

Doing Academia Differently: The Creation of a Cohort-Based Postdoctoral Scholars Program for Emerging Engineering Faculty

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Abstract

The postdoctoral to professoriate pathway is a conventional path to develop significant engineering faculty talent and diversify the engineering academia workforce. Relatively few studies have examined the science, technology, engineering, and mathematics (STEM) postdoc experience, even though these scholars have faced structural and interpersonal challenges as they navigate the transition to faculty positions.

Even less literature exists about the experiences of underrepresented minority (URM) postdocs in STEM. Data suggest that the number of URM postdocs is abysmal, revealing the need for more empirical studies and practical recommendations for recruiting, supporting, and retaining these individuals.

This paper examines the work and community of a public land grant university's College of Engineering Leading Engineering as Agents of Change and Equity (LEGACY) program. LEGACY was founded under Dean Ayanna Howard and influenced by Dr. Monica Cox's research work and lived experience with the mission to diversify the next generation of engineering leaders in academia. With a focus on intersectional mentorship, the purpose of the postdoc program is to create well-rounded scholars versed in research, teaching, and service. Using artifacts and postdoc reflections, this study aims to explore the experiences of the first cohort of LEGACY postdoc scholars to understand how a newly created intersectional mentorship model facilitates scholars' progression toward faculty positions while curating an inclusive community and culture for scholars.

The intersectional mentorship model framing this postdoc program is based on research conducted by Dr. Cox, with some adaptations from Walker et al.'s (2009) *The Formation of Scholars*, which presents a multiple apprenticeship framework that offers a holistic approach to mentoring for scholars. The three mentor types in the program are primary (focused on research), secondary (focused on teaching and/or service), and intersectional (aligned with identities of scholars' choosing). This integrated model engages scholars, mentors, and members of the administrative team in authentic dialogue to promote a culture that differs from traditional models of postdoctoral mentorship and development.

Initial findings show that to maximize the progression of postdoctoral scholars, it is important to understand and address their self-identified issues surrounding mentorship and professional barriers that impede their success. The target audiences of this work are institutional programs, individuals who work with postdoctoral scholars, and those with an interest in diversifying and retaining future URM STEM faculty. Authors offer suggestions about ways to support, mentor, and build an inclusive community for postdocs that help them become independent, confident, and competent emerging faculty who can succeed in academia.

Key Words

postdocs, underrepresented minority (URM), mentorship, engineering, (URM) early career faculty, faculty recruitment

Introduction

The Ohio State University hired its first woman of color dean of engineering in spring 2021. Given the racial unrest of 2020, she presented a bold vision to increase the number of underrepresented faculty in the College of Engineering under her leadership. Informed from research about URM STEM postdocs, LEGACY was launched in June 2021. Two years later,

seven scholars across four of the thirteen engineering departments have been hired in the first cohort of scholars.

In less than two years of their postdoctoral appointment, several of the LEGACY postdoctoral scholars have received competitive funding, including a Kickstarter grant, Accelerator Award, and National Institute of Health grant funding, during their time in the program. Additionally, scholars have also published peer-reviewed research articles, presented at research conferences, joined departmental diversity, equity, and inclusion (DEI) committees, and taught in guest lecturer roles. Some have even applied for junior faculty positions and undergone extensive training at an on-campus instructor training institute.

This paper examines the work and community of a public land grant university's College of Engineering LEGACY Scholars Program founded under Dean Ayanna Howard's leadership and influenced by Dr. Cox's research work and lived experience with the mission to diversify the next generation of engineering leaders in academia. With a focus on intersectional/cross-cultural mentoring and its impact on matriculation from postdoctoral scholars to faculty members, especially those from underrepresented populations, the purpose of the postdoc program is to create well-rounded scholars versed in research, teaching, and service. From previous studies, one can identify that for postdocs to have a successful transition from postdoc to a faculty member, they must be supported through multiple mentors, have their identities embraced beyond their STEM identity, and have a community of supporters whom they can relate and that aid in their progression toward academic independence.

Using artifacts, such as field notes and shared files, along with reflection prompts, this study aims to explore the experiences of the first cohort of LEGACY postdoc scholars to understand how a newly created intersectional mentorship model facilitates scholars' progression

toward faculty positions while curating an inclusive community and culture for scholars (using the three research questions below).

RQ1: How does the curation of deliberate mentorship impact the scholars?

RQ2: What elements (or features) make the LEGACY Scholar Program unique?

RQ3: How does the LEGACY Scholar Program help with the matriculation of becoming an independent scholar (e.g., grant writing, self-efficacy, professor)?

Literature Review

The postdoctoral to professorate pathway has become a notable means of transition for graduate students moving to faculty positions, however many of these scholars face structural and interpersonal challenges as they navigate the transition to faculty positions (Rybarczyk et al., 2016). Studies have identified that the structural challenges postdocs face are due to a lack of support from their institution in terms of career development and interpersonal struggles with feeling exploited for low-cost labor (Rohn, 2011; Times Higher Education, 2012). A solution posed, according to Sigma Xi Postdoc survey results, is structured mentoring and formal training (Davis, 2005).

