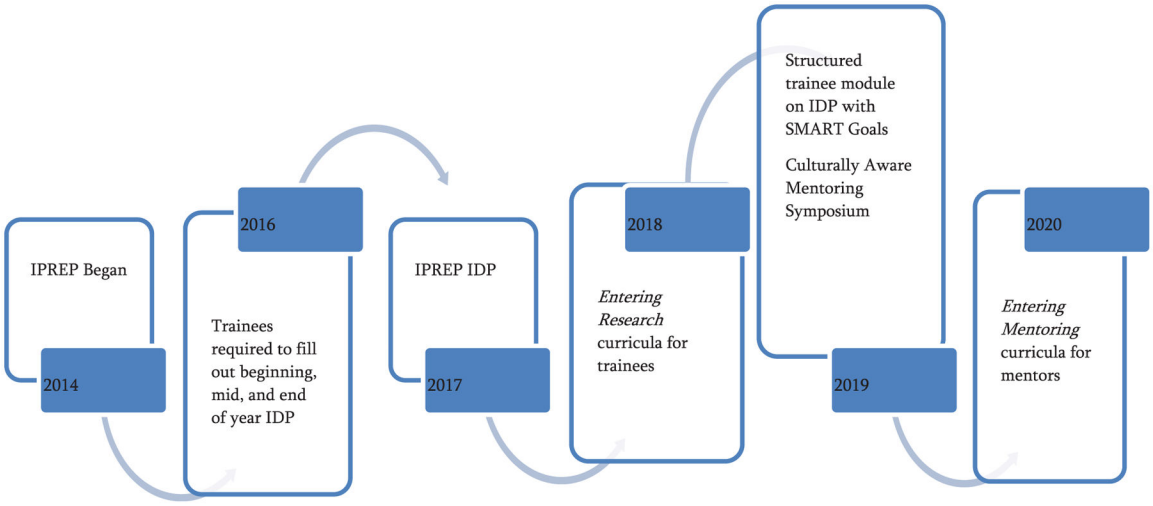

Figure 1.

Timeline of IPREP programmatic interventions to reinforce use of an IDP during the training experience including the introduction of the National Research Mentoring Network (NRMN)/Center for the Improvement of Mentored Experiences in Research (CIMER) Entering Research[24] and Entering Mentoring[14] curricula.

