



Mentoring Undergraduates in Research and Creative Endeavors

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Mentoring Undergraduate Researchers

Mentoring college students has become a common activity of university professors as national organizations have recognized the high impact of undergraduate research and creative endeavors. In 2005, the Association of American Colleges and Universities (AAC&U) initiated the Liberal Education and America's Promise (LEAP) Challenge, which encourages institutions to engage students in undergraduate research, major projects, and capstone signature work (Association of American Colleges and Universities, 2015). Mentoring independent academic work is a highly valued activity that is integral to students' success. Therefore, it is important to provide resources and guidance for faculty mentors as they prepare to collaborate with undergraduates on their first significant independent project.

By their nature, independent student projects vary in scope and structure. For example, projects may involve students working independently on innovative or unique projects they designed, or contrastingly, students may contribute to a research team that supports a professor's research agenda. The same variation is true of mentoring relationships, which can vary from highly structured teacher-student dyads to personalized plans designed to increase student independence and assimilation into the discipline. Therefore, before embarking on projects with undergraduates, it is essential for faculty to have a clear understanding of the various dimensions of mentoring in order to set expectations about the type of mentoring relationships that might develop. With clearly defined mentoring expectations and roles, faculty members can develop guidelines for students completing individual projects, participating on research teams, or engaging in other professional activities.

The purpose of this article is to provide an overview of current literature pertaining to mentoring undergraduate research or independent scholarly endeavors in any academic discipline. The intent is to blend current research on mentoring, recommendations from authors who have engaged in mentoring relationships, and relevant findings from educational psychology to create a concise resource for faculty. This background information is used to produce a list of key questions that faculty should consider when establishing expectations and guidelines for the students they are mentoring.

Mentoring & Mentoring Activities

The terms "mentor" and "mentoring" vary significantly across the extant body of literature on mentoring college students. For example, the role of a mentor may range from a supervisor and evaluator of a student interning in an educational or medical setting to a sage advisor who shares their vast experience to a new business colleague. The body of literature is also varied, including studies that rigorously examined the impact of mentoring relationships (e.g. Ishiyama, 2007;

Kardash & Edwards, 2012), articles that described mentoring programs and activities (e.g. Bauer & Bennett, 2003; Koblunicky & Dale, 2016; Schneider & Bickel, 2015), and recommendations from those who have successfully engaged in work with college students (e.g. Monte, 2001; Plummer, 2001). The variance in definitions is problematic for researchers who study mentoring, since without a common definition, it is difficult to determine what mechanisms or nuances lead to effective mentoring relationships. Crisp and Cruz (2009) provided a thorough critical review of seventeen years of literature pertaining to mentoring college students and argued that research in this area must carefully frame any definition to better understand the impact of mentoring. However, their work also provides an excellent theoretical framework for defining mentoring that can be useful to faculty members who are working to define their roles as mentors or wish to pursue research in this area.

Defining Mentoring & Mentoring Relationships

In their literature review, Crisp and Cruz (2009) found that the definitions of mentoring varied between and within disciplines. For example in business, mentors are defined as individuals who are more advanced in their career who provide support to those with less experience. The support might be focused on personal development, career advancement, or becoming a productive member of the organization. In contrast, mentoring in psychology typically emphasizes the psychosocial development of mentees while research articles in higher education tend to define mentoring in the context of student learning. Through their analysis, Crisp and Cruz were able to identify attributes and functions that illustrate the many dimensions of mentoring. Some of these include: *helping, teaching, reflecting, coaching, guiding, role modeling, encouraging, counseling, career advising, developing personal and social skills, and building self-esteem.*

To frame future research, Crisp and Cruz (2009) suggested four latent variables or domains that should be considered when researchers develop a definition of mentoring. Any mentor who is also interested in researching the mechanisms of mentoring relationships should review their work in its entirety, since it provides a strong theoretical framework for developing new theories. For the purpose of this article, the domains they identified can inform nascent mentors as they begin to define their roles. The domains include:

Psychological and emotional support. Mentoring often involves providing moral support and encouragement and, in general, creating a supportive relationship with the student. In this domain, mentors discuss students' concerns, uncertainties, or fears, assist in identifying problems, and work to build students' self-confidence.