While using a mentoring strategy has its merit, postdocs from underrepresented minority (URM) populations have still faced challenges that have caused them to abandon the pursuit of a faculty position (Chemers et al., 2010; Solorzano, 1998; Yadav et al., 2020). Yadav et al. (2020) conducted a study to explore the challenges that impede the success of STEM URM postdoc scholars, such as self-efficacy, sense of belonging, and identity, through the Professorial Advancement Initiative consisting of Big Ten Alliance universities.

Yadav et al (2020) report significant themes for URM postdocs and note issues related to belonging, mentoring, and institutional support. Their study revealed five significant themes: the

culture of the institution or work environment, sense of belonging, self-efficacy, identity, and confronting biases/stereotypes. A general finding was how the lack of belonging impacted postdocs' confidence and self-efficacy, which led to their ability to be productive. Additionally, participants in the study felt having too few mentors and collaborators with whom they could identify, as well as a lack of personal/social support, negatively impacted their sense of belonging. In terms of institutional support, scholars felt they lacked feedback, especially in terms of their teaching and research responsibilities, which led to a lack of direction and impeded their academic progression.

While some of these findings were general for the postdocs participants interviewed, there were also more specific themes aligned with URM postdocs' experience such as identity and stereotypes/bias. As of 2016, 5.37% of postdocs identified as Hispanic/Latinx, 3.49% as Black or African American, 0.50% as American Indian or Alaska Native, and 0.41% as Native Hawaiian or Another Pacific Islander with 58.64% being White and 19.41% identified as Asian (National Center for Science and Engineering Statistics, 2016). Yadav et al. (2020) found that URMs faced stereotypes/biases in pursuit of a faculty position, especially in terms of mentorship. One postdoc expressed they felt race played a role in their experience with a mentor. The implied sentiments of their experience hinted at signs of microaggressions and implicit bias and was hypothesized to have been derived because they were a younger Black woman, and their advisor was an older White man which made for a difficult environment. While another scholar expressed how as a URM they were treated differently than their white peers. One incident highlighted was a professor that did not like women or Black people and primarily approved only of white men. While the postdoc indicated this was a negative experience, they also had a team of supportive faculty members who helped them through their transition. From these

findings, we can conclude that mentorship and support can vary across the spectrum for postdoc scholars, but one essential point is the importance of identity and relatability between the scholar and their surrounding environment.

Two intersecting themes that emerged from Yadav et al.'s (2020) study are the value of family orientation and intersectionality, unlike Crenshaw's (1989) well-known definition of intersectionality, which examines how U.S. structures frame identities as isolated and mutually exclusive resulting in the theoretical erasure of multiple minoritized identities (Crenshaw, 1989, p. 139; Carbado et al., 2013; Harris & Patton, 2019). Yadav et al. (2020) detailed intersectionality from an identity-centered lens with a focus on the use of intersectionality as an analytic tool that focuses on multiple identities versus engaging with the complexities of identities (Luft & Ward, 2009; May 2016; Harris & Patton, 2019) as it relates to power and oppression dynamics that impact these postdoc experiences.

The limitation of an identity-centered lens versus one that considers identity and external factors diminishes the overlapping factors that may affect the pursuit of a faculty position. Conversely, programs like Syracuse University's WiSE Women of Color in STEM (WWoC STEM) used intersectionality as praxis to build community, foster a sense of belonging, and promote academic, professional, and interpersonal excellence (Johnson et al., 2019). The primary participants of that program were faculty members, undergraduate and graduate students, and postdoctoral scholars. WWoC STEM used scholar-led discussions focused on topics such as experiences with bias, strategies for support and success, self-care, and building relationships with faculty (Johnson et al., 2019). Participants in this program spoke to the importance of community, and how having other women with whom they could identify improved their academic and professional knowledge and experiences. However, the challenge that the program

faced was the lack of accommodation for the intersectional, multi-disciplinary, and collaborative nature of the program. Programs like WWoC are valuable to the professional development of postdoctoral scholars but are sometimes challenging to sustain.

Given findings from the literature, it's important to explore the concept of intersectionality within mentor-mentee relationships to understand the experiences of URM postdocs. URM postdocs' intersecting identities and cultural values need to be analyzed beyond their STEM identity to cultivate a community and better transitional experience. Programs such as Purdue University's Reinvigorating Engineering and Change History (REACH) Scholar Program aimed to build an intellectual psychosocial linkage between faculty and graduate students and create a scholarly community using a multiple apprenticeship model (Zhu et al., 2011). The multiple apprenticeship model consisted of five features: intentionality, multiple relationships, collective responsibility, recognition, and respect, trust, and reciprocity (Walker et al., 2009). The key strength of the program was the use of the multiple apprenticeship model as it encouraged a more human-centered approach to mentorship. This resulted in the approachability and accessibility of academic mentors which allowed scholars to feel comfortable expressing concerns (Zhu et al., 2011). Scholars also identified the intentional nature of the mentors and their readiness to help students navigate concerns, transition to graduate studies, and develop their network.

