CUR Focus

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Five Effective Strategies for Mentoring Undergraduates: Students' Perspectives

Undergraduate research has been shown to provide an exceptionally positive experience for students (Seymour et al. 2004). In a study of student learning outcomes following participation in summer research programs, 1,135 undergraduate researchers reported the highest learning gains on closed-ended survey items related to understanding the "research process" and how to approach scientific problems, followed by gains in knowledge of laboratory techniques and areas of personal development (Lopatto 2004). Other studies investigating the merits of undergraduate research have shown development of research skills (Kardash 2000), enhancement of intellectual curiosity and logical thinking (Bauer and Bennet 2003), and increased college retention rates (Nagda et al. 1998). Positive effects are seen across the spectrum of disciplines from engineering (Zydney et al. 2002) to social science to the humanities (Ishiyama 2002).

Integral to facilitating such benefits for undergraduates is a faculty mentor who can successfully introduce this mostly younger population of students to academic research. Mentoring undergraduates is distinct from the process of mentoring graduate students. Unique challenges stem from, for example, differences in the students' general level of experience and stage of career development. Given the marked benefits of undergraduate research and the importance of effective mentor-student interactions, it is worth exploring the interpersonal strategies that mentors can employ to facilitate the best possible learning outcomes for their undergraduate researchers.

In this article we provide mentors with purely student-derived insights on how best to approach mentoring undergraduates. Our insights stem from personal experience as current undergraduate researchers; also we are all ambassadors to the Office of Undergraduate Research at our university. In that capacity we promote involvement in research to the student body, and we advise students across disciplines on how to be successful researchers. The following are the top five strategies we have found to be the most effective for mentors to generate excitement, expertise, engagement, and a sense of student responsibility that ultimately leads to quality work. Thus we advise mentors to:

Make Yourself Available

Certainly one of the most valuable commodities a mentor can offer is his or her time. If the principal investigator has no time left to give, he or she should at least guarantee that a postdoctoral fellow, a graduate student, or even an experienced undergraduate is able to devote a considerable amount of time to mentoring a new undergraduate researcher. Learning in a research environment can be a dynamic and unpredictable endeavor. Simply spending time with students as they perform tasks allows the mentor to be able to clarify the young researcher's nuanced questions and the subtle discrepancies from the norm or the expected outcome that inevitability arise during the workflow due to the often hyper-detailed nature of research. The mentor may also find himself or herself delving into interesting side topics with the student, all the while generating knowledge and excitement that facilitates the learning and retention process.

Quality time with a mentor is paramount for student success, but how can this process be optimized to ensure that the time students and their mentors spend together is wholly productive? Often mentors may be present but do not actively engage with the student as he or she works on the research—or vice versa. Such a scenario may arise due to a strain in the mentor-student relationship; if the two parties are unfamiliar with each other or not comfortable with each other, it can lead one or both to act in a reserved way that can inhibit interactive learning.

It is important to note that mentor-student relationships are not immune to standard social psychology. There must be mutual trust and respect, openness and companionship. With this in mind, a mentor should not discount the value of taking time to eat lunch or grab a cup of coffee with the mentee, for example. Conversations about topics unrelated to the research, such as those giving the student advice about classes or future goals, can have a lasting impacts. Essentially, building rapport in such a way can help make the mentor-student relationship more comfortable. It is this fundamental comfort and connectedness that allow mentoring relationships to evolve into the most productive, educational, and constructive interactions in the research environment.

CURQ Vignettes

The Roller Coaster of Undergraduate Research

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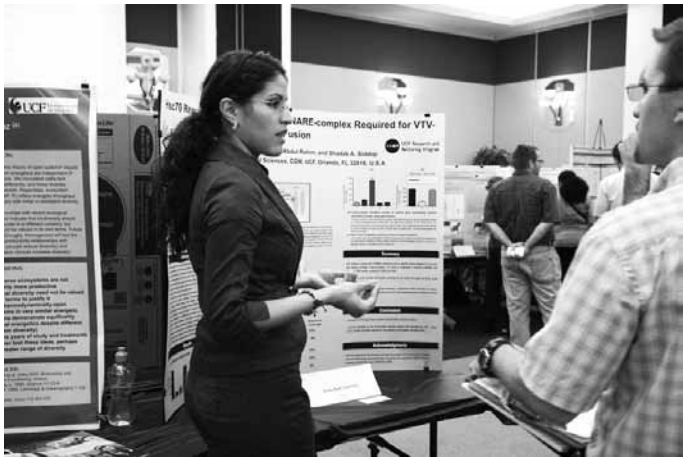
Trying to complete meaningful original research while juggling classes, homework, extracurricular activities, and some free time during the school year can be a very daunting task. Similarly, eight, ten, or twelve weeks during the summer is a short time in which to become familiar with a research topic. Yet thousands of undergraduate students not only want to have such an experience, they compete for it. The fundamentals of a successful research experience are careful selection of a mentor and project, ample preparation, and a final research presentation.

