Faculty as Undergraduate Research Mentors for Students of Color: Taking Into Account the Costs

JONI SCHWARTZ

Department of Humanities, LaGuardia Community College, The City University of New York, Long Island City, NY 11101, USA

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ABSTRACT: This article is based on the findings of a 2-year study that examined the nature of effective faculty/student undergraduate research (UR) science, technology, engineering, and mathematics (STEM) relationships. The study site was a large urban public college where three fourths of all incoming freshmen receive need-based aid; and although not a historically Black college or university (HBCU), 85% are students of color. The college offers 2- and 4-year STEM degree programs. Utilizing cultural historical activity theory (CHAT) as both a theoretical and methodological framework, this phenomenological study employed semistructured interviews, written surveys, and member checking to understand four paired faculty/student UR mentoring relationships over 2 years. The findings not only concur with the bulk of UR research, indicating UR’s promise for addressing the low enrollment and retention rates of students of color in the STEM disciplines but also raise issues around the emotional, financial, and professional costs to UR faculty. It is these costs that are the focus of this article that concludes with ideas, for university and college administrators and all others concerned, about on how we might support faculty in UR’s crucial work toward the goal of retaining students of color in STEM.

INTRODUCTION

It is 12 noon and Dr. C, an African American physicist, is taking his lunch break to talk to a group of approximately 75 young men of color, freshmen, and sophomores, at a
large urban technical college in a major American city. With a command of his audience by his sheer strong physical presence, piercing eye contact, and reputation for excellence in scholarship; he speaks to them about careers in science, technology, engineering, and mathematics (STEM), about being engineers, physicists, researchers, biologists, doctors, pharmacists, computer technicians, about majoring in biochemistry, biophysics, botany, environmental science, mechanical engineering, marine science, and mathematics.

With the passion of a preacher, the deep rich voice of a Shakespearean actor, the jargon of a scientist, and the affection of a father, he tells the students that graduating with a degree in STEM is not only about them but also about their communities, and their countries of origin. Because of the poverty, oppression, and inequity that many, if not most of the young men are acquainted, he tells them that they must go back to their inner city neighborhoods, the countries in the Caribbean, Africa, or South America with their expertise in the sciences. There is a need in these places for engineers to build the roads, environmental scientists to clean the water and stop the rape of the land, and biochemists to address diseases that are still rampant. He tells them that what countries like Haiti, before and after the earthquake, need are men and women of color who are scientists and engineers. He tells them that what Nigeria needs are men and women of color who are educated scientists who can point out that oil spills have been ruining the water and peoples’ lives in West Africa for 50 years, that it must stop, and science must collaborate with government and industry to bring restoration.

For Dr. C., STEM education is an issue of civil rights and social justice and he teaches at this college because it is overwhelmingly populated with underrepresented racial minorities (URM). He could make much more money and gain perhaps more prestige working in industry or in a White university; but he chooses to be in this room, at 12 noon, this day, missing his lunch again to talk with these young potential scientists of color.

According to Hrabowski (2010), president of University of Maryland, Baltimore County and chair of a leading committee of the National Academy of Sciences, “The US must produce many more scientists and engineers” to compete globally in the twenty-first century, and “minorities are the fastest-growing groups in the country, yet they are least represented in science and engineering careers” (p. 1). Both the Institute for Higher Education Policy and the National Science Foundation (NSF) report that we are not producing more scientists and engineers among our young men of color than in previous generations (Espinosa, 2010). “NSF data from 2006 indicates that Black, Hispanic, and Native Americans made up just 5%, 6%, and less than 1% of STEM bachelor’s degrees granted to men, respectively” (p. 1). From the groundbreaking work of such critical race theorists as Gloria Ladson-Billings and Tate (1995), we understand that this low representation of young men of color speaks to larger “inequalities that are logical and predictable in a racialized society and must be viewed in the context of large issues of marginalization and race” (p. 47).

With the critical theorists perspective in mind, colleges and universities are grappling with pedagogy that will increase both students’ aspirations and career goals in STEM, as well as their actual completion of degrees in STEM, with particular attention to lessening the gap between students of color and White and Asian American students. In this grappling, undergraduate research (UR) has captured much attention, and the research to date indicates much promise for this pedagogical approach. But good faculty mentoring is critical to this approach (Astin, 1993; Malachowski, 1996) which then raises issues around the nature, benefits, costs to faculty involved in UR (Malachowski, 1996), and how do we retain, particularly faculty of color, in these mentoring relationships.

