PURM
Perspectives on Undergraduate Research & Mentoring

Undergraduate Research Programs: Challenges and Opportunities

Dana Battaglia, Ph.D., CCC-SLP, Adelphi University, dbattaglia@adelphi.edu
Patrick R. Walden, Ph.D., CCC-SLP, St. John's University, waldenp@stjohns.edu

The value of student research has been at the forefront of high impact practices (Hensel, 2012; Kuh, 2008; Shanahan et al., 2015), demonstrating support for student retention and success (Graham et al., 2013). There is currently a movement in American higher education to create structured opportunities (i.e., support systems in place) for undergraduate students to participate in research (Bangera & Brownell, 2014; Corwin et al., 2014; Hensel, 2012; Merkel, 2003; Paterson et al., 2013). An example of commitment to scholarship and creative works is running a university wide undergraduate level research conference (Garde-Hansen & Calvert, 2007). Students who are provided these opportunities learn the value of scientific contribution to the profession and build a sense of community. The objective of this work is to describe how undergraduate research initiatives are helpful to proliferate scholarship and creative works on a college campus.

Universities who have a strong undergraduate research culture (irrespective of university size) typically have well-established systems in place to support such research (Hensel, 2012; Merkel, 2003). For institutions with progress monitoring mechanisms, there is a clear focus on academic growth of students that acknowledges hands-on, active learning as a best practice (Kilgo et al., 2015). Both students and faculty are mutually entering into an intellectual partnership in the spirit of inquiry and discovery. Mentors and protégés often continue their relationship long after a project has been completed. Similarly, when undergraduate students work with graduate-level students, they have early exposure to what life in graduate school is like (Dolan & Johnson, 2010), in addition to benefitting from near-peer mentorship (Shanahan et al., 2015).

Some universities have multiple forms of support for undergraduate research, while others do not. For example, in universities where research is of priority, administration is involved, supportive, and proactive (Hensel, 2012; Merkel, 2003; Shanahan et al., 2015) and allocate resources and direct focused initiatives via the university's strategic plan. Also, in these institutions, undergraduate research objectives are well-known and widely publicized, facilitating a community of scholars. Merkel (2003) also pointed out that this level of commitment strengthens the university, increases student satisfaction, and in many cases, heightens alumni involvement.

Merkel (2003) further described undergraduate research programs at four universities (i.e., Rutgers, University of Washington, MIT, and Caltech). The purpose in doing so was to identify strengths and challenges in pursing undergraduate research. In all four universities, common themes emerged. The first was the presence of a designated undergraduate research office (though varying in size and infrastructure). It was identified that there is a university-wide conversation about research (by way of research events, brochures, and communications). Summer research experiences were also offered

to students (beginning as early as prior to matriculation). Finally, there were private endowments and grant support (both internally and externally available to students and to faculty who are working with students). Taken together, these activities were important in building a culture of research activity. In doing so, there was shared conversation with common language across students, faculty, and administration. This work was later supported by the Council on Undergraduate Research (Hensel, 2012). In a culmination of 30 years of work, the call to action by the document titled "Characteristics of Excellence in Undergraduate Research," was written to acknowledge and support the notion that undergraduate research should be the cornerstone of the undergraduate student experience (Hensel, 2012).

Context for This Study

Adelphi University is a mid-sized (approximately 8,000 students), private, not-for-profit institution. At present, there is no centralized undergraduate research office at in place. At Adelphi University, intermittent efforts have been made to develop student critical thinking skills and scientific inquiry, both separately and jointly. For example, there is a college-wide student research day, in which all classes are cancelled and a student research program is scheduled for the day. This program begins with the President's opening message, followed by multiple poster sessions, and ending with lunch and a keynote speaker. Additionally, Deans of various colleges will offer one-time support to students for travel to conferences. However, this support for travel is at the discretion of the respective colleges and is based on budgetary availability. While these efforts show promise, a university-wide consistent plan for supporting undergraduate research has not yet been established.

Faculty in many departments are working with students who request research opportunities. These opportunities are individualized and diverse in nature. For example, one student may participate in regularly scheduled meetings, while another student may be mentored during a formal independent study with a faculty member. Another student may be conducting an experiment as an honors thesis, while a different student may volunteer to assist a faculty member in one isolated element of research (e.g., organizing data, obtaining references, etc.). All these experiences offer exposure to research at different levels of depth and breadth. Coordination of research resources with equitable access for all students via a streamlined process have yet to be established at Adelphi University.