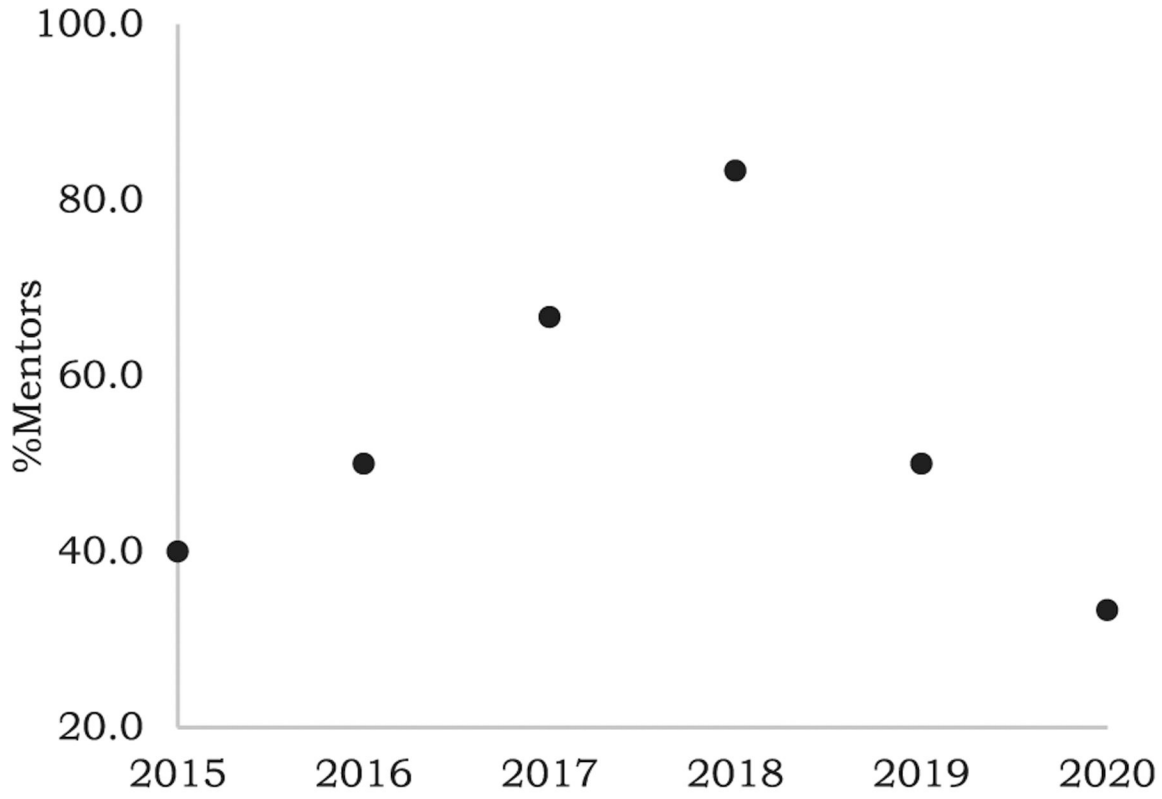

Figure 2.
IDP usage rates as reported by mentors. Percent of mentors who reported that they used the IDP.

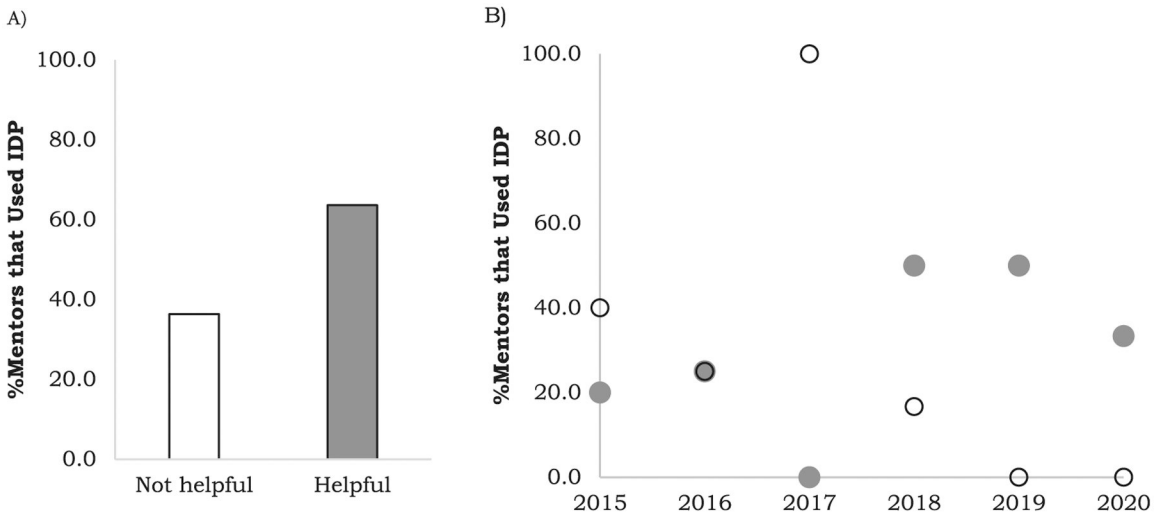

Figure 3.

Mentor satisfaction with the IDP instrument. (A) Mentors across all cohorts who used the IDP and commented that they found it not helpful vs helpful. (B) Percentage of mentors using the IDP that found the instrument not helpful (open circles) vs helpful (gray filled circles) each year.

