

## PRACTICAL TIPS FOR MANAGING CHALLENGING SCENARIOS IN UNDERGRADUATE RESEARCH

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Undergraduate research projects provide a unique experience for both a student and professor, but they can also bring about their own set of challenges. Professors eager to involve their undergraduate students in research often find themselves dealing with challenging scenarios that develop during the course of the project. As research does not occur in a typical classroom setting, the new work environment can be intimidating for students. Professors unfamiliar with this situation may struggle to find the best method of encouraging and guiding their students in the right direction. Many professors will involve as many as three or four undergraduate students in a single (or multiple-part) project and the dynamics of the group may cause a whole new set of challenges to arise. Given the growing popularity of undergraduate research and the need for effective mentoring, we hope to provide some insights for handling (and even avoiding) several challenging scenarios that can arise in directing undergraduate research projects.

The ideas contained in this article are based upon notes that were taken at the 2008 CURM workshop at Brigham Young University in Provo, Utah. The Center for Undergraduate Research in Mathematics (CURM) is the first and only (at present) national organization devoted to the advancement of undergraduate research in mathematics. The 2008 CURM workshop was run by the Director of CURM, Michael Dorff (Brigham Young University), and those attending the workshop were Bernardo Manuel Abrego (California State University, Northridge), Brad Bailey (North Georgia College and State University), Mark Budden (Armstrong Atlantic State University), Scott Chapman (Sam Houston State University), Silvia Fernandez (California State University, Northridge), Urmi Ghosh-Dastidar (New York City College of Technology), Matt Horak (University of Wisconsin-Stout), Kathryn Leonard (California State University, Channel Islands), Joan Lind (Belmont University), Brian Loft (Sam Houston State University), Andrew Long (Northern Kentucky University), Luca Petrelli (Mount St. Mary's University), David Strong (Pepperdine University), Nicoleta Tarfulea (Purdue University Calumet), and David Torain (Hampton University).

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The participants consisted of mathematics faculty from various fields of mathematics and all levels of experience in directing undergraduate research. As preparation for the undergraduate research groups that the participants would direct during the 2008-2009 academic year, a discussion session was held addressing several challenging scenarios that some of the more experienced faculty members had encountered while directing undergraduate research. The first three scenarios pertain mostly to the student-professor relationship and the last two involve group dynamics. Following each scenario, we provide a synopsis of the strategies that were discussed. We hope that sharing these ideas will make the undergraduate research experience more enjoyable and beneficial to all those involved in the process.

**Scenario 1.** *A student and professor have reviewed background material and the student has claimed to understand the material and is eager to begin some independent investigations. The following week, the student returns to report that no progress has been made, claiming “I do not know where to start.” The professor patiently re-explains the research plan and again, the student claims to understand and leaves to begin work. The next week, the student returns again without having made any progress.*

**Strategies.** One of the best ways of handling this scenario is to prevent it by not allowing students to merely claim they understand. Instead, ask probing questions about the material or even have the student explain the material back to you so that you may assess his/her true understanding of the material.

If working with groups of students, ask one student to explain a theorem or concept to other students in the group. Having them alternately present explanations can become part of the routine you develop for your group meetings.

If a student admits to not understanding, ask specific questions about what he/she does and does not understand. Your questions may assist in identifying the student’s stumbling blocks and if you begin with basic questions, you may build the student’s confidence as you proceed. It is possible that the student has not had adequate background for the problem you have posed or that the problem is simply too complicated for a student to tackle in its entirety. Simplifying the problem or focusing on a simpler problem first will be less intimidating to students who are new to research. Always be encouraging and never refer to any problem or concept as simple or easy.

**Scenario 2.** *You have an eager student who asks lots of insightful questions and gets plenty of work done. The student begins to come by your office asking questions outside of office hours. Addressing his/her questions usually takes only a few minutes, but occasionally requires longer periods of time. This escalates until the student is stopping by your office 3-4 times a day, making it difficult for you to get your own work done.*

**Strategies.** The key to dealing with this scenario is to make your students aware that although they should ask questions, it is important for them to learn to work independently and answer their own questions. Make students aware from the beginning that they must learn to work independently and build their confidence by praising their independent accomplishments. When a student stops by your office and asks “Have you got a minute?,” be honest with them and perhaps ask if they can return later in the afternoon. Often, the additional time will enable the student to answer his/her own question, serving as a confidence-booster.