The Principal Investigator (i.e., the first author, Dr. Dana Battaglia) engaged in an endowed Leadership Fellowship program in the spring of 2018. The Leadership Fellows program is a selective program that engages faculty in a process designed to develop leadership talent and skill. This program provided faculty members who were considering a career in academic leadership with structured development opportunities centered on a consequential project of mutual importance to the individual faculty member and the University. The current study arose from participation in this program in an effort to understand successful undergraduate research activities at Adelphi University.

The purpose of this investigation was to ascertain the general strengths and weakness of undergraduate (UG) research efforts across several schools and colleges within Adelphi University. More specifically, this project involved engaging in conversations with departmental leadership (i.e., department chairs) across schools and departments on campus. The context of these conversations focused on undergraduate research activities at Adelphi University. The primary research question here was, "how is undergraduate scholarship accomplished?" A second question was, "what are strengths and obstacles associated with undergraduate scholarly endeavors?" The authors investigated these questions in two phases. In the first phase, a series of questions in a semi-structured interview was posed to 10 leaders on campus. As a follow up, the second phase included Dana Battaglia interviewing four of the original 10 campus leaders more deeply, asking process

questions related to themes that emerged in Phase 1. Hence, responses to Phase 1 laid the groundwork for questions posed in Phase 2.

Method

Participants

This phenomenological qualitative investigation was approved by the university's Internal Review Board for ethical conduct. This investigation occurred in two phases. In Phase 1, Dana Battaglia obtained a list of current department chairs from the Provost's office. An invitation to the department chairs requesting an interview was then sent out to individuals on this list. Ten of the respondents were willing to be interviewed. See Table 1 for the general scope of each program.

Table 1. *Program Depiction by Number of Undergraduate (UG) Students and Number of Full-Time Faculty in Each Department*

Participant	Program	# UG Students	# Faculty
1	Psychology	317	29
2	Physics	58	6
3	Nursing	1,611	45
4	Music	26	5
5	Computer Science	143	10
6	Languages	19	8
7	History	73	8
8	Chemistry	63	8
9	Biology	370	22
10	Anthropology	24	4
	Total	2,704	145

The information gathered in Phase 1, by way of common themes, was used to develop the interview protocol in Phase 2. In Phase 2, Dana Battaglia again contacted the same 10 campus leaders who engaged in preliminary interviews in Phase 1. Due to participant attrition, only four individuals responded and were willing to have a follow up discussion. These leaders represented the departments of Chemistry, Biology, Physics, and Computer Science, all of which were housed within the College of Arts and Sciences.

Materials and Procedure

Phase 1 (The Successful Undergraduate Research Process)

Ten face-to-face interviews were recorded and later transcribed. Interviews ranged between 40 and 60 minutes in length. See Appendix A for the list of guiding questions used during interviews (e.g., "What are the obstacles you face in UG research/creative projects with students?" "Do you follow a prescribed model for UG research implementation?"). Questions were developed by Dana Battaglia to ascertain specific information, and were vetted by a faculty member not affiliated with this investigation. Each transcript was coded by the first author as to its meaning and similar codes were collapsed into larger categories representing the individual codes. A faculty member from a different institution experienced in qualitative analysis went through the initial coding of responses, independently of the author, for consistency and trustworthiness of the data. These categories were aggregated, creating major themes describing the most successful undergraduate research experiences at Adelphi University.

Phase 2 (Obstacles to Advancing Undergraduate Research)

Phase 1 was essentially a pilot investigation for Phase 2. During discussion of the findings with the second author, it was acknowledged that some questions in Phase 1 were finite and/or binary. An

example of such close-ended questions included, “Is there an undergraduate research/creative project program in place?” As such, the authors revisited the interviewees with additional “process” questions in Phase 2. Aligned with the themes that emerged during the interviews in Phase 1, the authors developed 20 standard questions, with two questions falling under each theme from Phase 1. See Appendix B for theme-related questions posed during Phase 2 interviews. Phase 2 engaged participants in process discussion, ultimately generating recommendations to advance undergraduate research at Adelphi University.

Interviews for Phase 2 were conducted via Zoom video conferencing software. Interviews were recorded. Audio files were extracted and transcribed. The first author reviewed all transcripts for accuracy and carefully identified codes (i.e., specific words used in responses). Codes were then collapsed to larger themes as described in Phase 1. To increase the trustworthiness of the findings, the authors performed multiple rounds of iterative reviews, which included discussing points of corroboration and discrepancy with a healthcare professional familiar with qualitative research who was not involved in the interview process.

Results

The primary purpose of this study was to ascertain how undergraduate scholarship is accomplished at Adelphi University. In seeking additional perspective, strengths and obstacles associated with undergraduate scholarly endeavors were illuminated.