Support for career selection and goal setting. In this domain, mentors seek detailed information about personal and career aspirations, often asking students to reflect and think critically about how to achieve their goals. Activities include assessing students' strengths, weaknesses, and abilities, and also listening to their ideas or beliefs. Engaged mentors also track students' progress on educational and/or career goals.

Supporting advancement of disciplinary knowledge. Mentors establish a teaching-learning process that allows for the acquisition of skills that will advance students in their chosen field. Mentors evaluate and challenge students, nominate students for promotions or awards, provide opportunities to increase their visibility, but also shield them from negative publicity.

Serving as a role model. Students also have the opportunity to observe how mentors resolve conflicts and balance professional and personal demands. This domain may involve mentors sharing or disclosing life experiences and developing a personal relationship with students.

Not all mentors define their roles using all four domains, but it is important for faculty and students to have similar understandings and expectations before beginning a project.

Perceptions of Important Mentoring Activities

Arguably, mentoring relationships are successful when both mentors and mentees perceive positive outcomes. While Crisp and Cruz (2009) correctly argued that there is a need to rigorously determine what activities and characteristics of mentoring lead to positive outcomes, there already exists a collection of studies which identified key elements that are perceived to engender good mentoring relationships (e.g., Ishiyama, 2007; Kardash, & Edwards, 2012; Lee, Dennis, & Cambell, 2007; Raman, Geisinger, Kemis, & de la Mora, 2016). These researchers developed their recommendations based on studies involving the perceptions of mentors and mentees. For example, Shellito and her colleagues surveyed 107 undergraduate researchers and interviewed faculty mentors in biology, physical sciences, psychology, mathematics and engineering (Shellito et al., 2001). In general, they found that “students valued a mentor who they perceived to be knowledgeable, approachable, encouraging, and supportive of students’ efforts and who was regularly available for consultation” (Shellito et al., 2001, p. 409). Based on faculty and student perceptions, they compiled a list of tips for faculty to become better mentors, which fell into three broad categories:

Managing time and resources. Not only is it essential to provide supplies and resources for a project, but it is also important to devote time to ensure the project is well-defined and aligned with students’ interests and abilities. Mentors need to manage not only the time they personally devote, but also recognize the time commitment required of the students. Student time should be managed as closely as other resources.

Establishing relationships with students. Good communication is essential for providing constructive feedback and encouragement that respects students as research colleagues yet also recognizes their individual needs. A strong foundation for mentoring relationships requires establishing mutual understandings and expectations.

Providing continued guidance and support after the research program ends. A well-designed research experience will allow students to progress toward their career goals by providing the scaffolding and structure that allows them to become increasingly independent. In addition, mentors can help advance a student’s career by offering career guidance, encouraging presentations and publications, and providing letters of recommendation after the project is complete.

One goal of mentoring is to foster the growth and development of students as they become future researchers and professionals. Leveraging a developmental focus, Brown, Daly, and Leong (2009) analyzed mentoring relationships in a program for professional psychology students at the undergraduate, graduate, and postdoctoral levels. They argued that mentoring should intentionally move students toward conducting independent research. A mentor should not only act as a guide and evaluator that can help introduce students to methods and questions, but also help them progress from faculty directed projects to more collaborative research endeavors. Importantly, Brown and his colleagues also identified ethical issues that should be considered which included providing equal access to mentoring, being wary of exploitation in mentoring relations, and issues concerning authorship credit and intellectual property. Not only are these important considerations for faculty mentors, but they are also issues students must learn as they engage in undergraduate research, independent projects, and creative endeavors in any discipline. Although the nature of these scholarly projects may vary, they will collectively be defined under the broadest definition of “undergraduate research” with the students referred to as “undergraduate researchers” for the

remainder of this paper.

From the voice of a student's perspective, Pita, Ramirez, Joacin, Prentice, and Clark (2013) added another list of recommendations for effective mentoring. These undergraduate researchers, who also served as ambassadors to their campus undergraduate research office, made five recommendations based upon their experience.