The overarching research question guiding the study, on which this article is based, is “What is the nature of successful UR mentoring relationships between faculty and students and of color that support retention in the STEM disciplines?” For purposes of this study,
UR mentoring relationships were defined as a faculty/student one-on-one and face-to-face tutorial in a laboratory setting conducting research commensurate with practices in a specific STEM discipline. The initial UR mentoring agreement was a minimum of a 3-month commitment with the faculty serving as supervisor, facilitator, and mentor to the student researcher.

Four UR faculty/student relationships from 2008 to 2010 were examined. The findings support previous research identifying UR as being highly effective for student engagement and retention in STEM but raise questions about the emotional, professional, and financial costs to faculty. This article focuses on these costs to faculty and suggests that an understanding of them may assist colleges and universities in identifying and pursuing educational policies and pedagogical strategies supportive to retaining URM’s in STEM.

REVIEW OF THE RESEARCH

There is a plethora of quantitative, qualitative, and mixed methods studies on the benefits of UR for student learning in the sciences, identity development, and retention in STEM programs for all students, including students of color. Seymour, Hunter, Laursen, and Dean-toni (2004) conclude that student responses to their UR experiences are “overwhelmingly positive” with few negative, ambivalent, or qualified assessments given. They cite 54 examples of literature on the subject of the benefit of UR including research and evaluative studies, descriptive accounts, promotional and discussion articles, histories, and reviews.

According to Guterman, “the belief that UR attracts students to careers in science—and makes them better candidates for such work—has gained almost universal acceptance in academe” (2007). Guterman cite three studies on the benefits of UR by Lopatto (2005), Russell, Hancock, and McCullough (2007), and Seymour et al. (2004) that substantiate this belief.

Research on UR’s impact on faculty, and more specifically the impact on STEM faculty of color, although present in the literature, appear less prevalent. A 2007 Colorado study reports the costs to faculty in terms of strain on personal and family lives, the toll that commitment to UR students takes on the faculty’s own research and publication, as well as the fact that faculty often complete their own research more quickly without students (Hunter, Lausen, & Seymour, 2007). Lei and Chuang (2009) state that the major costs from faculty perspectives are “insufficient or lack of research funding and lab space” and “the time required” for UR relationships (p. 237). And Crowe (2006) documents her work at Xavier developing a center for UR that supports faculty for the purpose of minimizing the costs both personally and professionally. Mitchell Chang from University of California, Los Angeles (UCLA), a leading researcher on the retention of URM’s in STEM, does raise issues around faculty focus on research rather than teaching, the limited number of faculty role models of color, and how these issues affect the “so-called science crisis” (Chang, Cerna, Han, & Saenz 2008).

Astin and Chang (1995) state that strong student-oriented institutions (this could characterize institutions with strong UR programs) are limited by lack of institutional will, policy, and [research] tradition. The key here is an institutional culture of research. Malachowski (2006) makes the case that most of our universities support a “teacher–scholar” faculty model, which rewards research and “original scholarship with publishable results.” He further makes the case that inherent in this model are costs to both faculty and students because what students need is a learner-centered or student-oriented model.

Walter Allen’s work at UCLA in higher education and organizational change suggests attention to institutional change is necessary in supporting faculty of color. More specifically,
Allen and his colleagues address “The negative impact of the promotion and tenure process on retention and job satisfaction for faculty of color and White faculty speaks to the need to reform the traditional reward structure of the academy” (Allen et al. 2002; Jayakumar, Howard, Allen, & Han, 2009, p. 557).

This article attempts to continue and expand on this discussion of costs to UR faculty, specifically as it applies to STEM faculty and undergraduate science education.

**THEORETICAL FRAMEWORK**

Cultural historical activity theory (CHAT) has in recent years received scholarly attention among educational researchers in North America and has had special interest for adult educators because of its grounding in “pedagogy of cooperation, learner-centered education, developmental education, participatory learning and communicative learning” (Koshmanova, 2007) as well as issues of power and power structures in learning environments. Similar to both social and critical constructivism (Postholm, 2008) and not unrelated to communities of practice and situated cognition (Wenger, 1998; Lave & Wenger, 1991), CHAT examines the activity or learning system holistically (Roth & Lee, 2007). In contrast to focusing on the individual learner, teacher’s approach or curriculum design, CHAT allows the research a wide lens embracing complex systems that impact learning including issues of race, marginalization, history, and culture (Ladson-Billings & Tate, 1995), providing for the possibility of an integrative and unified research approach.