Phase 1 (The Successful Undergraduate Research Process)

Four overall themes emerged from the data analysis procedures described for phase 1. Specifically, scholarship, mentorship, community building, and competitiveness/commitment emerged as central to the successful undergraduate research process. Descriptions of each are listed below.

Scholarship

During interviews, respondents reported that students engaged in meaningful research experiences when an advising plan was clearly laid out, options were introduced early, and offerings (either course-related or independent) occurred in a developmental sequence. For example, undergraduate students in Psychology encountered a sequence of three research courses, and then were invited to apply to the Emerging Scholars program, which required that students present at a research conference other than the University’s Student Research Day.

In Biology, students had to independently seek out a faculty member for mentorship. They then enrolled in a three-course research sequence, one of which met the program’s capstone requirement. Each student gave a presentation to the entire department, and they were expected to write a thesis and defend it to a committee of at least three members. Similar to Psychology, students who engaged in research in the Biology department were required to provide an oral presentation. Course offerings in Biology further include an advanced two-credit course, called Honors Colloquium, where external speakers are invited to the class. Not only did this facilitate meaningful discussion, but also further demonstrated the transfer of scholarship into the professional world. One faculty member stated, “What I’ve enjoyed, what I’ve got lucky at a few times… I had a series of very good students that joined my lab as sophomores, stayed for three years and then stayed and did their masters’ degree.” Similarly, a second respondent stated, “There is no time to lose, we can’t wait till the junior or senior year for the students get involved. It must be immediately when they come in.”

Mentorship

Shannahan and colleagues (2015) have identified mentoring as a best practice in facilitating undergraduate research. Working one-on-one with a faculty mentor is an asset to an undergraduate

research experience. Building extensions of the faculty member's own work, rather than facilitating a completely new concept with an undergraduate student, is effective as a mentoring practice. In Chemistry, students were able to work in small groups, alongside faculty while engaging in various levels of research. One faculty member stated,

> Being in an environment that's welcoming and is home essentially. Whether it's virtually, or physical you know. So it's interesting. We try to and I try, I don't know if my colleges do this, but I try to get my students to call me by my first name when we're in the lab setting and it's hard for them, they don't want to do that, but, when they get to be seniors they get a little more [comfortable] and they start realizing, especially it's easier if they have had the class with me.

Community Building

Community building has been identified as a best practice in the literature (Shanahan et al., 2015). Several examples of community building are noted in the Emerging Scholars program in Psychology, where students met as a cohort and took an internship class together. There was an initial large group luncheon, in which more seasoned undergraduate students spoke to students newly arriving to the research process. Both successes and current challenges were shared during the meeting. Students had monthly cohort meetings thereafter to maintain momentum, and meetings were facilitated by doctoral students. In Biology, each faculty member had a physical lab space, inviting students to experience the day-in and day-out of the research process. Similarly, the faculty in Chemistry placed great emphasis on the notion that lab spaces are to be homes for students. One faculty member stated,

> We tell the students from day 1, it is your home… so we set up environments for our students. We have two things to start with that are really really cool, one is [that] the undergraduate research is embedded, the other thing is that we have an eight semester sequence of [what] we call research seminars in chemistry that all of our majors go to every week, Wednesday at the same time, and all of our faculty go too. So starting off freshman, they take this class, freshman, sophomores and juniors, as a half credit. Seniors for one credit and we've gotten so many majors now that we've actually split out the freshman. They have their own section.

Competitiveness/Commitment

Students engage in research which is competitive. Having an application process with a minimum overall and major GPA is a first step. Explaining that there is a minimum time commitment (e.g., one year) helps students organize their course and personal plans as well. Students are thereby self-selected. However, sharing an understanding of the requirements and longevity needed for research lays the groundwork for future success in undergraduate study and beyond. One faculty member stated,

> Since 91' … in an uninterrupted way, all the way to this year, we …. nominate two students to go to NCUR [the National Conference on Undergraduate Research] for competition for peer review and then …. the university supports their endeavor to go and present …. as a representative of this department…. It has been an uninterrupted sort of record and I believe one of the strongest if not the strongest in the metropolitan region…. I don't think anybody has that record in the domain where students really have the chance to really be involved in research in that capacity.

When asked about obstacles faced when engaging in undergraduate research or creative projects with students, the following six themes emerged; time, funding, space, tracking, access, and mentorship. Descriptions of each are listed below.