Be available. Mentors, or a designated graduate student, should be available to young researchers to answer questions that come up in the dynamic and unpredictable environment of research. Mentors should be available since they are key to generating excitement or interest in the project.

Foster a sense of community. The undergraduate authors argue that a tighter community may produce more consistent, reliable work and may reinforce that research is not perfect. Community building strategies include forming journal clubs, holding team meetings with one or two students presenting work, and/or organizing social outings. A community can provide both positive reinforcement and negative consequences, such as causing embarrassment over not reading an article for a journal club meeting. For additional ideas on community building, readers may consult Kobulnicky & Dale (2016), who developed a model of community mentoring in their undergraduate research program.

Be attentive. Younger undergraduates need more attention. Therefore, mentors should use multiple modes of communication (e.g. email, phone calls, texting) and have a communication plan if work after business hours are expected. It is important to set deadlines to effectively structure experiences and clearly communicate expectations. It is necessary to periodically "check-in" with students or have the student "check-in" with supervisors about their progress.

Encourage students to participate in the broader research community. Departmental seminars, regional conferences, and summer internships may all increase interest and improve academic development.

Be understanding. Mentors should balance criticism with positive reinforcement. Since students are learning to balance classes and projects, it is important for mentors to value perseverance and enthusiasm, but that does not mean they must accept repeated failure or unreliability.

The recommendations provided by these undergraduate researchers are all activities that would create environments to support academic, professional, and personal growth. Interestingly, they also reflect a desire for developing personal connections with researchers, campus research communities, and their profession. These themes are also found in an inspiring collection of quotes drawn from nomination applications for Nature's outstanding mentoring awards (Lee, Dennis, & Campbell, 2007). The authors include a self-assessment that allows faculty to reflect on their mentoring practices.

Mentoring Diverse Students

The perceived value of many different mentoring activities may vary based upon the backgrounds of the students. For example, Ishiyama (2007) studied the differences in perceptions of diverse students by interviewing thirty-three undergraduate researchers from three groups: Caucasian students who were from first generation, low income (FGLI) backgrounds; African American students who were from FGLI backgrounds; and African Americans who were not first generation. Ishiyama (2007) found that while there were few differences in how they perceived the role of a mentor, "African American students generally were much more likely to value a personal connection with

mentors than White/Caucasian FGLI students” (p.545). The same students were also more likely to describe a good mentor as someone who was personally supportive.

To better understand the depth and impact of undergraduate research on students of color, mentors may wish to review Schwartz’s (2012) phenomenological study of four students of color who engaged in a STEM undergraduate research experience. Schwartz, who conducted the study at a large urban public college where students of color comprised 90 percent of the enrollment, carefully framed the research with cultural sensitivity and without adopting a deficit orientation. In other words, the participants’ experiences were contextualized in terms of historical and culture experiences but not degraded by assumptions of deficits in the students’ backgrounds (Schwartz, 2012). The findings not only echoed the general recommendations discussed above but also provided richer illustrations of why diverse students value mentoring and research experiences. The four students and their mentors discussed what they valued, which fell into four thematic areas.

Hands-on learning opportunities. The participants contrasted traditional lecture learning environments with hands-on research, appreciating the richness of what they learned. Interestingly, one of the students preferred undergraduate research because mistakes were viewed as learning opportunities, as opposed to traditional courses in which mistakes were penalized with lower grades.

Career guidance. First generations students especially knew very little of academic opportunities at major research universities. Mentors actively assisted them with information and networking that had not been readily available to them.

The affective nature of the experience. The participants discussed the value of having emotional support in their interviews much more than learning science. They noted how developing interpersonal relationships was naturally interwoven with completing research projects since they worked so closely together.

Developing an identity as a researcher. Mentoring relationships positively influenced the students as they began to join a scientific community with new friendships, broader opportunities and new experiences. Mentors were especially important when this transformation was in conflict with family culture and social pressures.