Noel, Miles, and Rida (2022) affirm these attributes of a mentor-mentee relationship in their findings that expand upon the work of Yadev et al. (2020) suggesting that successful mentoring relationships that involve clear communication, ongoing and regular support, and mutual respect of all parties leads to increased productivity, self-efficacy, and career satisfaction (Noel, Miles, and Rida, 2022). LEGACY intentionally models these research findings and uses

foundations of programs like the REACH Scholars Program to provide an improved experience for minoritized STEM postdocs.

Program Description

Aspects of LEGACY was modeled after Purdue University's Reinvigorating Engineering and Change History (REACH) Scholar Program using Walker et al.'s (2008) multiple apprenticeship model focused on graduate engineering students exploring multiple academic pathways with a community of supporters to be prepared for a career in different disciplines (Zhu et al., 2011). Figure 1 shows how the program goals of REACH have been expanded upon by LEGACY to support postdoctoral scholars. As shown in Figure 1, some of the key features of both REACH and LEGACY are centered around quality mentorship, community, and increasing the number of scholars prepared to transition to various stages/roles within academia.

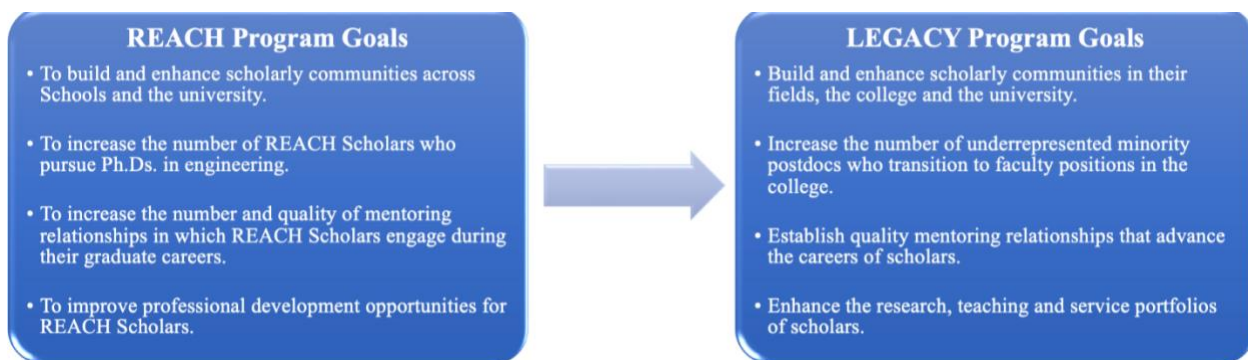


Figure 1: Mapping of the comparative goals of REACH to LEGACY.

Although both programs focus on quality mentorship using the multiple apprenticeship model, LEGACY expands upon the work of the REACH program by introducing cross-cultural mentorship which consists of three mentor types: primary, secondary, and intersectional mentor. Conversely, the REACH scholars had a singular academic mentor but were surrounded by an academic engineering community that provided a variety of perspectives to aid in the scholar's success (Zhu et al., 2011). The LEGACY Program was developed with the aim to prepare and diversify the next generation of engineering leaders in academia through mentorship that leads to

engagement in authentic conversations that promote a culture of inclusivity and scholar professional development in the areas of teaching, service, and research. These aspects have been embedded in the features of the program which are displayed below in Figure 2.