Time

Student time management was reported to be challenging. That is, students who are well-meaning may have external issues precluding them from successful research engagement (i.e., requirements at home, working, family management). For example, a large part of the Emerging Scholars program in Psychology at Adelphi University is independent. Poor student time-management may yield poor outcomes regarding the research experience. In Biology, there are more students but not enough time to mentor either individually or in small groups. This issue was quasi-resolved by way of generating a waiting list. Here, again, time-management on the part of the students was pivotal. Above and beyond the curricular laboratory requirements, if a student entered into independent research as a senior, he/she may never fully engage in the research process from start to finish (i.e., proof of concept to dissemination of findings).

Time is also a challenge for faculty. It appeared that a consistent compensation practice was not in place university wide. That is, some faculty were paid $100 per credit for Independent study work, while others were allotted .5 overload toward a three-credit release. Still others were offered no compensation at all. Even if compensation was consistent, the time required to mentor an undergraduate student who is completely new to research, on a completely novel concept, may remain prohibitive. One respondent stated,

> It's rare that [students] do an independent study, if they have like a really major project… something really substantial, that's taking up a lot of their time then we could count it as an elective in the department. But the most of the [students] do this on their own free time…. and you know those are the types of students that are really motivated.

Funding

This theme overlapped with the concept of time. When students registered for independent studies to do research, faculty received a small stipend, as per the union Collective Bargaining Agreement. In Psychology, faculty are reported to receive .5 credit toward course release, which can be banked until three credits are accrued. At that point, the three-credit total may be applied to a three-credit course release in any given semester. Funding for consumables is absorbed by way of faculty grant funding and small budget lines (up to $300 per year, per student). In Biology, a private donor supported summer research fellows for summer student work. This is a competitive program in which students were paid to do research as well as for some consumables and travel money to attend a conference.

Funding for student travel was also noted as an obstacle. Across all programs, students were supported to attend a general undergraduate-focused conference through the administration of the University. However, funding to attend more discipline-specific conferences, where conversations and connections are more focused, might offer students more direct exposure to their future professions. This concern was reported in several interviews. While the University does support students with small stipends, the following faculty sentiments were expressed,

> I think the only hurdle right now is the lack of funding… We'd like to send more students to conferences and stuff like that, but you know five hundred dollars doesn't do much for a college student. So I think that's one of the biggest hurdles; maybe if we could find like donors for some type of student research fund or something… People that want to contribute to experiential learning in research for students.

Space
The issue of space was expressed as an obstacle to conducting research, as well as for community gathering. Chemistry recommended evaluating a method to better institutionalize research, in which the campus is less populated over the summer, offering more space for students to do research in labs. Currently, both Biology and Chemistry are exploring off-site externship opportunities for research. One faculty member stated,

> We're space limited in this building. If there were faculty hires, I just don't imagine that they would be on a research active track just because… there's no more space in this building for a lab… Space is always an issue. We're landlocked as a campus and our building is effectively landlocked.

Tracking
Overwhelmingly, respondents raised the issue of monitoring students along the research pipeline (i.e., applying for IRB approval, collecting data, writing results), while also monitoring their progress in the curriculum (i.e., enrolling in relevant research coursework). In Psychology, there was reported concern for transfer students who may "slip through cracks" during scheduled course plans. There were further tracking glitches which may occur with overlapping requirements in the Honors College, requiring a third semester of independent study. Further, in Chemistry, faculty reported that students did not have an overt awareness that research was an option for them (also see "Access" section below). This lack of knowledge posed a tracking issue for curricular planning for faculty, as well as course selection for students, particularly those who initiated research later on in their course plan. One faculty member stated,

> This is something I'm in the process of moving online. In the past we had a form that they had to give to the professor and the professor had to fill it out and then I would get scans …and it was hard to compile … There's also the issue of transfer students… Or students who have planned to graduate a semester early. If we don't manage to catch those people at the right time… Likewise…transfer students who come in and wind up doing the program as seniors in a way that would have been better if they could've done this as junior.

Another obstacle reported in the Biology department was exponential growth of student interest with lack of resources to support them appropriately. Two ways to circumvent this obstacle are to potentially (1) create more competitive criteria to engage in research in the department, and (2) have students engage in group research or shared experiences.

Access
In this paper, the notion of access can be defined in two ways. First, access can be synonymous with awareness. That is, students do not know that they can have access to research opportunities at their will. There were several instances noted in which students reported to faculty that they did not know that research was an option available to them in their undergraduate experience. Second, access may be defined as a means of obtaining an item or experience. In both scenarios, the issue of access for under-represented students is an ongoing discussion in higher education. Hence, lack of access here may be caused by lack of resources, such as time, space, funding, or mentorship. There has been long-standing discussion about underrepresented populations in STEM fields (Fouad & Santana, 2017). Mitigating access issues for black indigenous people of color (BIPOC) can not only facilitate more diverse research, but also potentially fill a pipeline of underrepresented scientists. Sentiments on access from a faculty member included,

> Whenever I'm meeting with a freshman advisee who is in the honors college I say, "well you have to do research so why don't you go ahead and think about [joining] a research lab now and that way if somebody has a waiting list, you can wait it out for a semester."