Developed primarily from the work of Russian cognitive psychologist, Vygotsky (1978), it was expanded on by Vygotsky’s student A. N. Leont’ev (1978) and further expanded in a third stage of the theory’s development by Engeström and colleagues (1999). As previously stated, CHAT has both psychological and sociocultural underpinnings. Constructivist pedagogical frameworks are not new to studies of UR research, frequently utilized to capture the situated and social nature of this pedagogy (Wenger, 1998). Engeström’s theory of a multilayered, network of interconnected activity systems in which conflict can occur, and often does, within systems (Engeström et al., 1999) provided a lens to look at UR as it is interconnected with other systems such as the academy, family, culture, and society. Central to this study is that CHAT recognizes contradictions within activity systems and tensions upon activity systems (Diehl & Prins 2008). This has relevance for how faculty weigh their experience in light of institutional pressures to perform. CHAT is both the major theoretical framework and methodological framework for this study.

**STUDY DESIGN AND METHODOLOGY**

**Data Sources**

The study site was a large urban public college where three fourths of all incoming freshmen receive need-based aid; and although not an historically Black college or university (HBCU), 85% are students of color nearly half of the college’s student body report being born outside of the United States, and two thirds report that their parents did not attend or graduate from college. The college offers its students 2- and 4-year STEM degree programs.

Although this public college has a consistent track record of faculty/student research mentoring particularly in summer research internships through the support of NSF; it is not a major research university. One stated long-term college goal was to develop undergraduates who would become future scientists and researchers. Broadly defined, the college stated that it worked to increase the inclusion and educational success of URM in higher education.

Four paired faculty and student relationships in chemistry and physics were the focus of the study. These UR relationships were faculty/student one-on-one and face-to-face tutorials.
in a laboratory setting, conducted with research practices commensurate with chemistry or physics protocol. The initial UR mentoring agreement was a minimum of a 3-month commitment with the faculty serving as supervisor, facilitator, and mentor to the student researcher.

Criteria for selection of the faculty/student pairings were based on reported faculty history of UR involvement, participating students maintaining a minimum of 3.2 GPA, and students’ plans to pursue future research and graduate study. All eight participants were members of a Black Male Initiative (BMI) program designed to support students of color in the STEM disciplines and promote STEM research. The BMI program was housed in a large classroom on campus and provided: math tutoring, computers, homework help, counseling, recreational opportunities, “barber shop” discussions, movie nights, and UR research opportunities.

A BMI administrator suggested students for the study who met the criteria; these students were then approached and asked whether they might be interested in participating in the study. Once the students expressed interest, their UR faculty mentors were approached as well. All students and faculty invited to participate, after thorough explanation of the research project, agreed to participate. Dr. C, who is a physics professor, BMI faculty advisor, and long-time UR mentor, was a primary coordinator and himself a UR mentor at the college. The other three faculty participants who agreed to participate had been STEM UR mentor for a minimum of 3 years.

As stated previously, the overall purpose of the study was to examine the nature of UR mentoring relationships for both faculty and students of color. By design, the study did not specify gender, and although the research question specified students of color, faculty of color was not indicated. However, the demographics of the college and the fact that the study participant recruitment took place in the BMI program (although open and all inclusive) dictated that the majority of research participants would be male and of color. Nevertheless one White faculty and one female student of color were accepted into the study because their UR relationship met the criteria and both were eager to participate.

Figure 1 outlines the eight research participants. The four-paired relationships were Justin and Professor R, Tosin and Professor P, Anthony and Professor A, and Matthew and Professor C. At the inception of the research in the fall of 2008, all participants were either freshmen or sophomores enrolled in a chemistry technology program or teacher education program at the research site. All had taken either chemistry or physics courses with their faculty mentor and were recruited for UR while a student in these classes. By the completion of the study in the summer of 2010, all were successful in completing a 2-year degree at the research site and three have transferred to research universities to complete their undergraduate studies, then to go on to graduate school, or in one case, to pharmacy school. The research site offers associate degrees in chemical technology and foundational courses in physics but no degree completion programs. Therefore, serious and capable science students who want to complete graduate degrees and do STEM research must transfer to research institutions. These four relationships represented successful UR experiences as measured by retention in college, retention in STEM, development of a research identity, and continued pursuit of STEM professions and career goals in research.

