Mentoring Undergraduate Research: Student and Faculty Participation in Communities of Practice

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Abstract:

Working closely with a faculty mentor is a defining characteristic of a high-quality undergraduate research (UR) experience, and mentoring UR has become a desirable pedagogical practice across undergraduate disciplines. By participating in mentored UR, students are gradually introduced to research practices through the guidance and expertise of their mentors and progress from being newcomers in the community to developing professional identities and gaining confidence in their membership within a larger community of practice (CoP). Faculty mentors also derive benefits from engaging in mentoring as a pedagogical practice, though most empirical research has focused on student gains. In this literature review, the potential benefits and challenges to participation in a CoP are explored from student and faculty perspectives, as well as the broader institutional context.

Key Words:

community of practice, mentoring, undergraduate research, faculty development, high-impact practice

Introduction

> *"Undergraduate research [scholarship, and creative activity] is an inquiry or investigation conducted by an undergraduate in collaboration with a faculty mentor that makes an original intellectual or creative contribution to the discipline" (Wenzel, 1997, p. 163).*

In 1997, the Council on Undergraduate Research (CUR) developed this broad definition of undergraduate research (UR) that emphasizes the importance of intellectual, scholarly inquiry and the role of the faculty mentor in the teaching and learning process (Webber, Nelson Laird & BrckaLorenz, 2013). George Kuh (2008) identified UR as a high-impact educational practice, one that has the potential to deepen students' learning, strengthen self-awareness, and broaden perspective-taking

abilities, among many other benefits. Recent research findings confirm that participation in UR yielded significant personal and professional gains for college undergraduates, such as analytical abilities, communication skills, understanding of the research process, and self-confidence (Hunter, Laursen & Seymour, 2007; Lopatto, 2003; Osborne & Karukstis, 2009; Russell, Hancock & McCullough, 2007; Seymour, Hunter, Laursen & DeAntoni, 2004). There is consensus in contemporary higher education that research and inquiry-based learning experiences foster higher order skills necessary for students' future work in a global economy (Palmer, Hunt, Neal & Wuetherick, 2015).

There has been a marked increase in participation in UR over the past 15 years, due in part to conclusions of the Boyer Commission (1998) that research-based learning should become standard practice in undergraduate education and to endorsement from organizations such as the National Science Foundation (2000). In a recent large-scale study, Webber et al. (2013) examined faculty and student reports on participation in UR by analyzing several items on the *National Survey of Student Engagement* (NSSE) and the *Faculty Survey of Student Engagement* (FSSE) over a five-year period (2007 – 2011). There were 455 institutions in the sample, with a diversity of characteristics including Carnegie classification, private or public, size, and selectivity. The student sample consisted of over 100,000 seniors, and 19% reported engaging in UR with a faculty mentor. Of the nearly 40,000 faculty respondents, 57% reported spending "at least some time in research with undergraduates" (Webber et al., 2013, p. 233). Analyses of students' personal characteristics indicated that full-time students, students of color (particularly African American students), and students younger than age 24 were more likely to participate in UR experiences. Additionally, students in science, technology, engineering and mathematics (STEM) were much more likely to participate. Being at a small institution, and a highly competitive one, increased percentages of participation for both students and faculty. Faculty of color, those younger than age 55, males, and full and associate professors were more likely to participate in UR. Reinforcing the institutional culture of increasing emphasis on UR experiences for high-quality, high-impact undergraduate education, the majority of faculty said it was important for undergraduate students to participate in UR (Webber et al., 2013).

Working closely with a faculty mentor is a defining characteristic of a high-quality UR experience, and mentoring UR has become a desirable pedagogical practice across undergraduate disciplines (Behling, Johnson, Miller & Vandermaas-Peeler, 2015; Healy & Jenkins, 2009; Lopatto, 2003). According to Brew (2006; 2013), UR facilitates the intersection of research and teaching by focusing on students and emphasizing student engagement, participation, and inquiry. Although the importance of mentoring has been documented extensively, little past research has actually outlined and defined the roles and responsibilities of a UR mentor, or linked specific mentoring practices to academic and career outcomes (Byars-Winston, Branchaw, Pfund, Leverett & Newton, 2015; Feldman, Divoll, & Rogan-Klyve, 2013; Pfund, Pribbenow, Branchaw, Lauffer & Handelsman, 2006). In a recent literature review designed to bridge this gap, Shanahan, Ackley-Holbrook, Hall, Stewart and Walkington (2015) identified 10 salient practices that comprise effective UR mentoring. These included strategic pre-planning for the experience; scaffolding expectations; teaching technical skills; balancing rigor and emotional support; building community among student researchers and faculty mentors; and supporting the students' personal and professional development through a

variety of opportunities including networking and communicating findings through presentations and writing. Shanahan et al. (2015) and Johnson (2007) emphasize the critical importance of both intellectual *and* emotional connections for effective mentoring relationships between mentors and students in academic communities.