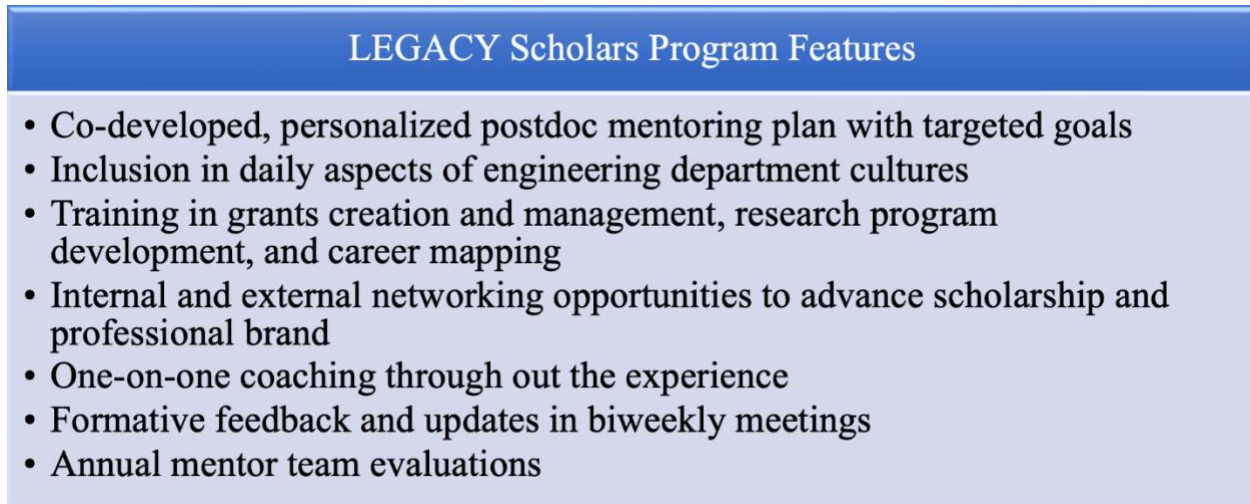


Figure 2: Details the key features of the LEGACY Scholars Program.

Conceptual Framework

There are several mentoring frameworks and apprenticeship models, such as Collins et al. (1989) cognitive apprenticeship model, and the cloning, nurturing, and friendship mentoring models as posed by Buell (2011). Collins et al.'s (1989) cognitive apprenticeship model has been directly applied to STEM studies because of its prioritization of cognitive skills, which is often required to engage in advanced problem-solving tasks common in STEM (Minschew, Olsen, and McLaughlin, 2021). While each of these models as well as others has merit, they are limited in their exploration of multiple mentor types especially as it pertains to the incorporation of an intersectional mentor.

The LEGACY Scholars Program combines Walker et al.'s (2009) multiple apprenticeship framework with a wedding model approach (e.g., old, new, borrowed, and blue) (Cox, 2015) to mentoring (Figure 3) that engages scholars, mentors, and members of the administrative team in authentic dialogue to promote a culture that differs from traditional models of postdoc

mentorship and development. The program director expanded this model to include primary mentors (focused on research), secondary mentors (focused on teaching and/or service), and intersectional mentors (aligned with identities of scholars' choosing). The cross-cultural or intersectional mentor aspect was added to take into account the negative experiences of URM STEM postdocs (Yadav et al., 2020) and develop quality mentoring relationships that engage the complex nature of scholars beyond their STEM identities. The following sections will delve deeper into the models that aided in developing the Intersectional Mentorship model.

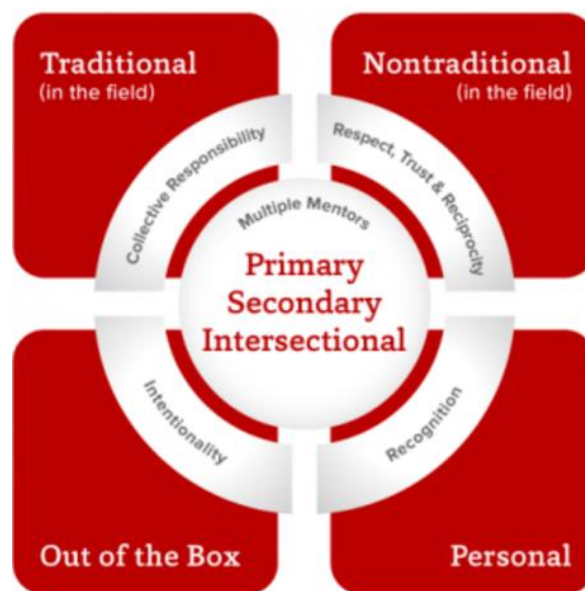


Figure 3: Intersectional Mentorship Model created by Dr. Monica Cox, adapted from the work of Walker, G. E., Golde, C. M., Jones, L., Bueschel, A. C., & Hutchings, P. (2009). *The formation of scholars: Rethinking doctoral education for the twenty-first century* (Vol. 11). John Wiley & Sons.

Mentoring Marriage Model Approach

The marriage mentorship model as developed by Cox (2015) serves as a point of guidance for how individuals should find mentors. Using the model of marrying a cohesive relationship in professional mentoring with marriage led to the use of the traditions of something old, something new, something borrowed, and something blue. Table 1 describes the aspects and attributes that a person should look for when trying to identify a mentor within each respective

category. Using this model, mentees can engage with a range of mentors from those who traditionally work in their respective fields with high levels of expertise to something blue mentors that are not as well defined but incorporate the unique nature of each person to formulate a more organic relationship. The marriage-mentor model features are used in the foundation of the intersectional mentorship model as they define the four types of mentors with whom scholars should connect. Walker et al.'s (2008) Multiple Apprenticeship Model will be further discussed in the next section.