As previously stated, although this research site was a 4-year technical college, the science degrees offered were associate degrees; therefore, most STEM students transfer. According to Espinosa (2010), this is a nationwide phenomenon. Espinosa explains this emerging pattern:
There exists a false belief that future research scientists are trained solely within the walls of the nation’s four-year research institutions; yet this is not necessarily the path most traveled, particularly when considering URM’s seeking STEM degrees. Taken one step further, strengthening two-year STEM education will further contribute to minority student success in these fields and the subsequent widening of the STEM pipeline. If higher education can successfully transfer more underrepresented students in STEM fields, we will no doubt see the number of STEM bachelor’s degrees increase.

Pertinent to this study is the college’s policies on promotion and tenure for faculty, which appear similar to many higher education institutions. According to the faculty policy manual, tenure and promotion is based on criteria in four categories including teaching ability, scholarly and professional development, service to the institution, and public service. In the category of teaching effectiveness, the following activities are cited as benchmarks or evidence-supporting potential promotion—curriculum development, formal academic advisement, internship supervision, and participation in collegewide programs. Emphasis is placed on research and publication, and although internships and participation on doctoral committees is specified as counting for promotion and tenure, UR is not specifically included.
Data Collection

The four relationships examined included both summer and yearlong UR projects. Data collection began with semistructured interviews. Faculty and students were interviewed separately, and interviews were from an hour to an hour and a half in duration. Fieldnotes were collected and transcribed within 24 hours of the completed interviews.

In total, 14 semistructured interviews were conducted over a 2-year period during and after faculty and students’ participation in the research projects. Seven faculty interviews were conducted; all four faculty were interviewed during the time of their work with a student and again almost 2 years later after students had successfully terminated their UR project. The second round of interviews included an opportunity for faculty to hear the responses they gave to questions in the first interviews and to reflect on their answers with the benefit of time and the assurance that the UR students had successfully moved on in their STEM training. The second interview also included questions about faculty’s current relationship with the students, networking, and the nature of the relationship 2 years later, plus the longevity of the relationship.

Open-ended questions covered a range of topics relevant to the potential benefits and costs to individuals participating in these relationships; they included questions around engagement in learning, identity development, college credit, monetary stipends, longevity of the relationship, the nature of the relationship cognitively and affectively, research products, gender/race of participants, and time committed to the project (see Appendixes A and B in the Supporting Information). Following the first set of interviews, a written survey was distributed to all participants based on themes and questions that emerged from the first set of interviews (Appendix C in the Supporting Information). The second set of interviews 2 years later were again conducted utilizing semistructured interviews, and this time based on the responses from the first set of interviews and survey. Questions were formulated to elaborate and clarify previous responses (Appendix D in the Supporting Information).

Data Analysis

Three stages of phenomenological analysis were conducted with an aim of understanding the lived UR experience. The first stage used an emergent theory method beginning with coding for recurrent themes (clusters of meaning) within the transcriptions of the first round of interviews and the surveys. An inclusive coding approach used all data collected. The data were color coded manually with hard copies of the data cut, sorted, grouped into these emergent themes, and eventually labeled as benefits of UR to students, costs to students, benefits to faculty, and costs to faculty. Initially the terms “costs” and “benefits” were not evident but were later labeled as such (Miles & Huberman, 1994).

For further data reduction and visualization of these broad themes derived from initial coding, matrix displays were utilized (Miles & Huberman, 1994) using the emergent themes as matrix headers. Cross-case analysis was utilized to compare responses from students with other students and faculty with faculty, as well as to compare student and faculty responses with one another.

In the second stage of analysis, the second faculty interviews served as both a source for new data and as a means of member checking (Lincoln & Guba, 1985) and further analysis. During these second interviews, participants were asked to respond to stage one emerging themes, thereby testing them for accuracy and obtaining the research participants’ interpretation. In other words, the member checking provided the participants with the opportunity to assess the adequacy of the data and the accuracy of the initial findings.