If the above methods fail to work, try a direct approach. Sit with the student and explain that you need time to get other work and research done. Remind the student that the two of you have a regularly scheduled meeting time, and that you will always be there for those meetings. As part of the solution, you could schedule more frequent meetings with the student or have the student work as part of a team with another student. You could also suggest that the student use e-mail as a means of communication since then you can read the student’s questions at your convenience. Furthermore, the process of typing the questions sometimes clarifies the student’s confusion and reduces the need for frequent help.

**Scenario 3.** *After your student has successfully grasped the background material, he/she successfully begins independent research and obtains regular results. After a while, the results seem to completely stop coming, the student begins to miss regularly scheduled meetings, and you become concerned that the student may be about to drop the research project all together.*

**Strategies.** Perhaps most important is letting the student know from the beginning that occasional lulls in progress is a normal part of doing research and that there exist some common techniques for overcoming these hurdles. Since the results must be written up eventually, you may ask the student to type up all the results so far. Sometimes a short break from research can be extremely beneficial and can lead to an avenue of research that has not already been explored. If the student’s results thus far are substantial, in addition to preparing a paper summarizing the results, the student can begin preparing a presentation or a poster.

If the student becomes frustrated, be sure he/she knows this is normal and consider simplifying the problem or providing a similar, simpler problem to work on. Within reason, do what is necessary to give the student a problem he/she can solve during the allotted time. No matter what, try to find a way to turn this into a positive experience for the student and draw attention to his/her accomplishments.

**Scenario 4.** *In a group with three students, call them X, Y, and Z, student X approaches the faculty advisor and indicates that he/she would like Z to be removed from the group because he/she “can’t stand that person.” A brief*

*investigation determines that no improprieties have been committed and that Z is doing his/her share of the work; there is simply a clash of personalities.*

**Strategies.** One idea is to attempt to prevent this type of problem by letting the students choose their own groups. If you want to place the students into groups yourself, perhaps based on ability or similar interests, you should consider personalities as well. If this scenario has occurred despite your efforts to prevent it, remind the student that team work is an essential element in the workplace and the student needs to learn how to succeed in group work.

If student X adamantly insists that working with student Z is intolerable, discreetly find out if the other group member, student Y, feels the same way about Z. If so, try to work with Z to resolve the issue or consider splitting the project into two pieces, giving one piece to Z and the other to X and Y. This solution depends upon the independent research abilities of student Z. If student Y doesn't feel the same as X, or in your assessment, student Z is not really the problem, offer student X the opportunity to work on a separate project, alone. Try to give the student the impression that it would behoove him/her to stay with the group. In the end, you may be able to have the group compile their separate results into one cohesive project.

**Scenario 5.** *In a group of 2 or 3 students, one particular student acts arrogantly and tries to seize control of communication with the professor, treating other students as if they are inferior.*

**Strategies.** Ideally, you will be familiar with the students in your group prior to beginning the project and may consider splitting the project so that a superior student has a separate, more challenging problem to work on. If the student is merely arrogant, be parsimonious with your praise of the arrogant student, while continuing to encourage and praise the other students. Praising the other students may give them the confidence to point out their strengths to the arrogant student. Carefully point out that everyone has something to learn. However, be careful not to humiliate or embarrass an arrogant student as this may lead to insecurities.

Finally, we want our students to be eager and confident but not arrogant. Therefore, set a good example: be enthusiastic, show confidence with humility, and be encouraging of all members in the group. Your students will likely follow your example and be less likely to develop inflated egos.

#### CONCLUDING REMARKS

As more institutions are encouraging their faculty to involve undergraduates in research, numerous opportunities are becoming available to professors and students involved in such collaboration. Availability of resources has increased the number of professors involving their students in research. However, challenging situations can arise and therefore, all of the scenarios discussed above involve a level of prevention in their strategies. We hope

that professors will consider preventative measures prior to directing undergraduate research and handle the scenario (if applicable) with the students' best interests in mind. It is important to keep in mind that praise can go a long way and the students should be proud to have the opportunity to work on a research project.

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