

Bending Twigs: The Act of Mentoring Undergraduate Student Research

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According to Blanford (2000), mentoring is a process in which tacit knowledge is transmitted from those who know to those who need to know. When mentoring undergraduate research, the primary mission is the process of training students to conduct research rather than merely answering the researchable question. In other words, the mentor may not be at all interested in adding to the literature or knowledge base of a topic, but may simply replicate studies in order to teach students the research methodology. While mentors provide supervision of a research project, and in many cases, collaboration on the project, mentors also provide a model of what it means to be a researcher. Mentors guide students, but more importantly encourage students to explore and figure out some of the process for themselves. This can include allowing students to make mistakes, which can provide a valuable lesson as well. Lanza (1988) describes mentoring undergraduate research as a “fine blend of direction and freedom”. She suggests that mistakes, while frustrating and sometimes time wasting, can be more instructive than constant supervision that doesn’t allow the student to develop problem solving and decision making skills.

Another unique perspective on mentoring is described by Koro-Ljungberg and Hayes (2006) who suggest that mentors are transformers: they facilitate the student’s transformation from novice to researcher. Mentoring is described as a process that leads to the development of the students’ research skills and, in essence, transforms their professional and academic selves.

Research on mentoring in academia has examined what characteristics make a good mentor (Appleby, 1999), the process of mentoring (Kram, 1986), the roles that mentors should play (Jpson & Paley, 2000) and different styles of mentoring (Stahlhut & Hawkes, 1990).

Important Mentor Characteristics

In a study of 212 student teachers, Stahlhut and Hawkes (1990) identified four styles of mentoring used by supervising teachers: Supporting, coaching,

delegating, and directing. The supporting style uses praise to promote cooperation, consideration and minimization of conflict. It is more relationship-oriented than task-oriented. The coaching style involves modeling and demonstrating appropriate behaviors. It includes integration, persuasiveness, and active assumption of the mentor role. The delegating style places greater responsibility on the protégé and tolerates greater ambiguity and freedom of choice. The directing style involves telling protégés what, how and when to do things. It places the emphasis on task completion and performance outcomes. Stahlhut and Hawkes (1990) found that mentors who adopted a supporting or delegating style positively influenced their protégé’s success in the classroom. The coaching style showed no significant relationship to success while the directing style had a negative influence on success as a student teacher. Flexibility in mentoring styles was found to be important allowing the style to be tailored to the needs of different protégés.

Although flexibility when tailoring styles to students’ needs is important in successful mentoring, three categories of attributes characterize a good mentor regardless of style (Appleby, 1999): interpersonal skills, personal attributes, and professional competencies. The interpersonal skills of a good mentor involve caring and encouraging, promoting and sponsoring, supporting and protecting, as well as challenging and demanding. The personal attributes of a good mentor include being mature and wise, friendly and optimistic, admired and respected, as well as trustworthy and dependable. Finally, good mentors should be professionally competent, which includes being qualified, experienced and seasoned, knowledgeable and informative, as well as professionally involved and active. Obviously mentors differ in the extent to which they exhibit these various qualities and Appleby suggests that students should conduct a critical self-appraisal to determine their specific needs (e.g., amount of direction; needed skills) and career objectives when choosing a mentor that will be most helpful to them. An initial meeting between mentor and student is a good opportunity to explore mutual interests, establish rapport, and ground rules for the

relationship, including availability, communication style, and expectations of the relationship.

Cronan-Hillix, Gensheimer, Cronan-Hillix, and Davidson (1986) conducted research on students' perceptions of what makes a person a good mentor. Students' descriptions of a good mentor were similar to those of Appleby. Students indicated that good mentors were interested and supportive, knowledgeable and competent and possessed positive personality characteristics including a sense of humor, compassion, dedication, patience, flexibility and loyalty.