Had this statement not been made by the faculty advisor, particularly to a student from a minority population, a valuable opportunity to engage in research and become an active STEM scientist may have simply never been happened.

Mentorship

Though not necessarily the focus of conversations, there were some issues reported related to mentorship. At times, a mentor and student may not always be a good match. This may be due to different needs of different research labs, and/or incompatibility of time availability. To that end, based on variables such as faculty time, space, and access, students may not always engage in the same experience. While this is largely due to resources, academic freedom, and loyalty to one's own research agenda, it poses an issue of equity to students. One faculty member, who reflected on his own mentorship experience during undergraduate study, stated the following,

> We sometimes raise the bar a little bit too high and the best work I did as an undergraduate for the most part… up until my senior year, but the best work I did was pretty much guided … That very rarely was … "oh come up with some idea"…

Phase 2 (Obstacles to Advancing Undergraduate Research)

Discussion of obstacles centered on the aforementioned themes that arose organically in Phase 1. Hence, the questions in Phase 2 were developed to facilitate discussion on process (e.g., "what is the process with which you offer opportunities for scholarship and/or creative endeavors for your undergraduate students?"). This again gave rise to the discussion on obstacles to advancing undergraduate research.

Qualitative analysis of transcripts in Phase 2 identified four main themes: (1) department-wide process, (2) faculty obligation, (3) scale of program, and (4) resources. Each is described with examples from interviews. These themes aid in answering the empirical question of this work, which is to identify the strengths and obstacles associated with undergraduate scholarly endeavors.

Department-Wide Process

There are inconsistencies in departments regarding processes in place to facilitate student research. Where two out of the four departments had a process in place, the remaining two did not. For the two who did not, the respondents reported that lack of processes in place inhibited ability to advance student research. For example, one responded stated, "It's very informal. And that creates some problems. One thing that we do is we reach out to students in their sophomore year, usually, and we start chatting about possibilities." A different respondent whose department reported to have a process in place stated,

> [Students are] exposed to [research] as freshmen because they're attending our research seminars and chemistry class once a week…. During that freshman year, upperclassmen come talk about the research they're doing. And the freshmen also attend the main seminar… to hear presentations by the students. So they're hearing what's happening in the labs. Then, as part of their second semester, freshman will be assigned to go visit in groups various professors' research labs and find out what they do…. they start [from the] beginning to figure out which lab they want to work at…

Faculty Obligation
All respondents stated that facilitating student scholarship is required for tenure and promotion. All respondents further stated that faculty, beyond obligation, demonstrate an intrinsic desire to work with students to facilitate scientific inquiry. Although a requirement which faculty are passionate about, there are roadblocks in space, time, and funding to accomplishing this. One respondent stated,

> We are teachers! That's what we were hired to do.... We all want to do research ourselves so we can't, we can't, if we, just us, did the research wouldn't have enough time.... It's fun! It's fun working with young kids.

Similarly, another respondent stated, "We value it really highly for tenure and promotion... I would say most of the faculty in my department who have active research labs mentor students. Faculty who don't even have active research labs will still mentor."

Scale of Program
There is a wide variation in numbers of students handled in each department. Where one program maintains 50 undergraduate students, another matriculates 400. This poses administrative challenges regarding tracking students through the research pipeline and offering the same quality of mentorship in a consistent manner. The space and time requirements needed to facilitate active research with a larger number of students are more challenging. Where one respondent stated, "I would love to have more community engagement.... I have 400 majors." Another reported, "When you have less than 100 majors, you can do these kinds of things because.... I usually know all the students by their first name." In both faculty reports here, the number of students in the major have been offered. However, it was not possible throughout this study to offer an accurate number of students engaged in research. Students engage in different levels of scholarship, and may or may not enroll in associated coursework, creating an issue for tracking such activities.

Resources
The two main resources which were discussed during interviews were space and funding. With respect to space, three out of the four respondents reported that their faculty have research labs. However, all four respondents reported that management of space is a continued area of concern. For example, one respondent stated, "We have three labs. The [students] use those spaces for research. They are community spaces. We can have three research groups going at once. That's great. But once you get more than that it's a management issue.... who gets priority over the space?" Similarly, another respondent stated, "Well, at least in my lab, I can't have three people filming at the same time because I've got two cameras."