The experience itself is difficult to explain; it involves more than just the mere "ups" and "downs" of research. More specifically, the learning curve, loop-the-loops, climbs, and dips in the research process make undergraduate research resemble a ride on a roller coaster. The type and pace of each project is as unique as each roller coaster: launch, wooden, or even inverted. Every roller coaster, though, is dependent on the operator to guide it along its rails. Similarly, the undergraduate's research mentor holds the keys to easing the student's transition onto the ride of choice and to fulfilling the student's expectations. For example, a mentor may build the student's foundation for the project before the ride begins, providing ample time and information for an enthusiastic student to absorb while waiting in line for the fast-accelerating coaster. Once the student is in the seat and finally ready to go, the mentor reminds the student to hold on and enjoy.

Ultimately, the eager rider has the chance to test ride a research experience. After a long and sometimes slow climb to the top, he or she may finally attain a great view—understanding the broad scope of the project and thus being able to enjoy the upcoming thrills with minimal plummets. The possibilities of discovery at that height of view are endless and exciting. Once the coaster returns to the station, the riders share their experience with those waiting to soon embark on a similar journey. Much like a conference, one finds much joy in presenting the outcome of the test ride. Along the way, the rush of G-forces while pushing though the "ups" and "downs" excites a young research student and roller coaster fanatic.

Foster Community

In the broadest sense, community has always been vital to human progress. Human beings are fundamentally social creatures; we thrive in interpersonal relationships and synergistic interactions that allow us to better ourselves collectively. This collective progress is a hallmark of community, and it is important to recognize that the microcosm of the research environment is not immune to this core principle. Following are some examples of how to build a community within a research team; they show precisely why forming a robust community is helpful to undergraduates.



Students present research projects to the UCF community at the Showcase of Undergraduate Research Excellence (SURE).(Photo Credit: University of Central Florida Office of Undergraduate Research- Student Undergraduate Research Council)

As student researchers, we have had the most success when we have been in welcoming environments that provide us with a support system—one that not only encourages participation, but also holds us accountable for our respective duties. We have found this balance between positive reinforcement and negative consequences (e.g., embarrassment due to unpreparedness for a journal club meeting) to be crucial. The tighter and more supportive the community, the more likely we are to produce consistent and reliable work in an enjoyable manner. Conversely, too much pressure to succeed or obtain perfection can be unrealistic and off-putting for inexperienced researchers. Moreover, undergraduates are usually young; we are still learning how to act professionally. We have heard professors explain their reluctance to accept undergraduates for this very reason. Forming a community can counteract naive behavior by appealing to the innate psychological drives a true community elicits: a person's desire to feel that he or she belongs and a feeling of responsibility to the community.

As students and peer mentors who have experience with numerous research environments, we are confident that implementing activities to build a community will have profound effects on the behavior and productivity of undergraduate researchers. The following have been useful in our own research environments:

- ***Team meetings.*** It is important that all members of the research group become familiar with the projects and tasks of their peers and colleagues. Team meetings support discussion and collaboration among researchers in the same environment, and they can be particularly useful for the efficient use of available resources. During such meetings, one or two members of the research group can present the progress of their specific research projects and allow the mentor and other researchers to ask questions. We have found an open discussion period at the end of the presentation to be especially important for furthering the project in the best way possible.
- ***One-on-one meetings.*** We have found one-on-one or small group meetings to be an important supplement to team meetings. Such meetings give students time

Peer Mentors teach undergraduates about research at the Summer Research Academy (SRA). (Photo Credit: University of Central Florida Office of Undergraduate Research- Student Undergraduate Research Council)

to express their concerns to the mentor in a confidential environment. Interpersonal concerns with other researchers can be addressed, in addition to research-related questions. In these meetings, mentors are able to make their expectations of the student clear and set the stage for subsequent discussion.

- ***Journal clubs.*** In addition to meetings, a journal club can be a useful venue for the exploration of unfamiliar, yet relevant and exciting topics. Journal clubs are also particularly valuable for undergraduate researchers because the process teaches students how to effectively criticize and scrutinize research articles. Finally, these meetings will enhance the formation of a community and help lead to the benefits previously discussed. Journal clubs and team meetings can be combined into one weekly or bi-weekly event.
- ***Social outings.*** It is especially important to foster professional relationships with co-workers because effective teamwork is often crucial to a project's success. There are many ways this can be accomplished. For example, host a potluck where members bring an ethnic dish from their culture, go to sports games, have lunch together, or attend research presentations as a group. It is easy to discredit some of these activities as frivolous, but we have found them helpful in constructing a stronger and more natural community within the research environment.