A bad mentor can be as damaging as a good mentor can be helpful. A bad mentor is often someone who does not understand the need to balance criticism with reinforcement and encouragement. Bad mentors tend to misunderstand the negative impact of too critical an approach, and lack self-awareness in their relationships with others. Sometimes, a bad mentor is so focused on what they want out of the relationship (e.g., student assistance in running subjects) that they fail to provide the student with a meaningful learning experience. Interestingly, Cronan-Hillix et al. (1986) found that personality characteristics were the single most important characteristics of a bad mentor, which included being rigid, critical, egocentric, overextended, disorganized and untrustworthy. While the list of characteristics that define a good or bad mentor can be extensive, perhaps the most important individual factor that defines a good mentor is his or her commitment to the role of mentoring.

Mentoring style and mentor characteristics can contribute to the success of a mentoring relationship; however, it is the relationship itself that is most important. To develop the relationship, mentors and protégés must take the time to develop trust (Merriam, 1983). Mutual trust and respect are goals to work toward. It is important that mentors follow through on their commitments, clearly state their expectations, and set clear boundaries. It is important that students feel free to share their fears and failures as well as their joys and successes. When trust exists between the mentor and the student, the student is able to take risks they might not have taken without the trust. The mutual trust between mentor and student provides a safe space for the latter to dare to achieve what might appear difficult, impossible, or overwhelming. The trust the mentor provides is fundamental for the learning experience to occur. Many of us who mentor undergraduate students in research have experienced the feeling of believing that students are capable of more than they think they can accomplish, and being proven right when a student rises to the occasion.

What We Expect of Mentors and Students

When a faculty member makes a decision to mentor undergraduate research, there are a number of practical factors to consider. Mentoring requires a significant time commitment. The time required will be greatest at the beginning of the project and should lessen as the project continues. The mentor needs to be available to give direction and help the student choose the appropriate research methods. Merkel and Baker (2002) suggest that the most crucial point in the beginning of an undergraduate research collaboration is establishing the mentoring relationship and getting the project going. The student should then begin taking ownership of the project, at which point the mentor's time commitment may lessen. As the student begins to mature as a researcher, the mentor can let the student try out their own ideas but will be ready to step in before serious problems develop.

Another consideration is how much the mentor should be involved. Some mentors prefer to be included in all aspects of the project, which may be seen as collaboration, while other mentors prefer to adopt a teaching role, allowing the student to take the lead. The instructor may determine his or her level of involvement based on the student's prior experience with research. A student with no experience would likely benefit more from a collaborative effort where a student with some research experience may benefit from taking the lead and making more of the decisions. An instructor that sees the student becoming more comfortable and confident (and correct) in their decision-making can begin to pull back from taking the lead.

The long-term responsibilities also need to be considered. Working with a student really does not end as soon as the last analyses are done or even when the last sentence is written. After completing a project, the next logical step is to disseminate the results as an oral presentation or poster at a regional or national conference, or as a journal publication (Lanza, 1988). Sharing research with the community is the ultimate goal and students will learn that more quickly when given the opportunity to participate in these experiences. The mentor can continue to work with the student in any of these endeavors. If the student is going to give an oral presentation, the mentor can review the presentation and give feedback so that the presentation, poster, or publication may be revised as needed to provide the best possible learning experience.

Mentors are often asked for letters of recommendation because they have had the

opportunity to work closely with students and can describe aspects of their knowledge and performance that goes beyond their success in a single course. Mentors not only have the opportunity to observe students' enthusiasm for the field and their work ethic, but may have learned about a student's long-range plans. The mentor's letter of recommendation can say much more about a student's fit in a graduate program than either test scores or grades..

The Challenges of Mentoring

Selecting protégés

In a booklet published by the Council on Undergraduate Research entitled "How to Get Started in Research", Goodwin and Hoagland (1999) suggest several criteria that could be used in selecting student researchers. First, they suggest that mentors look for students who demonstrate curiosity, arguing that inquisitiveness is fundamental to being a good researcher. In addition, they suggest that mentors look for students they believe will be committed to working hard, motivated by intrinsic interest in the discipline, and able to work well with others. They also suggest that students with high grades are not necessarily the best researchers, as sometimes the best classroom students can become frustrated by the false starts and side-trips inherent to the research process.