The discussion of funding was dichotomous. That is, departments which were larger and with external funding were better able to allocate funds than smaller programs without such funding. Notably, all four departments represented in this sample fall under the same college (i.e., Arts and Sciences), in which a $700 stipend is allocated to undergraduate students for conference travel once during their time at Adelphi University. Respondents appreciated that this funding mechanism was in place. However, they also shared concern about the dollar amount and frequency of this funding (i.e., one time only) to support projects for students dedicated to ongoing scholarship. A specific example was shared in which a student who is a fall semester sophomore may be funded (with appreciation) to attend a conference to share pilot data with the scientific community. However, this same student may continue to expand this research beyond the pilot phase, yet not be funded as a senior with a more well-developed and innovative project.

Discussion

The motivation for this study was to assess the undergraduate research activity happening at Adelphi University. The underlying objective was to ascertain strengths and weaknesses in current research programs already in place. By conducting interviews, the authors were able to generate recommendations to offer to Adelphi University. These findings expand the boundaries of existing scholarship on undergraduate research, with recommendations divided into the following areas: (1) access, (2) scholarly activity, (3) mentorship, (4) community building, (5) time, (6) funding, and (7) administrative support.

Access

Faculty and advisors should discuss different options for research early on, perhaps as early as during welcome events. Further, when meeting one-on-one for advisement, students and faculty should discuss options for research with specific faculty in mind related to key courses. Students already engaged in research at the university may also be invited as guests to freshmen seminar. Departments may consider developing an application process with clear requirements and associated required activities and coursework. Finally, to increase clarity of process, departmental leadership could outline research options in the departmental undergraduate student handbook.

Scholarly Activity

Once a student and mentor have been matched, a contract should be developed with clearly laid out expectations regarding the scholarly process. Such an agreement should include hours required dedicated to research, including length of participation, writing suggestions, presentation formats and venues, and publication authorship. If a student is enrolled in an independent study to monitor research activity, faculty should provide a syllabus with objective measures for grading and completion of work. This has been stated as a best practice in mentoring of undergraduate students (Shanahan et al., 2015). Faculty and departmental leadership together should identify where funding will come from to support these endeavors in the contract and/or syllabus, so that students are informed in advance (i.e., partial funding available through XZY mechanism).

Mentorship

Administration and faculty together should consider a structure in which there is a gradual process from 1:1 mentoring, to small group mentoring, to senior students mentoring new students (with supervision). This approach will not only facilitate independent research over time, but also alleviate some of the time-related burden from the faculty mentor. In order to ensure a positive mentor-mentee relationship, expectations should be discussed up front, as stated in the preceding section. Developing a “curriculum within a curriculum” will minimize access or equity issues while maintaining autonomy and offering value to students in the research process. Explicitly building undergraduate research opportunities into the curriculum can help support underachieving students, who benefit from mentoring and active learning experiences. Parker (2018) offered support of this claim by conducting an evaluation of the impact of undergraduate research opportunities on student achievement. While a positive impact was found for all students, the magnitude of this impact was greater for underrepresented populations. While this notion may be considered under “scholarship”, the level of mentorship required warrants placement here.

A proposed set of mentorship activities may include but are not limited to the following: (1) discussion of selected mentor’s work and how it aligns with student interests, (2) independent completion of the Collaborative Institutional Training Initiative (CITI) training with a follow up discussion, (3) peer-reviewed journal article critique with discussion of strengths and weaknesses, (4) proposal development for an offshoot study based on the mentor’s immediate research agenda, (5) access evaluation of participants and feasibility of the said study, (6) completion of an IRB application, (7) data collection for the study in question, (8) sharing of preliminary findings in a

discipline specific conference, in addition to participation in student research day at the University, and finally, (9) preparation of a manuscript for publication.

While the aforementioned recommendations are particularly relevant for social and physical sciences, similar activities may be applicable for the humanities and creative disciplines. Mentorship in these cases may include, but not be limited to (1) discussion of mentor's present works and creative endeavors, (2) independent review of relevant exhibits and assigned readings, (3) development of a proposal for an offshoot creative work while evaluating access to resources and feasibility, (4) engaging in the creative process, and (5) sharing outcomes with the campus community by way of an exhibit or show.

Community Building

Faculty, together with departmental leadership, should designate regular semi-formal meetings (e.g., monthly, bimonthly) in a communal venue. During these meetings, faculty and students should celebrate both professional and personal achievements. During this community engagement, a near-peer mentorship system may intrinsically emerge whereby more experienced undergraduate students work with novice students new to the research experience. Extending beyond regular meetings, support for discipline specific conference attendance, both financially and functionally, should be offered. Finally, faculty should enlist the help of graduate and doctoral students when possible and appropriate.