Table 1: Mentoring Marriage Model (Cox, 2015)

Marriage Mentor Model Feature	Definition	Alignment w/ Intersectional Mentorship Model
Something Old	“Go-to” people and the people who possess organizational knowledge and respect. People who lead initiatives in their field.	Traditional
Something New	You will have to move out of your traditional circles to find these mentors. They are people who are extremely innovative and do things in ways that appeal to you although you may not know exactly <i>how</i> to connect to them initially.	Non-Traditional
Something Borrowed	Mentors are often found through common connections- people who know you and know your potential mentor.	Intersectional/Out-of-Box
Something Blue	There is no formula for finding these mentors. This type of mentorship occurs organically and often among peers.	Personal

Multiple Apprenticeship Model

Walker et al.'s (2008) *The Formation of Scholars* presents a holistic approach to mentoring via five key features: includes (1) intentionality, (2) multiple relationships, (3) collective responsibility, (4) recognition, and (5) respect, trust, and reciprocity. Table 2 presents each portion of this multiple apprenticeship model and its alignment within LEGACY. Elements of the model are displayed in the inner circle of Figure 3 and influence the relationship that scholars develop across mentor types. Table 2 details how the features of LEGACY align with Walker's Multiple Apprenticeship Model.

Table 2: Features of the LEGACY Scholars Program using the Multiple Apprenticeship Model (Walker et al., 2008)

Multiple Apprenticeship Model Components	Definition	Corresponding LEGACY Scholar Program Activities
Intentionality	Faculty with scholarly and professional expertise help students self-reflect upon the process of creating scholarly ideas and communicating them to others in their field.	Co-developed, personalized postdoc mentoring plan with targeted goals. Internal and external networking opportunities to advance scholarship and professional brand. One-on-one coaching throughout experience
Multiple Relationships	Students engage with numerous intellectual mentors.	Developing relationships with primary, secondary, intersectional, and personal mentors.
Collective Responsibility	All parties share responsibility for the development of students' learning.	Formulating a community with shared governance and a focus on inclusivity.
Recognition	Allow individuals to learn mentoring techniques and be recognized and rewarded for demonstrating these techniques.	Engagement with professional and personal mentors Formative and summative professional feedback about their progress
Respect, Trust, Reciprocity	Within a community, individual differences are taken into consideration and are acknowledged.	Participation in a two-year cohort with other postdocs

Methods

We employed an ethnographic study approach to examine the culture of LEGACY and share learned patterns of values, beliefs, and language among the scholars in a culture-sharing group (Creswell, 2007). Ethnography is advantageous in the exploration of the LEGACY Scholars Program because it allows for the adoption of a holistic perspective especially as all aspects studied under the phenomenon as parts, in this case, a cohort style model, cross-cultural mentorship, and community, are interrelated. This methodology requires extensive participant observation and for the researcher to be immersed in the day-to-day of the people observed, both of which are met through the program's weekly meetings that the researcher attends and is involved in.

Each week scholars engage in a one-hour weekly group meeting with the Program Director to discuss their matriculation to the professorate, such as advice on grant writing, working with undergraduate and graduate students as an educator and mentor, and partaking in service within their respective disciplines. During this meeting time, the Graduate Research Associate is also present to take notes and assist in meeting facilitation. As a part of examining the culture of the program, artifacts like presentations, shared resources, and documents, that are produced during weekly LEGACY scholar meetings are collected during the semester. The field notes were analyzed and used to answer RQ1 and RQ3 and provide implications to answer RQ3 by identifying cultural themes or issues about the group.

Data Collection

The data collection process consists of analysis of artifacts within the LEGACY Teams folder from the Spring of 2022 to the Spring of 2023. Artifacts include Stanford University's individual professional development plans (IDPs), chalk talk presentations, shared resources, and

other documents made available to the program. These resources have been shared by both scholars and the administrative team to help each scholar to be successful or aid in their professional development, research, teaching, and service.

Part 2 of the data collection process will consist of distributing and collecting responses from reflection prompts to better understand scholars' experiences and progression in the Program based on the program's key features as well as the critiques they have for the program.

Sample prompts include the following:

1. Provide feedback on the LEGACY Scholar Program. What have you received and been impacted by? What were your expectations, and have they been met?
2. Examining the program features provided: What feature do you most subscribe to? How do these features align with your goals as a scholar and help you to work toward them?
3. What are the critiques or any additional features you would like to see in the LEGACY Scholars Program?
4. How has the cross-cultural/intersectional mentorship within the program focused on and/or unpacked your intersectionality?
5. How has the use of a cohort-style model aided in building community both in and out of the academic setting?

Data Analysis

The LEGACY Microsoft Teams folder has three primary areas: general, resources, and scholar information. The general folder consists of past and present meeting notes, program resources, and proposed questions. Primary data of interest for this paper are the meeting notes and program information.

To organize the data, we developed categories that would best fit each type of artifact or discussion based on the information found in the meeting notes and published/shared files within each of the folders. In deciphering the categories of the artifacts, we first identified items that focused on the three elements necessary to become a faculty member, research, teaching, and service.

Starting with meeting minutes, we were able to use meeting topics such as inclusive mentoring, navigating conferences, and grant writing 101 to determine the categories that topics best fit in. Some of the topics were found in the meeting notes while others were shared in the Teams folder. Although several of the artifacts could be immediately categorized in the three faculty categories, some of the content did not directly align. Therefore, an additional category was created for professional development as it is one of the key features of the LEGACY Scholars Program and allowed for activities or discussions around the topic to be categorized. Several discussions centered around professional development such as the faculty mentoring map (see NCFDD) shared on Teams and meeting topics focused on branding for social media. This resulted in Table 3 which displays a broad overview of the types of artifacts created from the LEGACY’s Teams folder.