But what if you have a student who wants a mentoring relationship but does not fit the description of the model protégé? One suggestion is to team them with students who do have the strong protégé skills. It is likely that this situation can be beneficial to both students, the more experienced student protégé who can take on the role of teacher and the novice student protégé who can learn from a student who has been in their shoes more recently.

Choosing a research topic

The type of research that one engages in with undergraduate students is not restrictive. Because the outcome of the research project does not have any consequences regarding graduation or even publication expectations, the research can be of a riskier nature. In general, the outcome of the research is not as important as learning the research process. Also, undergraduate research does not need to fit with a particular theory; it can simply be based on a question that a student wants to answer. Research with undergraduates can also be of a supplemental focus: looking at a project that has been done and replicating it with a slight variation. Undergraduate

research can also be of an exploratory nature that may become the basis of a larger study. For example, the beginnings of programmatic research may be more exploratory rather than based on theory.

Students are most likely to be excited about a research project that provides a chance to address a real and testable hypothesis of interest to the student. Students generally find laboratory exercises with predictable results to be boring. Similarly, challenging questions that do not lend themselves to a straightforward research methodology can often generate data that defies interpretation, which students also find frustrating. When undergraduate students work on "real" research projects they are more likely to get excited and involved.

Managing individual and team effort

If your student research team includes three or more members, you will need to monitor their activity to ensure that everyone contributes their fair share to the effort. Social loafing is most likely to occur when students believe that their individual contributions to the group effort will not be evaluated. To address this, mentors can assign particular tasks to individual group members, structure the project so that the individual's specific contributions can be easily identified, and provide students with a choice as to what tasks they would most like to do.

It is also important to discuss the issue of social loafing and to set clear expectations about what students are expected to do. In addition, a discussion of the time commitment expected could clarify for the students what level of effort is required of the endeavor. This discussion of expectations should also include some idea of what the indicators are that the research project is completed, for example, what is an adequate number of participants in the study. Finally, when students work together in research teams, it is helpful to have all members of the team evaluate everyone's contribution on each of the research tasks. This evaluation should recognize not everyone is expected to contribute equally in all areas, but that in total, each student will contribute their fair share.

A second issue in the area of managing individual and team efforts is how to handle those students engaged in a group project who want to go-it-alone. Often these students are high achievers who would rather do it all than be pulled down by less committed peers. To address this, one can structure the tasks so that no one person can handle all of the jobs required to successfully complete the research project. When high achievers realize that they must work with others, they often assume leadership roles within the group. This emergent student leadership

can be very useful to mentors in managing the day-to-day activities of the research team.

Providing direction

Students differ in the amount and type of direction they need and this need varies at different stages of the research process. Encourage students to take an active role in the critical feedback process. Ask them what feedback they need on particular tasks and at particular stages. It is important in working with undergraduate students to keep the research project on track. To do this, it may be helpful to hold weekly group status meetings with all of the students you are mentoring to utilize social comparison processes as well as making you aware of where additional direction is needed. Having a written research plan and schedule to check the students' progress is also helpful. Mentors and protégés should agree on how often they will meet face-to-face and when e-mail is appropriate for certain communications. It is also helpful for mentors to develop a system for remembering previous conversations with students so that the student doesn't have to provide a lengthy introduction before asking about the situation on his or her mind at the moment. Building the research group as a supportive learning community by having students help one another, engaging in social activities outside of the research lab, and being readily available to advise students when things become confusing all help to keep projects on track.