Student Participation in Undergraduate Research Communities of Practice

There are a number of models of student participation in faculty-mentored UR, from one student working with a faculty mentor to multiple students working in teams or research groups with faculty guidance. Undergraduate students are often considered apprentices or novices who work with more experienced faculty mentors, graduate students, and/or peers to develop expertise (e.g., Fair, King, & Vandermaas-Peeler, 2004; Feldman et al., 2013; Hagstrom, Baker & Agan, 2009; Vandermaas-Peeler, Nelson, Ferretti & Finn, 2011). Apprenticeship models rely on a developmental, social constructivist theoretical approach to learning, in which students learn through engaged and sustained collaborative participation in authentic activities (e.g., Lave & Wenger, 1991; Rogoff, 1990; Vygotsky, 1978). Through the process of mentored UR, students become part of "scholarly, inclusive, knowledge-building communities" (Brew, 2006). Students are slowly introduced to research practices through the guidance and expertise of their mentors and more experienced peers, and move from being newcomers in the community to developing professional identities and gaining confidence in their membership within a larger community of practice or CoP. The basic criteria for participation in a CoP include a shared domain of interest; a group of people who communicate and engage in joint, sustained activities; and the development of a shared repertoire of knowledge and expertise through experiences, stories, and tools (Wenger, 2006). Lave and Wenger (1991) emphasized the importance of the learner's participation in a social community of practitioners, critically defined by a process called *legitimate peripheral participation* in which newcomers to the community participate in multiple, increasingly complex practices with an eventual goal of full participation and an increasing sense of identity as a master practitioner.

In their longitudinal and multi-institutional study, Hunter et al. (2007) employed a social constructivist lens to investigate the role of UR participation on students' personal and professional development. Analyses of interviews with students and their faculty mentors yielded interesting information about perceived benefits of UR experiences. Though both students and faculty mentors reported similar benefits from participating in UR, the faculty were much more likely to view student development as part of the process of "becoming a scientist" whereas students focused more on their own personal growth but did not conceptualize it as professional socialization. The study findings supported a social constructivist model in which faculty viewed student development as moving from legitimate peripheral participation towards a more centralized role in a community of scientists, while the students were still viewing the process from the periphery (Hunter et al., 2007). In a subsequent study, Thiry and Laursen (2011) investigated STEM UR students' perceptions of the advising and mentoring processes that facilitated their growth and development as scientists-in-training. At these research-intensive universities, graduate students often served as mentors, along with a faculty member who supervised the projects. A continuum of practices was identified across three domains, including professional socialization, intellectual support, and

personal/emotional support. Novice students, with two semesters or less of UR, identified the need for clear guidelines and disciplinary anchoring of the project, such as conceptualizing the research within a larger disciplinary context and learning relevant disciplinary language and methods. Experienced students had completed at least three semesters and one summer of UR. Their needs for professional socialization included scaffolding for application and analysis, areas identified as more challenging and less often addressed by mentors.

Recent research emphasizes the importance of mentoring students from underrepresented minority (URM) groups, particularly with regards to professional socialization (e.g., Camacho, Holmes, & Wirkus, 2015; Thiry & Laursen, 2011). Camacho et al. (2015) asserted the importance of mentoring within collaborative learning communities in which students from URM groups "provide leadership to their own learning and the learning of others." In their research on mentoring nontraditional participants in a Research Experiences for Undergraduates (REU) program, they emphasized the importance of the co-creation of environments that foster relationships among the participants, acknowledge students' backgrounds, and guide their futures (Camacho et al., 2015). Other studies also found that students from URM groups report gains in confidence, self-efficacy, and a greater understanding of potential career paths as benefits of UR mentoring (Byars-Winston et al., 2015; Thiry & Laursen, 2011).