The third stage of analysis examined data collected from all faculty interviews and surveys. And in contrast to the first stage, this stage was theory driven utilizing CHAT methodological framework and its’ seven components (Figure 2). CHAT takes a broad view of learning systems looking at all the component parts: tools and artifacts, activities, people, environments, rules, community, needs and outcomes, and how they operate together, or in contradiction, within the system and without the system to produce learning (Engeström, 1999). In simple terms, CHAT’s unit of analysis is an activity and that activity is the engagement of a human subject toward the achievement of a goal or objective. Ryder (1998) describes the term activity within this framework:

An activity is undertaken by a human agent (subject) who is motivated toward the solution of a problem or purpose (object), and mediated by tools (artifacts) in collaboration with others (community). The structure of the activity is constrained by cultural factors including conventions (rules) and social strata (division of labor) with the context. (p. 4)

For purposes of this study, the activity system was the UR relationship. Figure 3 shows how the CHAT matrix was used for categorizing data and how the data were broken down and distributed among the CHAT categories. Similar to stage one, but this time theory driven, data were manually sorted, grouped, and recategorized. The choice for a manual versus an electronic approach was intentional by design, although perhaps more time intensive and certainly an onerous undertaking considering the voluminous nature of the data, it assured thorough familiarity with the data, particularly with the multiple analysis approach.

Validity and Reliability

Two techniques were employed to ensure validity and reliability of the research, member checking (Lincoln & Guba, 1985) and triangulation. As stated previously, research participants had an opportunity to look at the findings, ask questions, make comments,
and respond—member checking. Without exception, participants thought the emergent findings were consistent with what they said during data collection and believe the findings (emergent themes) to be consistent with their lived experience of UR.

Three types of triangulation were employed: source, collection, and methods (Denzin & Lincoln, 2005). Source triangulation occurred by including both faculty and students as research participants; collection triangulation included interviewing and written surveys over a span of 2 years, and methods triangulation included emergent coding, CHAT theory-driven coding, visual matrix displays, and cross-case analysis.

**STUDY FINDINGS**

Consistent with the UR literature, the data suggest that the benefit to students is impactful in terms of experiential science learning, career guidance and networking, affective support, and retention in the STEM disciplines. But in contrast, the findings for faculty indicate that emotional, professional, and financial costs seem to outweigh any altruistic satisfaction faculty receive from helping students. In fact, these costs are perceived by the faculty in this study to have the potential to hinder faculty academic and professional advancement and may be increased for faculty mentoring students of color.

**Emotional Costs**

Professor R has mentored students for 14 years with an average of 5–7 UR students per year. Of the students he has mentored, he states that easily 80% go “somewhere” else to study after being with him following their sophomore year; some have earned their Ph.D.s. He stated that one of his former students is now a professor and “wants to do for minority students what you [Prof. R] did for me.” Professor R, himself, had his own undergraduate mentors. They still email each other after 20 years. He states,
One of the things I want the students to see is that “there is another world out there” that is part of this world. Inner city kids—to see that they could be an Einstein, mentoring and exposing them to the possibility of that world.

Although the bulk of the data indicate that both Justin and Professor R believe their UR relationship to be profoundly beneficial; and Professor R finds it very emotionally satisfying, he also has very conflicted emotions. Professor R knows that without his support, networking, and mentoring, Justin may have been in a very different place in his STEM studies and future career. He realizes that his UR mentoring can mean the difference between a student like Justin finishing college or not and the quality of opportunity a student receives. But Professor R does not know how long he can continue to do UR and feels that even when he works with students like Justin, they are not receiving the kind of quality research experience that he himself was privileged to.

Professor R is troubled and believes the research site (college) needs to be changed to support UR and faculty. He believes the institution does not value UR as evidenced by substandard laboratory facilities, the limited number of students who have access to UR, and no long range plan for institutionalizing UR beyond the current grants. Professor R feels that there is so much need to support our young men of color in the STEM disciplines, so much talk about that need, yet when there is a viable strategy like UR, there is little institutional support for it. This takes an emotional toll on a man who cares deeply about the success of his students and knows they are not receiving the best lab experiences, and so few have opportunities for even a less than optimal UR experience.

Professor P sees himself training students for 2 years and then sees his job as “handing them over to someone else” to go on to finish their degree and graduate school from a research institution. He sees his job as ushering them on, making professional connections, and “making a call for them,” which he has done for a number of students. Like Professor R, Professor P expresses conflicted emotions as well. At the time of a second interview with Professor P, he had decided not take on any new UR students because of a promotion to department head. He felt badly that this choice had to be made, and he could not continue with students. He knows the value of UR to students and wishes there were other faculty willing to take on this important role.