Table 3: Sample of Categorized Artifacts

Research	Teaching	Service	Professional Development
Johns Hopkins University Postdoc Funding Opportunity	Drake Institute for Teaching and Learning: Course Design Institute	Conference Panel/Reviewer Volunteer Opportunities	National Center for Faculty Development & Diversity: Faculty Mentoring Map
The Ohio State University Grant Writing 101 (MOSAIC K99/R00)	The Ohio State University Mechanical & FAST Program	Creating a Space for Mentees	Updating Professional and Social Sites

Some of the artifacts presented above are external from universities, like Johns Hopkins University, and national centers, such as the National Center for Faculty Development and Diversity (NCFDD), for which Ohio State is a member institution. The NCFDD Faculty Mentoring Map has been used to help scholars identify potential research, teaching, personal, and intersectional mentors. This also provided a tool scholars could use to help them expand their mentor network beyond the comprehensive view of mentors requested by LEGACY. The mentor map can serve as an assessment tool to help scholars identify if the mentor they selected aligns with the needs and purpose they wish for them to serve. In addition to the external resources, there were internal artifacts from Ohio State that were departmental and university-wide through resource centers. Scholars often used the university-wide resources to support their professional and teaching development to gain skillsets that would facilitate their matriculation to faculty.

Results

In this section, we present the results of the artifact and reflection prompts analysis, along with a discussion of how the themes that emerged from the data align with the program goals and features.

Artifacts

Artifacts were defined as tangible documents and resources such as meeting notes, shared files, and LEGACY Team's folder. Meeting minutes began in May of 2022 and have remained ongoing. During meetings, scholars were asked for topics they would like to discuss. Many of the suggested real-time topics aligned with daily challenges of scholars and included program features such as engagement with mentors, transition to a faculty position, and professional development to succeed as a tenure track faculty member. From the meeting minutes, the

collaborative nature and responsibility of the scholar community naturally emerged through scholars' commitment to helping each other achieve the goal of successfully transitioning to a faculty position. The commitment to collaborative responsibility conveys the inner workings of Walker et al.'s (2009) Multiple Mentorship Model as all parties (scholars) are sharing in the responsibility for the development of their learning.

Additionally, examining the Team's folder of published and shared files included documents shared regarding funding resources for research and professional development tools such as mentoring maps and development plans. Like the meeting minutes, many of the documents shared within the Team's folder were from the scholars again showing the collaborative responsibility intertwined with the features of the program and community. Table 5 shows the connections between the type of artifact found and its alignment with a feature and/or goal of the program.

Table 5: Artifact Analysis

Type of Artifact and Category	Name	Alignment with Feature and/or Goal
Teaching (Website Link)	Biomedical Engineering Faculty Job List	Goal: Increase the number of underrepresented minority postdocs who transition to faculty positions in the college Feature: Transition to a faculty position in the College of Engineering
Research (Website Link)	JHU Postdoctoral Research Funding Opportunities	Goal: Enhance the research, teaching, and service portfolios of scholars
Professional Development/Research (Website Link)	MOSAIC K99/R00	Goal: Enhance the research, teaching, and service portfolios of scholars Feature: Training in grants creation and management, research program development, and career mapping Feature: Transition to a faculty position in the College of Engineering

Mentoring (Document/Website Link)	National Center for Faculty Development & Diversity Mentoring Map	Goal: Establish quality mentoring relationships that advance the careers of scholars Feature: Engagement with professional and personal mentors
Teaching (Website Link)	Course Design Institute	Goal: Enhance the research, teaching and service portfolios of scholars Feature: Transition to a faculty position in the College of Engineering Feature: Professional development in areas of need for success as a tenure- track faculty
Professional Development (Document)	Stanford University Individual Development Plan (IDP)	Feature: Co-developed, personalized postdoc mentoring plan with targeted goals Feature: Formative and summative professional feedback about progress
Meeting Minutes (Fieldnotes)	Weekly Wins & Chalk Talk Topics	Goal: Build and enhance scholarly communities in their fields, the college and the university Feature: Participation in a two-year cohort with other LEGACY postdocs
Meeting Minutes (Fieldnotes)	Branding for Social Media & Networking	Goal: Build and enhance scholarly communities in their fields, the college and the university Feature: Internal and external networking opportunities to advance scholarship and professional brand Feature: Participation in a two-year cohort with other LEGACY postdocs
Meeting Minutes (Fieldnotes)	Evaluation and Reflection	Goal: Establish quality mentoring relationships that advance the careers of scholars Feature: Annual mentor team evaluations Feature: Formative and summative professional feedback about progress Feature: One-on-one coaching throughout experience
Meeting Minutes (Fieldnotes)	Navigating Conference Sessions	Goal: Enhance the research, teaching and service portfolios of scholars Goal: Build and enhance scholarly communities in their fields, the college and the university