As noted by Shanahan et al. (2015), mentoring for professional development should ideally be scaffolded within and across a variety of opportunities over time. Undergraduates typically participate in numerous on- and off-campus experiences with multiple mentors including adults outside the academic institution (e.g., community-based experiences such as internships). Thus, they are members of multiple, overlapping CoP. However, little is known about the variety of mentoring relationships in an undergraduate context. Even in traditional, formalized models of UR in which the student is paired with one faculty mentor, the student is learning within a social network in which peers and other faculty and staff members at the institution are providing academic and social supports. In a recent publication outlining characteristics of excellence in UR, Rowlett, Blockus and Larson (2012) indicated that "the undergraduate research enterprise on a campus should be integrated and coordinated, where possible, with other high-impact practices to maximize student development, leverage resources, and incorporate undergraduate research across the institution" (p. 3). Empirical research is needed to investigate the ways in which participation in multiple communities of practice influences students' personal and professional development.

A significant challenge within the institutional context of mentored UR is the issue of scalability. Given the mounting evidence that undergraduates benefit substantially from mentoring relationships with faculty, institutions are developing more UR programs and initiatives. Nonetheless, student demand for these experiences may be exceeding availability. In the 2014 Gallup-Purdue Index, a comprehensive study of college graduates, only 22% reported having a mentor in college (Gallup, 2014). This was particularly disheartening given the study findings that the long-term benefits of mentored experiences in college included significantly greater engagement at work and overall well-being. Institutions of higher education are grappling with how to include

more students in mentored UR opportunities while still maintaining the benefits of high quality, sustained mentoring more consistent with a one-to-one relationship.

Faculty Participation in Mentoring Communities of Practice

Faculty mentors also derive benefits from engaging in mentoring as a pedagogical practice, though the focus of the vast majority of extant empirical research is on student gains. There is a significant gap in scholarly knowledge concerning the faculty perspective in mentoring UR relationships (Baker, Pifer, Lunsford, Greer & Ihas, 2015). Johnson (2007) reported positive outcomes of mentoring for faculty, including personal satisfaction and fulfillment, professional rejuvenation, and networking. Baker et al. (2015) conducted focus groups with faculty members at five different academic institutions to determine motivations and barriers to participation in mentoring UR. Three important supports included internal funds and/or compensation, student support, and professional support, while three challenges were inflexibility in the methods of compensation, time, and lack of recognition for their mentoring. Interestingly, faculty who were engaged in professional activities such as publishing and presenting at conferences were also more likely to engage in UR mentoring. Johnson, Behling, Miller and Vandermaas-Peeler (2015) reviewed institutional, departmental, and individual faculty obstacles to effective mentored UR experiences, including systems of promotion and tenure that ignore mentoring; proliferation of part-time faculty appointments; competitive rather than collegial work environments; lack of diversity among the faculty; faculty workload; and faculty development for optimal mentoring relationships, among others. Institutions must support the commitment to mentored UR experiences by creating and supporting "cultures and structures conducive to promoting, reinforcing, and celebrating" excellent mentorship (Johnson et al., 2015, p. 450).

Behar-Horenstein, Roberts, and Dix (2010) examined faculty perceptions of their roles and effectiveness as mentors in students' development as scientists. They conducted a multi-case narrative analysis of five mentors and five students engaged in UR in the sciences. Students and professors agreed that mentors provided information, guidance, expertise, and advice. However, there was less correspondence between perceptions of availability and regular contact between mentors and students. Supporting prior research, students and faculty concurred that active presentations and discussions of the findings were key elements of socialization into a professional scientific community (Lopatto, 2003). Some of the challenges described by professors in their roles as mentors included difficulties in recruiting students from URM and quality of teaching provided by graduate students. Behar-Horenstein et al. (2010) suggested that formal training in mentoring and/or clearly communicated expectations for the mentoring relationship are needed. Similarly, in their review of a mentoring seminar for graduate students and postdoctoral researchers in the sciences, Pfund et al. (2006) concluded that "good mentoring can be learned" (p. 473).

In an interesting retrospective study of Australian scientists' perceptions of their own mentoring experiences, Lunsford (2014) found that scientists who reported having a mentor during their undergraduate or early graduate years reported more positive experiences with their own students. The scientists in her study were more likely to report that career (instrumental) support facilitated their own development as scientists,

but characterized their own mentoring of students using psychosocial support. During their own professional socialization, the respondents reported receiving support from multiple advisors, emphasizing the importance of CoP and social networking for professional development in the sciences.