During the past 10 years, Professor C has worked with 13 undergraduate students. At the time of the second interview, he had worked with an additional 30 undergraduates either in UR relationships himself, by placing them with graduate students at another institution, or facilitating UR mentoring with other faculty.

UR is personal and emotional for him because as an undergraduate student, he had two great mentors himself. Professor C’s first mentor was a Black physics professor originally from the Caribbean. His mentor’s mentor, who was White, was Professor C’s second mentor. Professor C spoke about his first mentor:

I was a fish out of water, and he [first mentor] rescued me. He taught me how to learn. I was in his house, home; he gave me books in the office. He cared for me beyond a father and a son. I must care.

Professor C thinks that his relationship with young men of color is different from working with other racial and ethnic groups. He says he identifies with their pain, understanding their identity crisis. He believes they are asking, “Where do I belong? How do I fit in?” According to Professor C, there is a tug between the neighborhood and academia—a gap. Professor C sees himself as the “bridge,” and this role is an emotional one. Mentoring
requires an emotional output, listening, showing empathy, and giving advice. This happens during UR. He states there are “emotional costs and sacrifices.”

Data indicate that the affective and interpersonal nature of the undergraduate research relationship may be just as significant as the academic. Students published and coauthored with Professor C and other scientists, and most went on to graduate work and were currently completing undergraduate degrees in STEM. But the rigorous cognitive work done by students was clearly linked to affective aspects of their lives. Professor C expressed this connection in this manner:

The students are suffering; can’t just ignore that—cannot separate from the “whole” life. This achieves better results on the research end. I think this relationship is unique. I think my colleagues do not care about the life experiences. I am very involved in their lives. Other mentors choose the “crème of the crop.” I don’t always choose the “crème of the crop.” I build them up.

In addition to the conflicted emotions and emotional output, Professor C was angered and frustrated by the treatment of students by other nonparticipating college faculty. In his mind, other STEM faculty was not giving students the affective and caring support they need. Particularly when he spoke of young men of color in the sciences, he felt they needed particular affective support in their relationships. Professor C articulated it this way:

Our young black men are wounded need healing. They are in pain, especially young black men. Not many black scientists doing physics research. The young men see themselves in me.

Professor C felt unsupported and undervalued in this work by administration and in some cases his department. Data suggest that faculty did not believe that the administration understood the emotional support young men of color need in their learning and that UR often provides. In addition, Professor C felt the administration undervalued UR’s role in student retention and the overall value to the college in terms of graduating students in STEM then ushering them into prestigious universities for further study.

In this “ushering” role, faculty guide students into and assist them in navigating a new cultural world of academia with new social capital. This is no small function and an emotionally taxing one. Participants felt that they would not survive in academia with its very competitive edge, foreign set of rules, and new jargon without someone to “open the door” and hold it open until students could do this for themselves.

The findings suggest that particularly for the students of color, negotiating a mainly White culture in the STEM community can be difficult. Faculty reported that it is crucial that students begin to develop an identity as both a scholar and researcher—a “research identity.” Faculty reported playing this important role of “ushering” and assisting students in negotiating a new academic culture. Several of the UR students reported that faculty had either talked or counseled them around personal family issues that presented potential obstacles to staying in college.

But faculty report that there was an emotional cost to performing this role of problem solver, guide, and counselor often making the relationships emotional taxing. Faculty believe that without partnering with larger research universities and using their labs, they feel they are short changing students and not giving them the kind of authentic and rich UR experience that they themselves enjoyed at major research universities during their own undergraduate years. This “short changing” troubles them. Data indicate that they are unhopeful that things will change because they feel that college administrations

do not have vision for “thinking outside the box” when it comes to expanding UR support for faculty and for reimaging UR as integral to their work collegewide.

They lament the fact that the need is great; they have a proven tool in UR to help them, but they are not certain whether they personally and professionally can sustain the investment. They often feel conflicted and unhopeful that their institution will change. Either way, whether they decide to continue participation in UR or whether they make the hard decision not to participate for professional reasons, they “pay an emotional price.”