When Schwartz asked if the race of the mentor was an important factor, all participants indicated that it did not matter. However, some noted that having common backgrounds was helpful as students transformed their identity because it was easier for mentors to empathize with personal struggles (Schwartz, 2012). It is important to recognize that students with diverse backgrounds may place higher value on different mentoring activities, and those activities often extend beyond learning academic content embedded in the research. Beyond the perceived value of mentoring, students may also have different perceptions of their development as researchers. For example, Karadash (2000) studied student perceptions of their skills and/or ability to understand concepts before and after a research experience. Her analysis of fifty-seven undergraduates and their mentors found that female students perceived fewer improvements than their male peers.

When working with students from diverse backgrounds, it is important to



recognize that their personal histories, cultures, values, and experiences may not only affect how they value mentoring activities, but also how they develop their identity as researchers. Rather than attempting to create a research environment that is neutral to race, gender, or ethnicity, mentors should be aware of individual student needs and approach those needs with cultural sensitivity. Furthermore, mentors must be watchful of deficit orientations, which tends to characterize a student's background as not only deficient but as the primary barrier to student success (Valenica, 2010). Deficit orientations ignore structural barriers that may hinder student growth and underappreciate the value of diverse perspectives that can enrich the mentoring experience.

The diverse perceptions of mentors and students reinforce and add valuable dimensions to the domains provided by Crisp and Cruz (2009). Strong mentoring relationships provide psychological support to students through good communication strategies and build a sense of community in the case of research teams. Strong relationships also embed mentoring activities that support students as they develop research skills and deepen their knowledge of their field. This often leads to relationships that last beyond the research project as mentors provide career guidance and support, or serve as role models.

Brief Insights from Educational Psychology

As mentors define their roles and establish their management system for undergraduate research experiences, it may also be helpful to review some key findings in educational psychology that are helpful to consider when designing supportive environments for undergraduates. These are not intended to be exhaustive, but provide concise descriptions of theories or constructs used in research on student learning.

Designing research experiences through motivational theory. In educational psychology, student motivation can influence academic performance and has been widely researched. Three of the major constructs within motivational theory include: expectancy (e.g. perceptions of competency, self-efficacy, etc.), perceived value of the activity (e.g. intrinsic or extrinsic values), and control beliefs (i.e. belief that effort results in positive outcomes) (Pintrich, 2003; Pintrich, Smith, Garcia, & McKeachie, 1993). Undergraduate research experiences can be designed to provide feedback that can focus on any of these constructs. For example, mentors should consider assigning challenging yet appropriate work to help build the confidence and research skills of their mentees (to address expectancy). However, mentors may also consider allowing students some level of choice or control in designing activities (to foster perceived value) and provide feedback that recognizes effort (Pintrich, 2003). For additional reading, consider Paul Pintrich's (2003) thorough review of motivation and design principles in educational settings.

Motivating students through research failures. Research projects are often unpredictable and can have setbacks, which students may interpret as "failures." How students interpret failure may have a lasting impact on their motivation to take on future projects. The body of educational research has shown us that highly motivated students will invest more effort in challenging tasks, explore new strategies for solving problems, and have more resilience when encountering problems. However, student motivation is strongly related to attribution theory, which is how students interpret their successes and failures. If students believe they are successful because of their effort, they are more likely to succeed; if they believe their failure is due to lack of ability regardless of effort, they would be more likely to fail in future undertakings (Dweck, 1986; Lin-Siegler, Dweck & Cohen, 2016). As students encounter research success, mentors should praise their hard work, without reinforcing concepts such as "talent" or "innate intelligence." When students experience a setback, mentors should applaud perseverance, discuss the nature of research, and note that a failure to support a hypothesis is often an important finding, not a "failure." Interestingly, feedback that is personal, such as "you are a great student" has been demonstrated to be much less effective when compared to

feedback that informs processes directly related to the task, such as “your analysis and critique was thorough” or to self-regulation, “your goals for the next week are ambitious” (Hattie & Tipperley, 2007).