The majority of research on UR mentoring has focused on the sciences. However, two recent studies examined the perceptions of faculty in multiple disciplines utilizing campus-wide surveys at institutions in which UR is a valued practice. Potter, Abrams, Townson and Williams (2009) investigated mentoring practices and beliefs of faculty at a public university classified by the Carnegie Foundation as "research high activity, community engaged institution." In response to questions about the amount of time they spent on UR mentoring activities, 24% of faculty reported between 11 and 30 hours, and 20% reported between 31 and 50 hours over the semester. The majority of this time was spent in face-to-face meetings. Interestingly, more full professors agreed that UR mentoring motivated them to do their own research; overall only 15% of faculty believed that their research was hindered by UR mentoring activities, though significantly more female faculty members shared this belief. Overall, faculty agreed that there were great benefits to UR mentoring, including relating better to students in class and personal satisfaction. In open-ended responses, faculty supported an apprenticeship model of mentoring and professional socialization.

In another exploratory study of faculty mentors at a mid-sized private university, Vandermaas-Peeler, Miller and Peeples (2015) investigated faculty perceptions of their UR mentoring practices, the relationship between mentoring and other roles at the institution, and the influence of belonging to a CoP for mentoring UR on mentoring practices. When asked to describe key mentoring goals and practices, respondents often focused on helping students acquire professional skills through a variety of research experiences in order to foster their participation in a disciplinary CoP. Interestingly, faculty reported that the challenges for students of participating in mentored UR were largely psychosocial or relational in nature (e.g., finding the right mentor), but that the challenges for faculty were instrumental (e.g., finding the time to mentor appropriately). The reported gains for faculty were often a blend of instrumental and psychosocial (e.g., getting to know a great student and develop scholarly collaborations). Faculty perceived UR mentoring as more aligned with scholarship than teaching or advising. Some faculty respondents reported that they belonged to a community of mentors, and found it helpful to work with other mentors through departmental or programmatic activities (e.g., mentoring workshops and social activities). As noted by Johnson et al. (2015), institutional and/or departmental support was an important provision for participation in a CoP related to mentoring UR. However, some respondents indicated that they did not have time to engage with a community of mentors, did not know how to find one, or perceived that research and mentoring practices were largely individual activities that did not merit collaborative communities. Further studies across multiple types of institutions are needed to understand how UR mentoring corresponds to other faculty roles and responsibilities, as well as the extent to which participation in a mentoring CoP may facilitate and extend mentoring UR practices within and across disciplines and institutional contexts.

Future Directions for Faculty Development

Like their students, faculty mentors are members of multiple communities on and off campus. Higgins and Kram (2001) conceptualized a developmental network approach to mentoring at work, acknowledging that individuals utilize a network or constellation of multiple mentors to support their career development. Some individuals seek multiple mentors including peers as well as more experienced colleagues, and research on organizational mentoring has begun to focus on developmental network perspectives that acknowledge the complex social networks in which individuals learn and develop (Mullen, 2010; Ragins & Verbos, 2007). Although few if any studies have examined the influence of social networks on faculty mentoring UR, this is a promising avenue for future investigations. In addition to institutional contexts, professional organizations may play a greater role in fostering CoP for faculty mentors of UR, particularly in light of recent findings that being an engaged scholar influences faculty mentoring activities (Baker et al., 2015; Vandermaas-Peeler et al., 2015).

By definition, CoP are relational and dynamic, such that every community involves relations between the members, the activities, other communities, and the world (Lave & Wenger, 1991). Faculty participation in academic CoP involves overlap among their various roles at the institution, including UR mentors, graduate mentors, teachers, scholars, advisors, and more. This overlap can contribute to positive influences on faculty development (e.g., overlap between mentoring UR and faculty scholarship can lead to increased productivity) as well as tensions (e.g., emphasis on one role for promotion and tenure may impact levels of participation in other communities). The dynamic nature of CoP can present interesting challenges for newcomers and more experienced members as well. For example, new faculty mentors of UR need to learn elements of traditional practice as it has been maintained in the community, and the experienced mentors at the institution share this time-honored knowledge. However, the social practices of any community must evolve over time and the challenge for experienced members of the community is to adapt to a changing ecology that is continually influenced by the newest members of the community (Lave & Wenger, 1991). Investigations of the types of supports that would enhance excellence for new mentors and continue to develop and refine best practices among more experienced mentors are needed. How do evolving social practices and changing institutional cultural ideologies influence notions of excellence in mentoring UR? Prior research confirms the importance of institutional supports for mentoring relationships, and future research is needed to determine how we can best support the development of faculty mentors of UR within and across their various CoP (Behar-Horenstein et al., 2010; Lunsford, 2014; Pfund et al., 2006). Situating faculty mentoring of UR within a broader institutional context is essential (Johnson et al., 2015).

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