Handling disappointment

Students need to be free to make mistakes but this does not mean that they will like doing so. It is important that mentors explain that it is not a failure when data does not support the student's hypothesis and in fact, that is the point of science - to test, not confirm hypotheses. Mentors must be prepared to soften the disappointment when things do not turn out as expected. On the other hand, if part of the problem is not finding evidence in support of the hypothesis is due to a failure on the part of the student researcher, then those mistakes should be discussed so that the student is better prepared for the next research project. This process places the mentor in the role of encouraging the student to reflect upon the research experience in order to learn from the process, including the mistakes made (see Koerner, Rust & Baumgartner, 2002).

Research Ethics

Additional challenges for mentors concern the issues of research ethics, intellectual property and dual-roles. It is important for the mentor to be sure that the student is aware of research ethics and how ethical rules apply to practical research decisions. In many institutions, students as well as faculty are required to complete human subjects training. Mentors can encourage students to complete this training even if they are not required to take it. When it comes to intellectual property, mentors and their students should discuss who retains the rights to the work if it is collaborative, and why. Some of the specific questions identified by Merkel and Baker (2002) are: How will authorship of papers be handled? Who owns the research? Can a student take the data from the laboratory at the end of the summer? These are issues that can be handled in a variety of ways but it is important that they be addressed early in the relationship.

Mentors are almost always thrust into a dual role situation. A mentor may be working with a student on an independent project, but may also be the student's instructor in a class, academic advisor, or the advisor for an organization to which the student belongs. The mentor could also be a student's neighbor, landlord, or employer. To avoid potential difficulties associated with dual roles, boundaries should be established and mutually agreed to as soon as possible.

The Benefits of Mentoring

From the student's perspective, the benefits of being mentored include a sense of inclusion (Boyle & Boice, 1998), assistance in establishing career goals (Bogat & Redner, 1985), and the development of research skills, which can help the student to adapt quickly to new situations and to solve difficult problems (Gonzalez, 2001). Involvement with a mentor has also been linked to student retention, satisfaction with college, and academic achievement (Astin, 1984). Johnson and Huwe (2003) suggest that while a student can be successful without mentoring, there is clearly a strong connection to success in graduate school and beyond when mentoring has occurred. Garfield (1987) suggests that one of the primary benefits for the undergraduate involved in research is based on the close relationship that is built between a student researcher and a faculty mentor.

Lanza (1988) describes a number of benefits for the undergraduate student researcher. They include providing the students with concrete knowledge and skills, as well as an opportunity to mature

emotionally. While students will clearly learn information in a specific area, they are also likely to learn specific technical skills. In addition, they are likely to improve their general research skills to include activities such as conducting a literature review, computer use, statistical analysis, and strengthening their verbal and written communication skills. Lanza also suggests that undergraduate students who experience success in a research project will seek greater challenges in the future.

Benefits identified for the senior faculty who are involved in mentoring students in research include intellectual stimulation, improvement of their managerial skills (Reich, 1986), and an opportunity for reflection and review of their own teaching (Boyle & Boice, 1998; Nicholls, 2002). Other benefits for mentors can include gaining a sense of satisfaction through helping and passing on knowledge, values, and skills; acquiring opportunities for rejuvenation; enhancing productivity via increased research activity; opportunities for convention presentations and publications; and augmenting one's influence because the mentor is viewed as a leader (Davis, 1999).

Conclusions

While teaching in the classroom setting is enjoyable, we feel that mentoring undergraduate research has been truly rewarding. Lanza (1988) suggests that the mentor should excite and engage students by demonstrating that they are essential contributors. She also suggests that the mentor must care about student progress, communicate this attitude to each student, and be flexible enough to use different strategies with different individuals. The research mentor needs the sensitivity, patience, and ability to respond to each student individually. In the words of Merkel and Baker (2002, p. 4) "Mentors gain personal satisfaction from working with students. They often enjoy training the next generation, watching students mature intellectually, and knowing that they played an integral part in that process. Students can bring a fresh perspective to the work because they have not developed biases about what should or should not happen, and they might ask the simple questions that are often overlooked when one has been immersed in the research for a long time."

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