Professional Costs

UR is time intensive for faculty as well as students. Faculty reported spending 10–16 hours a week engaged in these relationships teaching, modeling, supervising, assessing progress, networking, presenting at conferences with students, career counseling, mentoring students on family or personal problems, and academic acculturation. This commitment of time and energy are in addition to faculty’s teaching load (often four or five classes a semester), committee work, faculty responsibilities, and departmental responsibilities. Long-term these expenditures of time and energy take the faculty away from the all-important time needed for their own research and publication, which has potential ramifications for their career advancement.

Professor R spoke extensively about the costs to him personally in terms of time and energy and ultimately to advancement in his career. These costs are why he now only has two UR students and by the end of the study decided that he could take on no more:

I am very involved in all aspects, designing, teaching techniques, analyzing results . . . . I work with them (UR students a couple of days a week for eight or nine hours a day. When they [the students] are engaged they ask to come on Saturdays and holidays when they take ownership of the project . . . . In the past I have taken them to conferences at Yale and Harvard, but for the past four years I haven’t. Can’t sustain it. We have no graduate students, too taxing. It is a tremendous cost to me, costs to my career, taxing.

At the time of the first interview in 2008, Professor P when asked about his own research and writing, he explained,

I don’t have time now [for research]; I am acting as the chair of the chemistry department. In principle, “yes” but I don’t have time. [Only] one day a week I have time for research in my lab. . . . To do research, absolutely that is the expectation [by administration]. Time is an issue for faculty, teaching responsibility, external funding is needed.

At the time of the second interview, Professor P had been appointed chair of the chemistry department and no longer had UR students. He said that if he were not chair, he would take students. He went on to articulate that from his perspective, UR mentoring is not valued by administration for tenure and promotion; and in his experience on tenure and promotion committees, discussions about the value of UR do not go on.

Professor A has had a similar journey. He has been successful in ushering well more than a dozen students of color into Ph.D., M.D., and research programs through the past 10 years. But again at the time of the second interview, Professor A no longer had UR students. He stated that he was at a “crossroads” in his career and could not mentor. He sees little or no personal gain for himself in these relationships. Professor A knew that the mentoring was very valuable to the students, and in that sense valuable to him, but he did not think the administration understood that or rewarded it. Therefore, because of the need
to think about his own research and career, he would no longer take undergraduate students in research relationships.

Unlike his colleagues, Professor C will continue in UR relationships; however, he is well aware of the professional costs. According to him, time is costly. When he is on campus and in his office, he cannot work as students are continuously coming to talk. Some students have his cell and home phone numbers.

Professor C stated that the institution (college administration) “does not value service to students.” UR centers on direct service to students. Data analysis showed that Professor C, along with his other UR colleagues, thought that institutions need to reprioritize their evaluation schemes for faculty promotion and tenure. Although all four faculty were committed to research and publishing, they believed that service to students needed to count equally toward tenure and promotion alongside publishing and research. Professor C believes it is all about what is valued; college institutions give “lip service” to students and UR, but service to students needs to be placed on an “equal footing” with professional development requirements. Professor C stated that “administrators told him personally to “cut these young men loose (UR students) and focus on your own professional development.”

Findings indicate that faculty believed if you want to help students and participate in UR, you will do this at your own disadvantage, and it will “hurt you in the end.” The faculty participants report that junior faculty “run away” from UR as they think it hurts their own personal and professional development chances. After unsuccessfully recruiting STEM faculty for UR, Professor C reported,

For the first five to seven years they don’t want to work with UR students. They say maybe after I get a promotion or tenure, I can do UR.

Combined with heavy teaching loads, departmental and committee responsibilities, UR’s time intensive nature takes faculty away from their own research and writing. Many faculty want to participate in UR and do understand the importance to their students, but they feel conflicted as the time-intensive nature of these relationships has strong impact on their own research and publication pursuits. They are concerned that when considered for tenure or promotion participation in UR is not considered, and they are unwilling to jeopardize their tenure and promotion chances.

**Financial Costs**

Beyond the emotional and professional costs, data indicate that there are monetary costs as well. As stated previously faculty put in from 8–16 hours per week on UR; most often this is above and beyond a 35- or 40-hour work week. Data indicate that they receive no compensation for their time, or if they do through UR grant money, it is a minimal stipend for their hours. Faculty believe that funding faculty to participate would be beneficial, but they also thought that “in kind” support such as freeing faculty from classroom teaching responsibilities, participation on college and department committees would be another form of compensation. They recognize that although these other responsibilities are important to the life of the college, UR was vital to the lives of their students and ultimately accomplish one mission of the college that was to improve retention in the STEM disciplines.