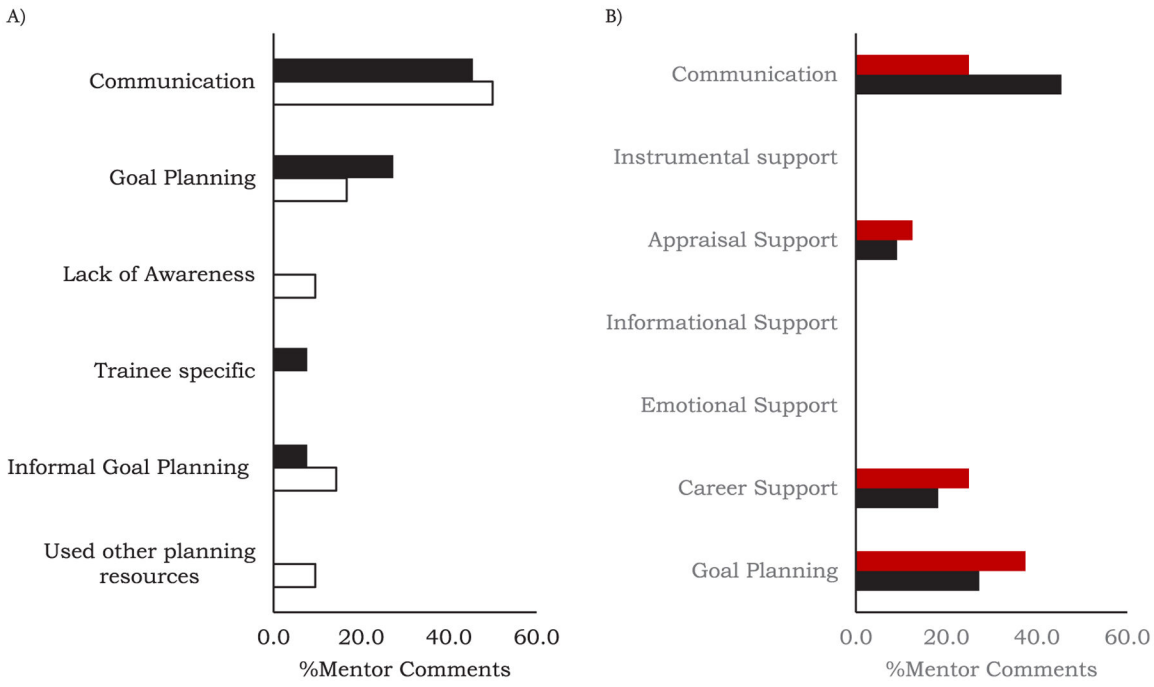

Figure 4.

Guidance themes in mentor comments about using the IDP. (A) Mentor comments when they chose to use (black) and not use (white) the IDP. (B) Comments as to themes mentors used when they found the IDP helpful (red) vs all mentors that used the IDP (black).

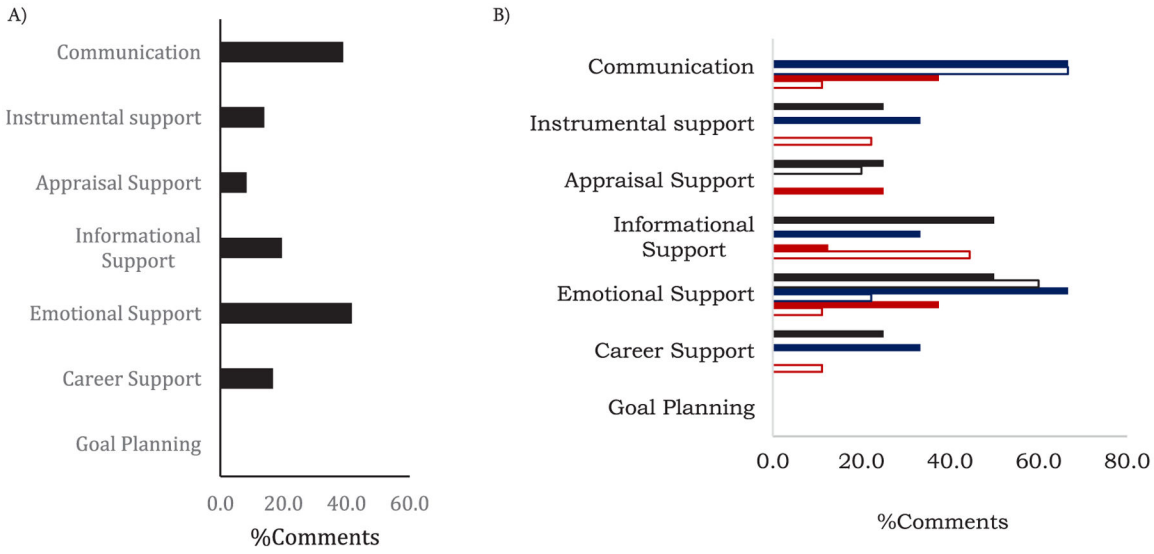

Figure 5.