Investing in group work. A significant body of evidence suggests that regardless of the subject matter or content area, students learn more and retain information longer when they work in small groups (Dean et al., 2012), however, the structure of those working groups are critical. Strong functioning groups balance individual accountability with positive interdependence, which means that each group member can succeed when others succeed as well (Kaendler, Wiedmann, Rummel, & Spada, 2015). It is also helpful to remember that student participation in groups is impacted by reporting expectations (Cobb, 1995). If mentors expect students to report to larger audiences, rather than remaining relatively anonymous in their groups, they will be more likely to be productive and professional. Kobulnicky and Dale (2016) provided many strategies for establishing research communities that are productive.

Key Questions for Research Mentors

Mentoring undergraduate researchers in any context, such as individual, group, science, clinical, humanities, etc., is complex and dimensional, but can be very enriching for both the mentor and students. However, it is very beneficial to review key questions before establishing a mentoring relationship.

How do I define my role as a mentor? Will you establish yourself as a teacher, coach, career advisor, role model? This definition is foundational since it allows you to set your boundaries in your mentoring relationship and establish appropriate expectations with your students.

How will the research experience be structured? What are the roles and responsibilities of the student, or each member of the research team? When are meetings scheduled and what will they entail? Are students reporting progress or learning about your profession? What is the time commitment for each researcher and can you anticipate time challenges (e.g. final exams, conference travel, ordering supplies)? Are you building a realistic scaffold that allows students to develop and become increasingly independent?

What are the expected student outcomes? You need to include not only the end product, but also the items that can be formatively assessed to provide feedback to motivate students. Expected outcomes and timelines can be negotiated or flexible and may include outcomes students’ desire, such as letters of recommendation and career networking.

What resources will be required? Consider not only materials, but also time. Consider not only the research activity, but also the dissemination of that activity. Mentors who assume the role of career advocates may also want to plan for professional activities, such as journal clubs, guest speakers, etc.

What is your communication plan and strategies? After you establish your expectations, how will you communicate them to your students? What is the most efficient way to communicate (e.g. email, phone, weekends, evenings)? What strategies will you use to reinforce growth mindsets and address concerns of individual students?

How will you address developmental concerns? Students will vary in needs, personalities, and experience. Time may be needed to develop research skills, to improve content knowledge, and for team building. Training on research ethics is also essential if students are not exposed through their academic programs. Denh (2010) provides an excellent synopsis of the concerns

related to responsibly conducting research and includes ample resources for training and policies. Others have also discussed ethical issues that administrators, research faculty, and students should consider before beginning an undergraduate research program (e.g. Graham et al., 1998).

How will you assess the effectiveness of the experience? Given the many dimensions of mentoring and the wide variety of structures that can provide undergraduate research experiences, there are many approaches to assess the impact of the experience. The University of North Carolina at Charlotte has compiled a collection of surveys and instruments designed for mentors, students, and programs, many of which were created through funding of the National Science Foundation (CISE REU Assessment Work Group, 2017). This includes the Undergraduate Research Student Self-Assessment (URSSA) (Weston & Laursen, 2015). In addition, Lopatto (2004) has developed several iterations of a survey of Undergraduate Research Experiences.

After considering all of the questions, it is important to prepare written guidelines for students that clearly communicate roles and expectations for the undergraduate research experience. An example of guidelines has been produced by Monte (2001), but guidelines may also take the form of a letter or syllabus. Aligning the expectations of mentors and students is the foundation to building a productive experience and strong professional relationships.

Conclusion

There is a strong body of research that delineates the benefits of undergraduate research, yet choosing to become a mentor can be intimidating because the role can be very complex. Fortunately, there are many resources available to nascent mentors that extol the personal rewards for investing time in working with students and suggest the nuances and structures required for efficiency and productivity. However, there is a significant need for rigorous research on well-defined mentoring roles, activities, and their impact on student outcomes across all academic disciplines. The body of research on the scholarship of teaching and learning would benefit significantly from a better understanding of the components of mentoring that best serve undergraduates from diverse backgrounds. Therefore, as you consider becoming a mentor of research, please consider becoming a researcher of mentoring.

Acknowledgement

I would like to thank Dr. Sue Tomkiewicz, Director of RiverPark at the Honors College of Columbus State University, for her assistance in editing this paper and her many years of mentoring undergraduate projects.

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