Another financial cost verbalized by two faculty was what they spent of their own income to support the work of UR. A case in point is Professor A who sees his work as preparing his UR students to be mentored by someone else in a larger, well-equipped, and connected research setting. But to prepare students for a larger setting, they first need an experience

with him. But when he first arrived at the college there was no research lab, so he spent his own resources and created one:

I have an interest in people. I want to see them succeed—that is the only incentive. All of the faculty in the chemistry department want to benefit students. I created the research lab, the infra-structure so that the students would have some research culture. It was built from scratch. I designed the research lab.

He spoke about the need to partner with other more well-financed and well-equipped research labs because of the limitations with infrastructure, vision, and finances of the college:

We have no research culture here [at the college]. It takes a financial investment and partnering with another lab. Vision. And I haven’t seen that. It is better to partner with other labs. . . . I want to send them to Johns Hopkins’ lab. We need more funding for mentoring.

Faculty perceived a lack of vision for a larger research culture that includes an extensive, well-supported UR program and lab. In this vacuum, several of the faculty verbalized that they have compensated with their own financial resources often at great financial cost to them and their families. These kinds of financial sacrifices, coupled with potential financial loss if faculty do not receive promotion and tenure, are costly. Particularly for junior faculty, the financial risk seems particularly great.

**CONCLUSION AND RECOMMENDATIONS**

Consistent with the UR literature in the field, the data suggest that the benefit to students is potentially transformative (Mesirow, 2000) for their engagement in STEM, and this was certainly true for the young people of color in this study. On completion of the 2 years of data collection, all four student researchers were still in college. Three had transferred to 4-year research universities of very prominent status in the STEM disciplines. One student remained at the local college and was completing a 4-year degree in math education. All four intend to go on to graduate programs. Three intend to go to medical or pharmacy schools and two intend to have careers in research. Three of the four have received full scholarships to complete their undergraduate study. It is anticipated that the mentoring relationships that began with UR will continue into the students’ graduate study and early STEM careers.

Unfortunately, for faculty this apparent student success is at emotional, professional, and financial costs to them. These costs seem to outweigh any altruist satisfaction faculty receive from helping students. Of the faculty, two have decided to no longer take on UR students but to work on their own scholarship; one is now an administrator for his department and one continues to participate in UR. Data indicate that if faculty experienced what they perceived as more institutional support for UR, all would gladly continue working with students in this capacity; but as it stands, the costs do not balance with the benefits for them.

In light of Walter Allen’s extensive work on the challenges to faculty of color in academia, Allen et al. (2002) and consistent with Stanley (2006), in his autoethnographic research on faculty of color in higher education who has made a variety of recommendations for administrations in the area of teaching, mentoring, collegiality, identity service, and racism for faculty retention, the following recommendations are suggested. Both the findings of this study and subsequent recommendations may have particular applicability to community
colleges with 2-year certificate programs and 4-year institutions with high URM populations preparing students for transfer to major research universities and medical schools.

These recommendations are not made without an awareness that there are other pedagogical tools that may be equally effective in successfully addressing the issues of sustaining students in STEM or that faculty research and publication is of vital importance for scholars, the institutions they represent, academia at large, and an informed democracy. Clearly, how to support UR faculty as they support STEM students of color is fraught with hard choices and trade-offs especially in times of limited higher education resources. Nevertheless, the retention of students of color in STEM continues to be a stubborn higher education dilemma deserving of thoughtful reflection. It is with this understanding that these discussion points and recommendations are offered:

- Begin discussion around creative ways to institutionalize UR in STEM departments.
- Reevaluate current tenure and promotion guidelines to include or give additional weight to UR mentoring.
- Discuss ways to decrease teaching load for faculty who participate in UR.
- Free faculty from committee and departmental work in lieu of direct service to students in the form of UR.
- Work with research universities to encourage graduate assistantships and postdoctoral fellowships in UR to assist faculty with UR students.
- Increase partnerships with major research institutions and corporations to create state of the art lab facilities at public colleges with UR programs.

For colleges serious about retaining students of color in STEM and ultimately addressing systemic issues of inequity of opportunity particularly in science education (Hrabowski, 2010); these discussion points are a small but pragmatic way forward to reimagining institutional change in support of UR faculty with hopeful translation into support for students of color in STEM.

REFERENCES