Time

Beyond the nominal per-credit payment for faculty for an independent study, a university may want to consider instituting a more consistent 0.5 credit banking system. That is, for each student mentored, faculty are allotted 0.5 credits of release time per semester, which can be banked until a 3-credit limit is achieved, the equivalent of one course by the majority of faculty in a teaching institution. This compensation should be tied to enrollment of a course, so that the student obtains recognition on their transcript. While some students may be engaged in research on a voluntary basis, in which case faculty are not being financially compensated, academic leadership may also want to offer an increased number of paid research assistants. Furthermore, leadership may also support stipends for doctoral students to facilitate more undergraduate research. Alternatively, departments may want to realign current assistantships to be more focused on scholarship and less focused on service/administrative tasks. Finally, from a health and wellness perspective, a university may want to provide personalized and discipline specific wellness lectures, time management lectures, and discussions from invited guests from different corners of campus during regular meetings. During interviews, several respondents noted that self-care was critical to student success. Hence, focused offerings on the aforementioned aspects should yield a return on investment on undergraduate research productivity as a collateral benefit to overall good mental and physical health.

Funding

Four recommendations are offered regarding funding for UG research programs: (1) considering a model of funding for PIs who are receiving NIH or NSF funding, whereby a portion of the fringe payment is returned to the PI's lab for ongoing funding support, (2) engaging in focused conversations with the advancement office to further undergraduate research endeavors by way of summer stipends and travel support, (3) allocating the University funds for students not only for general undergraduate conference experiences but for discipline specific conferences, and (4) as an undergraduate research program grows either on a departmental level, a university level, or both, investing in an administrative assistant for continual tracking to facilitate efficiency in the undergraduate research process both for students and faculty.

Administrative support

While support in the above areas was limited to the department level, there were several instances where a desire for administrative support from executive leadership were communicated. Shanahan and colleagues (2015) identified pre-planning as a best practice in mentoring undergraduate research. Hensel (2012) discussed the need for administrative support in detail. While several pockets of activities are currently in place at Adelphi University to facilitate student success, the absence of a centralized undergraduate research office is a major barrier for resources mentioned here. Accordingly, a recommendation would be for investment from executive leadership to develop some degree of a centralized system, with administrative staff placed to support tracking, funding, etc. This office is not to be confused with an office of sponsored research, which manages IRB applications, external funding, etc. Rather, this office should endeavor to be a liaison between the faculty and the research office on any campus aspiring to advance an undergraduate research agenda as part of its strategic plan.

Limitations

While information obtained from this investigation has been illuminating, there are several limitations to this work. Specifically, the small number of participants may not reflect the University's practices as a whole. The second limitation is that the individuals who did respond to the invitation to participate were likely to be those with more experience and success with the process. However, this allowed for some appreciative focus on key processes and activities that work to facilitate undergraduate research, as well as exploring barriers. Finally, interviews were conducted on one campus alone. A larger scale qualitative study, interviewing participants across several universities, would offer a greater scope of perspective on catalyzing undergraduate research.

Summary

In summary, this project was initiated as part of a leadership development program. The objective was to ascertain the undergraduate research activity at a mid-sized private non-profit university in America, while identifying challenges and strengths. What has emerged as a result of this work is a list of recommended best practices when developing, maintaining, and expanding undergraduate research programs, both within and beyond Adelphi University. While the themes identified here have organically emerged during the interview process, they have been noted in previous literature (Hensel, 2012; National Academies of Sciences, Engineering, and Medicine, 2017; Shanahan et al., 2015). The findings in our work support the work of the National Academies of Sciences, Engineering, and Medicine (2017). The authors here are offering additional support, reinforcing the need to offer explicit and structured opportunities for all students at the undergraduate level.

Considerations regarding scholarship, mentorship, community building, and competitiveness/commitment, as well as resources and administrative support are pinnacle to developing an UG research experience that is accessible, equitable, and productive for both students and faculty for a potentially transformative experience for all stakeholders involved. Results obtained during this investigation have been shared in an executive summary to administration at Adelphi University. Recommendations offered here are hoped to have a more far-reaching impact with the objective of advancing a culture of research earlier rather than later in a student's academic plan. In doing so, we can collectively advance our students and their respective disciplines.

Acknowledgement

This work was funded by the Viret Family Leadership Fellows program at Adelphi University.

References

Bangera, G., & Brownell, S. E. (2014). Course-based undergraduate research experiences can make scientific research more inclusive. *CBE-Life Sciences Education, 13*(4), 602-606.

Corwin, L. A., Graham, M. J., & Dolan, E. L. (2014). Modeling course-based undergraduate research experiences: An agenda for future research and evaluation. *CBE-Life Sciences Education, 14*(1), 1-13.