		Feature: Internal and external networking opportunities to advance scholarship and professional brand
Meeting Minutes (Fieldnotes)	Guest Speaker from The Ohio State University	Goal: Build and enhance scholarly communities in their fields, the college and the university Feature: Internal and external networking opportunities to advance scholarship and professional brand Feature: Training in grants creation and management, research program development, and career mapping

Table 5 aids in answering research questions **2) What elements (or features) make the LEGACY Scholar Program unique;** and **3) How does the LEGACY Scholar Program help with the matriculation of becoming an independent scholar (e.g., grant writing, self-efficacy, professor). Several of LEGACY’s features align with topics co-developed by the scholars and aid in their achievement of programmatic goals, especially becoming an independent scholar to transition to a faculty member.**

Discussion

We framed LEGACY around typical faculty expectations of research, teaching, and service. From their cohort experience, scholars shared additional resources that aligned them into digging deeper into the nuances of academic life. They co-created the weekly curricula based on their needs across departments. Since hiring in the first cohort was staggered, scholars hired earlier in the program unintentionally served as peer mentors for new scholars and assisted with onboarding to the university and in some cases, the country.

The intentionality of department placement and multiple mentoring outside our mentoring framework enhanced scholars’ academic experiences. Instead of the onus of their professional development resting on the program director or their primary, secondary, and

intersectional mentors, additional mentors in departments and across the university supplemented the experiences of scholars. The deliberate placement of more than one scholar in engineering departments also increased the likelihood that scholars would be integrated into the cultures of the departments where they will transition to become tenure-track faculty.

Finally, with intersectionality as a focus of scholars' mentorship experiences, they relied on resources tailored to their personal needs at the institution. Although there are limited numbers of underrepresented engineering faculty in the organization, many scholars engaged with them intentionally and formed high-quality relationships that have led to new opportunities resulting in their early success as independent researchers.

Implications

There are five primary implications/recommendations that have been derived from this study: 1) prioritize diversity, 2) incorporate intersectional/cross-cultural mentorship, 3) emphasize well-rounded training, 4) offer multiple mentors, and 5) foster inclusive and supportive communities for scholars.

Beginning with prioritizing diversity, as found in the literature only about 9.77% (National Center for Science and Engineering Statistics, 2016) of postdoc scholars in the U.S. are from racially/ethnically minoritized groups, thus there needs to be an increased focus on recruiting, retaining, and supporting these scholars to increase the representation of minoritized groups and ensure they achieve their desired outcomes. Prioritizing diversity in programs begins with the goals and features that make the program, they must be created with intentionality to enhance scholars' academic experiences. By administrators, faculty, and staff prioritizing diversity with intentionality in mind, they can better ensure that postdocs are provided with clear expectations and goals, which can help to guide their development and progression. While

emphasis does need to be placed on diversity, equity and inclusion are a necessity as well. Yadev et al. (2020) conveyed how marginalized postdocs experienced stereotypes/biases in pursuit of a faculty position concluding that identity and relatability between the scholar and their surrounding environment is important. Thus, it is recommended that when a university is developing a program for postdocs, they consider the faculty involved, develop an environment that centers the scholars, and intentionally align program objectives with scholars' desired outcomes.

Moving to the focus on intersectional/cross-cultural mentorship, this study conveys the importance of incorporating various components of Walker et al.'s (2008) Multiple Apprenticeship Model, such as intentionality, collective responsibility, respect, reciprocity, and trust. Including these components can play a crucial role in creating supportive and inclusive environments for postdocs, as well as help with the assessment of how effectively the program is in achieving its goals and/or features.

For instance, collective responsibility can encourage a sense of shared accountability among program participants, promoting a more collaborative and supportive program culture. Additionally, it provides a space where program participants can feel comfortable seeking support whether it be professionally or personally fostering an atmosphere of respect, reciprocity, and trust. Furthermore, this can increase scholars' sense of safety and belonging, which is essential for scholars' success in their careers. Ultimately, by incorporating these components of the Multiple Apprenticeship Model, postdoctoral programs can better support the growth and development of postdoc scholars and aid in facilitating their transition to independent academic careers.

As postdocs work towards becoming independent scholars, it is vital to holistically develop these scholars in the areas of research, teaching, and service. LEGACY was intentionally developed to prepare and diversify the next generation of engineering leaders in academia. Rybarczyk et al. (2011) argue that postdoctoral training should include independent research experience, productivity in the form of peer-reviewed publications, and improvement in scholar's skills in grant writing (Rybarczyk et al., 2011). To prepare scholars, LEGACY trains scholars in grant creation and management, research program development, and career mapping. Additionally, as LEGACY Director, Dr. Cox works with scholars to independently brand themselves using social and professional networks so that more people can learn about the scholar and their work. Scholars also receive weekly formative and annual summative feedback on their scholarly progress to help them advance their career trajectories. Rybarczyk et al. (2011) argue that a lack of structure in programs can make it challenging for scholars to achieve the skillsets necessary to matriculate to a faculty position (Rybarczyk et al., 2011). We would also argue that in addition to structure, postdoc programs need to be developed with a scholar-centered approach to allow scholars to co-develop their curriculum and mentoring plans with targeted goals aligned with their desired outcomes.