Be Attentive

A mentor should be attentive to the student being mentored. Maintaining continuous communication with a mentee can be an effective way of curbing the occasional unreliability found among undergraduates because it allows for immediate accountability. While it may be somewhat time-consuming, such attentiveness is especially worthwhile for the younger undergraduates. To remain attentive, a mentor can employ multiple modes of communication, including email, phone calls, and even texting. Contacting students to inquire about their projects through such modes of communication can be useful if the mentor cannot do so in person due to other commitments.

In addition, setting deadlines for certain tasks may be an effective way to create structure and promote clear communication of expectations. Finally, knowing when a student plans to perform certain research tasks and promptly checking in with the student (or having the student check in with the mentor) about their progress around the time of the deadlines can be an important way to maintain the student's sense of responsibility and quality of work. Many undergraduates complete their work on nights and weekends, so having the mentor check in and respond to inquiries during off-hours can be helpful.

Encourage Participation in the Broader Research Community

Time spent as an undergraduate is formative and novel; getting a young researcher involved in the research community beyond the student's specific project (e.g., through departmental seminars, local or national conferences, and summer internships) can inspire and dramatically encourage students. A mentor can suggest that students travel to conferences in different cities or countries, help them construct research posters, or use other institutional contacts to help the students find summer research opportunities. It is important to realize that many undergraduates are not aware of these types of activities and that campuses usually have resources to help students participate, such as travel funding for conferences. Overall, we have found conferences and internships beneficial to the work we provide at our home institution. In terms of forming a better mentor-student relationship, these activities may increase a mentor's interest in the mentee's personal and academic development.

Be Understanding

Undergraduates are under tremendous stress at times for a number of reasons. They may have underestimated the workload and time commitment their classes require or they may be overwhelmed by the transitions faced in college and the responsibilities of adult life. Undergraduate research is frequently difficult due to the necessity for students to balance coursework (and its sometimes unaccommodating class schedules) with highly involved research projects. With all of this in mind, it is important for the mentor to maintain empathy for students, and to be understanding of the student context.

Due to time constraints and general inexperience, undergraduates may need considerably more time than graduate or postdoctoral researchers to fully adapt and thrive within the research setting. Mentors should be understanding about a student's failures; we have found that negativity only breeds more negativity. Mentors should make an effort to ensure their criticism is constructive and not demeaning

to the student. Always balance criticism with positive reinforcement. This does not mean, however, that the mentor has to accept repeated failure and unreliability, but rather should value a student's perseverance and enthusiasm over his or her initial results. Mentors who employ this strategy may find students who initially had difficulties evolving into valuable assets on their research teams.

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What to Do When Everything Goes to Hell

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Dear student colleagues in research:

I call out to you from the Great Beyond (post-graduation), and, like Marley's ghost, I come bearing a message to save you from eternal torment, or at least, from project failure. The chains I forged in my academic life were the smelted remains of a research project that threatened to go straight to hell. That experience left me with the following instructions that I now impart to you, to be deployed in the event your own work begins to smell like sulfur and brimstone.

Don't panic and become entrenched in your approach to the research. Both reactions will cut off your ability to see other options. Don't hide the problem you have encountered or lapse into denial. (Similar to panic in terms of a sheer knee-jerk reaction, this is a normal response; however, it is just as self-defeating). Don't give in to negative feelings about your worth as a researcher (a direct route to panic and self-defeat).

Communicate with your professor at all times so he/she knows the project's status. Your best hope lies there.

Ask for help. Not just from your professor, but from any professional on campus, within your community, or through social networks, who has expertise in the area of your research. Help may come from unexpected quarters, but you first have to ask.

Look for inspiration in the thing that caused the breakdown of the project in the first place. This can spark your creativity by forcing you to look at an aspect of your topic you hadn't examined closely before, or it may make you look at your topic a completely new way. Be ready to reconfigure/redirect/drop back and punt as needed.

Never give up. Even if all possibilities seem to be exhausted, and the project is still failing, your professor may be able to present you with alternatives, such as writing a grant proposal instead.

Last, don't fake it. Do not attempt to bluff, cheat, or plagiarize your way out of a jam. You WILL get caught. An entire failed course; having to face an honor board; possible suspension; and destroyed credibility are far worse than a failed project. Unlike a failed project, there may be no future redemption.