Dolan, E., & Johnson, D. (2010). The undergraduate-postgraduate-faculty triad: Unique functions and tensions associated with undergraduate research experiences at research universities. *CBE-Life Sciences Education, 9* (4), 543-553.

Fouad, N. A., & Santana, M. C. (2017). SCCT and underrepresented populations in STEM fields: Moving the needle. *Journal of Career Assessment, 25*(1)*,* 24-39.

Garde-Hansen, J., & Calvert, B. (2007). Developing a research culture in undergraduate curriculum. *Active Learning in Higher Education, 8*(2)*,* 105-116.

Graham, M. J., Frederick, J., Byars-Winston, A., Hunter, A. B., & Handelsman, J. (2013). Increasing persistence of college students in STEM. *Science, 341(6153), 1455-1456.*

Hensel, N. (2012). *Characteristics of excellence in undergraduate research (COEUR).* The Council on Undergraduate Research. https://www.cur.org/assets/1/23/COEUR_final.pdf

Kilgo, C. A., Ezell Sheets, J. K., & Pascarella, E. T. (2015). The link between high-impact practices and student learning: Some longitudinal evidence. *Higher Education, 69,* 509-525.

Kuh, G. D. (2008). *High-impact educational practices: What they are, who has access to them, and why they matter.* Association of American Colleges and Universities.

Merkel, C. A. (2003). Undergraduate research at the research universities. *New Directions for Teaching and Learning*, *2003*(93), 39-53.

National Academies of Sciences, Engineering, and Medicine. (2017). *Undergraduate research experiences for STEM students: Successes, challenges, and opportunities*. The National Academies Press.

Parker, J. (2018). Undergraduate research, learning gain and equity: The impact of final year research projects. *Higher Education Pedagogies, 3*(1)*,* 145-157.

Paterson, G., Rachfall, T., & Reid, C. (2013). Building a culture of research: Using undergraduate research to advance the TR profession, build research capacity, and foster collaborative relationships. *Therapeutic Recreation Journal, 47*(4), 259-275.

Shanahan, J. O., Ackley-Holbrook, E., Hall, E., Stewart, K., & Walkington, H. (2015). Ten salient practices of undergraduate research mentors: A review of the literature. *Mentoring & Tutoring: Partnership in Learning, 23*(5)*,* 1-18.

Appendix A: Semi-Structured Interview Questions for Campus Leaders

1. What is the name of your department? What is your role in your department?
2. How many full-time faculty do you have? Part-time faculty?
3. How many opportunities do you have to engage students in research or creative projects within your program?
4. Is there an UG research/creative project program in place?

5. What are the obstacles you face in UG research/creative projects with students?
6. Do you follow a prescribed model for UG research implementation?
7. How is this project(s) funded?
8. Are you satisfied with the program in its current form? How would you like to revise it (ideally), or how might you like to grow this program?

Appendix B: Process Questions Posed in Phase 2 of This Investigation to Four Campus Leaders

Scholarship

1. What is the process with which you offer opportunities for scholarship and/or creative endeavors for your undergraduate students?
2. Why is your department invested in this level of activity for your undergraduate students?

Mentorship

3. How is mentorship accomplished for students who seek scholarship and/or creative work for your undergraduate students?
4. Why do faculty volunteer to mentor students? Alternatively, who do faculty choose not to mentor students?

Community Building

5. How do you establish community among both students and faculty centered on scholarship and creative endeavors?
6. Why is this a priority for your department?

Competitiveness

7. From previous interviews, the idea that scholarship/creative work is a competitive process came up. Describe how you infuse the idea of competitiveness into your undergraduate research processes?
8. Why is competitiveness important to faculty and students? Why not?

Commitment

9. How do you obtain a level of commitment from UG students to complete their scholarship/research endeavors?
10. Why do faculty deem commitment to a creative endeavor a priority?

Time

11. How are your faculty able to allocate time to UG students to support their scientific inquiry? How do students manage their time to get research and/or creative work accomplished?
12. Why might time be a factor in success in student and faculty endeavors?

Funding

13. How does your department secure funding for students to conduct research and/or attend professional conferences?
14. Why might this be a priority (or not) in your department?

Space

15. How do you dedicate space for students to conduct research and/or creative endeavors?
16. Why might space be an issue in scholarship and/or creative work?

Tracking

17. How are students tracked as they 'travel' through the research pipeline?
18. Why might tracking be a barrier for faculty or students?

Access

19. How do you address access to financial resources for your students engaging in undergraduate research?
20. Why might access to such opportunities be a facilitator or a roadblock for faculty or students?