To aid scholars in achieving their desired outcomes, LEGACY utilizes intersectional/cross-cultural mentorship where scholars have three different mentor types. The intersectional mentorship model used by the LEGACY Scholars Program has a focus on a primary mentor for research, secondary for teaching and/or service, and an intersectional that aligns with their identity. Using this mentorship model allows for the co-creation of an effective and inclusive mentoring program as well as to begin establishing quality mentor relationships from the start. Scaffidi and Berman's (2011) study on a postdoc cohort revealed that scholars

“high satisfaction with mentorship and perceived support correlated with increased interest in an academic research-focused career” (Scaffidi and Berman, 2011). Other studies have shown that incorporating mentor training improves the success of researchers in training (Fleming et al., 2012).

One limitation of LEGACY’s work is the lack of training for the three mentor types to ensure they can adequately provide support to postdoc scholars. While some mentors may have training in formal and informal mentorship, it could be beneficial for LEGACY to still provide training so that they can ensure mentor relationships are aligned with the goals and features of the program as well as students’ desired outcomes. We recommend that postdoc programs offer multiple mentor types to scholars with an emphasis on the intersectional/cross-cultural mentorship model and provide training to the mentors to ensure scholars’ success.

The woven theme between each of the previous four implications is to center scholars and their development as they progress toward a faculty position. A final part of centering scholars and their development is to create an inclusive and supportive community. One of the features of LEGACY is scholars' participation in a two-year cohort, the establishment of a community co-created by scholars, and one on one coaching throughout their experience.

Additionally, LEGACY intentionally uses a cohort-style model where postdoc scholars are in similar departments, so that as they engage in networking, milestones, and progression toward a faculty position, they have peer support. By LEGACY setting the foundation of an inclusive community for the scholars, a potential implication is they will use this intentionality and training into account when developing their research groups, interacting with students, and working with diverse groups in their faculty position. Montgomery and Schmoll (2020) found that authentic learning experiences based on DEI ideas can help students develop a sense of

belonging and a positive STEM identity (Montgomery & Schmoll, 2020). Thus, we recommend that postdoc programs, especially in STEM, include learning experiences or training using DEI ideas to increase postdocs' sense of belonging and equip them with useful skillsets for the future. Outside of developing an inclusive community to serve as a support, LEGACY supports scholars fiscally with a stipend for research and professional development, moving expense reimbursements, and salary. This allows scholars to begin taking the steps necessary to become early career faculty such as partaking in professional development activities like conferences, working on research and grants, and engaging in service.

Overall, the five implications proposed, 1) prioritize diversity, 2) incorporate intersectional/cross-cultural mentorship, 3) emphasize well-rounded training, 4) offer multiple mentors, and 5) foster inclusive and supportive communities for scholars, are vital elements to include for successful development, execution, and outcomes of a postdoc scholar program. These implications are not an exhaustive list but are components that should be considered because they can help develop a strong program foundation. We recommend using these components in addition to others when designing program features and goals to ensure alignment between practices/actions and desired outcomes.

Future Work

To expand upon this body of work, a qualitative research study could be conducted that investigates postdoc scholars' experiences in LEGACY, specifically exploring their experiences as a postdoc, relationships with mentors, community culture as a LEGACY scholar and within their department, and how LEGACY has helped with preparation in matriculating to a faculty position. This qualitative study would consist of semi-structured interviews to allow scholars the space to detail their experiences as well as reflection prompts to gain feedback on LEGACY.

Other future studies could include a longitudinal study that explores the experiences of engineering postdoc scholars at historically White institutions and their matriculation toward faculty positions and/or other careers after graduation to understand the influence of program and department cultures on postdoc outcomes. Using the findings from this work could offer recommendations for universities looking to implement support programs for postdocs as well as assess those that currently exist based on diversity, equity, and inclusion.

Conclusion

The LEGACY Scholars Program is unique in its implementation of a cohort model, its focus on the multiple apprenticeship model, and intersectionality. Artifacts confirm that the framework for program engagement aligned with traditional models of postdoctoral development and included scholars in the creation of weekly content, thereby enhancing their experiences and ownership of the program. Although our intention was to create a repeatable model for other programs, we realized the key insight is that these programs should be tailored to the needs of the scholars in it. As such, our primary feedback to practitioners and researchers is to be attentive to the unique needs and identities of scholars and the co-development of their experiences. Postdocs must be given the space and room for them to be authentic and learn from each other.

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