Executive committee comments on how to improve the program for trainees. Guidance themes in the comments as to the type of needed mentoring (A) and then broken down by year (B) 2015 (open red), 2016 (closed red), 2017 (open blue), 2018 (closed blue), 2019 (open black), and 2020 (closed black).

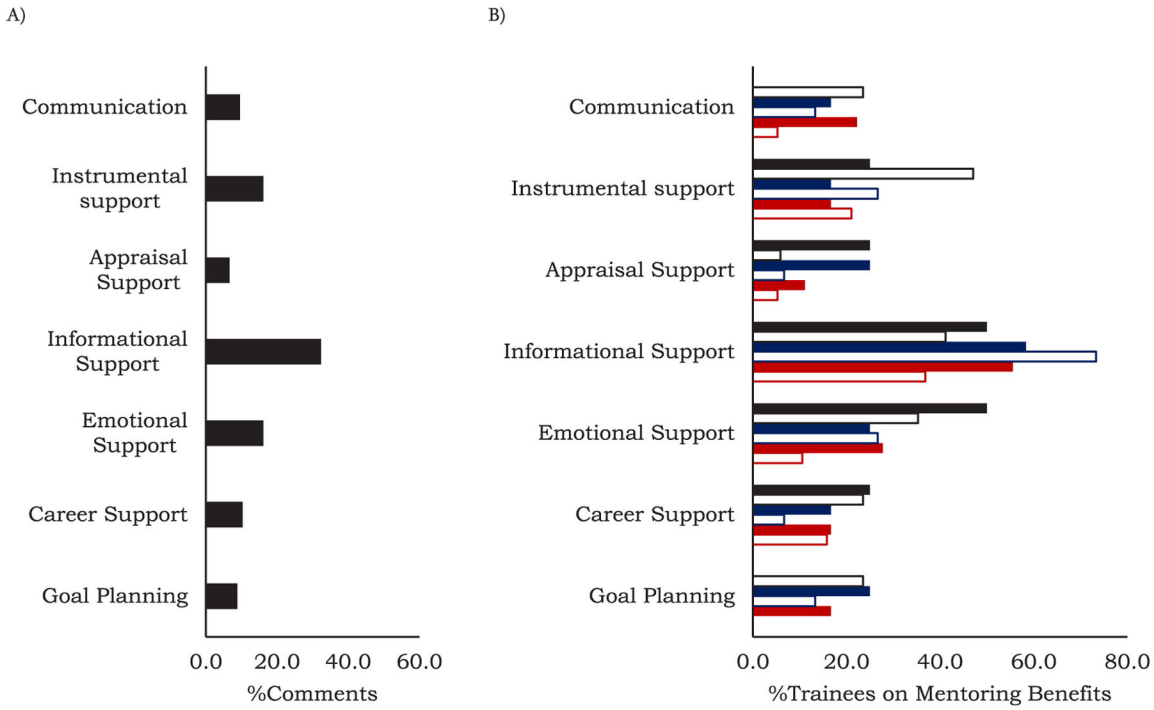

Figure 6.

Trainee comments on the programmatic experience. Guidance themes in the comments as to the type of mentoring the trainees received (A) and then broken down by year (B) 2015 (open red), 2016 (closed red), 2017 (open blue), 2018 (closed blue), 2019 (open black), and 2020 (closed black).

Table 1.

Questionnaire Items

Respondents	Questions	Response Coding
Trainee	Mentoring expectations	Structured goal planning
		Learning goals Attained
	Research goals and objectives	Career support/social Support
	Achieved as part of the IPREP program	Social support: emotional/informational/appraisal/ instrumental
	Perceptions of greatest benefits of IPREP program	Communication tool
Mentor	Please describe how effective the individualized electronic personal development plans were in helping you provide guidance to your trainee	Used/did not use
		Used other resources/lack of Awareness
		Helpful/not helpful
		Informal goal planning/structured goal planning
		Career support/social support
		Social support: emotional/informational/appraisal/ instrumental
		Communication tool
Executive committee	What aspects [of the program are] going well?	Structured goal planning
		Career support/social Support
	What aspects [of the program are] NOT going well?	Social support: emotional/informational/appraisal/ instrumental
	What specific suggestions do you have for improving the program for future cohorts of trainees?	Communication tool

Table 2.