Conclusion

What makes an ideal research mentor for undergraduates? While each of the strategies we have discussed is beneficial in the mentoring process, the overarching theme of each is: be involved. Be available to create a healthy and open line of communication with students. Take time to build companionship. Form a community to create an efficient environment and counteract unfavorable behavior. Follow up your statement of project expectations by regularly checking in with students. Encourage students to participate in presentations and off-campus experiences. Be mindful of the academic, social, and age-related context of undergraduates when judging their performance. As undergraduate researchers ourselves, we have found that these strategies facilitate a mentor-student relationship of mutual respect and transformative guidance, of productivity and mutual reliability. Employing these strategies should empower undergraduates to generate meaningful work and, in doing so, inspire the next generation of researchers.

As mentors, faculty members have the opportunity to have a lifelong impact on their students, particularly those early in their careers. In our experience as researchers, we are forever appreciative for the time our mentors have spent with each of us.

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Mario Pita

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Mario Pita is a senior at the University of Central Florida (UCF), majoring in biomedical sciences and psychology. He has worked in Dr. Kiminobu Sugaya's laboratory at UCF for over three years, performing experiments and collecting data for a project aimed at developing a novel therapy for Parkinson's disease. Pita also won a summer internship at the National Institutes of Health when he was a sophomore and worked for two summers in Dr. Mark P. Mattson's neurosciences laboratory at the National Institute on Aging. His work there led to four co-authored publications including a paper in the Proceedings of the National Academy of Sciences. *Pita has also worked in numerous outreach and mentoring programs and recently founded the Central Florida Chapter of the Society for Neuroscience, where he aims to foster public outreach and education, as well as collaboration and communication, among scientists, doctors, and students in central Florida.*

Christopher Ramirez is a junior at the University of Central Florida studying chemistry. He is part of the undergraduate research and mentoring program at UCF, and his research project investigates polyaniline and reversible photoacids. In his spare time, he mentors students and encourages them to get involved in research through the Summer Research Academy at UCF, which promotes undergraduate research. Ramirez has participated in research for almost two years and plans to attend medical school.

Nathanaelle Joacin is a senior at the University of Central Florida. She became interested in research when she attended the Summer Research Academy at UCF before her junior year. She serves on the Student Undergraduate Research Council at UCF and is part of the research and mentoring program. Her research concerns cardiovascular disease and stem cells. She is also involved in an independent project related to health issues concerning minorities in America.

Sarah Prentice is a senior at the University of Central Florida majoring in psychology and minoring in leadership studies. Her current research interests are focused on attention, cognitive psychology, and linguistic development in infants. She is completing her undergraduate honor's thesis under the supervision of Dr. Kim Renk and is also a research assistant in the Understanding of Children and Families Lab. Prentice serves as member of the university's Student Conduct Review Board and is president of the UCF Psychological Society. She plans to pursue a PhD in clinical psychology.

Christy Clarke is majoring in early childhood development at the University of Central Florida and minoring in child life studies, having always had a strong interest in working with children. She actively conducts research as a Ronald E. McNair Scholar and is on the university's Student Undergraduate Research Council. She is intrigued by research that involves mother and infant interactions, as well as early intervention methods. She is interested in pursuing a PhD in early childhood development geared toward the health development of children and adolescents. Her ultimate goal is to provide counseling to families and children.

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A Self-Conscious Tutor Transforms Into a Confident Mentor

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It was a normal night at the campus writing center. After attempting—and awkwardly failing—to make conversation with Kaylyn and Devlin, the soon-to-be tutors I was mentoring, I started helping Kaylyn with the literary journalism essay she was writing.

I felt confident tutoring Kaylyn. I had several suggestions to help her connect the different sections of her essay. While I was tutoring her, though, I was anxious about what would come next—a tutoring session with Devlin. He was naturally a better writer than me, and he had self-confidence. Would he assume all of my suggestions were worthless?

My mind was slightly eased by Devlin's interest in receiving help from me; he willingly ran from the writing center to his dorm to get his essay in time for me to read it before we closed.

While Devlin read his essay about fruit art, I gained confidence. I knew his essay could be improved. He could focus less on his research and work on integrating it more smoothly into the reflective sections. This was a technique I had trouble with when I was training to become a tutor, so I could easily find the problem and relate to it. I became impatient, rather than reluctant, for my turn to give advice.

As I showed him where he went into too much detail and failed to connect facts to his reflective points, he fought against reducing the descriptions of his research. I knew it would be a more meaningful and readable piece if he followed my suggestions, though, so I encouraged him to make the changes. I felt Devlin's respect and trust increase as we finished.

I didn't learn specific research techniques that night. But by gaining the respect of a peer, I discovered that despite my lack of natural writing talent or adequate self-assurance, I have the ability to analyze writing and improve it. Knowing I have valuable ideas gave me confidence to analyze others' writing as well as my own, improving not only my tutoring but also my ability to incorporate research into my own writing.