Mentor Comments on Their Experience with the IDP

Year	Used IDP	Did Not Use IDP
2015	"Moderately helpful."	"The individualized electronic PDP was not particularly helpful… However, this may have been because [this trainee] had been in my lab for a year prior to becoming an IPREP trainee. By the time the PDP was made available, [we] had already game-planned [the] continued training."
2017	"We had one meeting on it, then did not use them again. Not sure if we were supposed to but they did not have an ongoing impact."	"Not much—The trainee and I met weekly and most the professional development occurred informally."
	"It was not helpful at all. I got far more out of simply talking with the trainee each week about interests, goals, strengths, and weaknesses… and about how we might address those in the training."	
2020	"Well, we only used it at the beginning to really identify strengths, weaknesses and specific things he wanted to do. We had weekly check ins, and did meet his goals, but only checked in with the IDP halfway through."	"I'm not sure what this is or was. Never communicated to me clearly."
	"These were helpful in setting initial goals and having something to reflect back to throughout the year."	

Table 3.

Pre- and Posttest Results of Trainees' Social and Academic Learning Accomplishments ($N = 34$)

Social and Academic Learning Goal Item	Pretest ($N = 34$)		Posttest ($N = 34$)		
	Mean[a]	SD	Mean[a]	SD	*T*-Value
Conducting independent, scholarly research	3.79	1.29	4.88	0.93	−4.16[b]
Giving oral presentations about scientific research findings to diverse audiences	3.97	1.65	5.06	0.91	−3.93[b]
Bringing new insights to the research issue at hand	3.27	1.35	4.61	1.06	−4.30[b]
Not getting discouraged by setbacks and unforeseen events	4.12	1.49	5.27	1.08	−4.34[b]
Showing flexibility and a willingness to take risks and try again	4.45	1.48	5.39	0.66	−4.03[b]
Developing positive mentoring relationships with faculty members	4.47	1.60	5.25	0.98	−2.83[c]
Attaining a PhD degree in a biomedical or behavioral sciences field	4.27	1.73	5.42	0.83	−3.74[b]
Pursuing a career in biomedical or behavioral sciences	4.55	1.72	5.39	0.86	−2.75[c]

[a]Means on scale: very low level = 1, low level = 2, slightly low level = 3, slightly high level = 4, high level = 5, and very high level = 6.

[b]Refers to $p < 0.01$.

[c]Refers to $p < 0.001$.

Table 4.

IDP Supported Mentoring and Trainees' Accomplishment of Learning Goals: Example Trainee Responses

Trainee Preprogram Learning Goals	Trainee Postprogram Learning Goal Accomplishment
I would like to obtain sufficient research experience so that I can convey my knowledge of how to design, conduct, and write up a research project to a graduate admissions committee in an interview. I would also like to gain familiarity with various research techniques used in the biomedical sciences.	I successfully designed a research project, collected data, analyzed and interpreted my data, and presented my findings to other scientists. I gained several research-related technical skills, experienced setbacks that occur during research projects and learned how to deal with them, and learned how to conduct research in accordance with ethical standards.
Understand the process of starting a research project and gain experience as a research fellow, a position I plan on taking when I attend graduate school	My biggest goal was to learn how to design my own research project and I believe that that was a goal I achieved during IPREP with the help of my mentor. I was able to understand that it was through keeping up to date on published studies and building on those findings that researchers are able to design groundbreaking research projects.
I would like to obtain sufficient research experience so that I can convey my knowledge of how to design, conduct, and write up a research project to a graduate admissions committee in an interview. I would also like to gain familiarity with various research techniques used in the biomedical sciences.	I successfully designed a research project, collected data, analyzed and interpreted my data, and presented my findings to other scientists. I gained several research-related technical skills, experienced setbacks that occur during research projects and learned how to deal with them, and learned how to conduct research in accordance with ethical standards.
I just want to gain a vast knowledge of what discipline I chose as my research lab. I desire to be challenged and have the opportunity to work independently to develop myself professionally. I was to learn how to think critically when it comes to research topics, issue resolution and practical usage.	I wanted to experience the process of having my own research project and all that was need to start, experiment and interpret results for the project. I achieved this goal alongside writer communication development.
Independently design and conduct a research experiment, present posters at conferences, prepare a manuscript for publication.	Gain skills and competencies necessary to prepare my first manuscript with mentorship and guidance.