

Preparing Students for STEM Research at the Lyman Briggs College

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ABSTRACT

Fifteen students were participants in a scholarship program which actively engaged them in the exploration of a range of science careers (from their 2nd through 4th year). Through interviews and reflective essays, we found that they did not initially understand 1) the expectations of a research based science career, 2) how to advance on a path necessary to reach a career, and 3) the breadth of potential science careers. These deficiencies suggest steps for overcoming these common problems and in the process increasing the retention of students in science fields.

Keywords: STEM, Conference Proceedings, Higher Education, Student Support

THE STUDY AND METHODS

To more fully understand the experiences of potential future scientists, we studied a cohort of fifteen students throughout their career in a science residential college at a large research university. These students were participants in a three-year scholarship program which actively engaged them in the exploration of a range of science careers (from their 2nd through 4th year) funded by the National Science Foundation (*American Competitiveness and Workforce Improvement Act of 1998*). Additional to their science curriculum, the students interacted with many science practitioners through site visits, interviews, seminars, and discussions. The students shared their experiences through short reflective papers (Caracelli & Green, 1993) and semi-structured oral interviews (Rubin & Rubin, 2005) stratified throughout their three years.

DISCUSSION OF KEY FINDINGS

In a country where approximately 50% of those students who enter college seeking a degree in science, technology, engineering, and mathematics (STEM) will leave the field of science (PCAST, 2012), retention of future scientists within the field is a critical issue (AAU, 2011). Our study helps identify the key experiences that helped retain these students in the sciences and suggests keystone experiences that could be added to other science programs. In particular, the students initially demonstrated a very limited understanding of science careers. We found that they did not understand 1) the expectations of a research based science career, 2) the path necessary to reach a career, and 3) the breadth of science careers. Over the three years the students reconsidered many of their assumptions about careers in the sciences and typically gained confidence in themselves and their own career decisions.

The demands of pursuing a research-oriented career were generally misunderstood by the students. Within the first year of the program, one third of the students indicated that they were reconsidering pursuing a research-oriented career, a path they had previously dismissed (Sweeder & Strong, 2012). This highlighted the disconnection that frequently exists between the student perception of research in science (as viewed through typical science classes) and actual workplace practices; the students mostly believed that research entailed isolated and solitary work in a sterile laboratory. Through visitations to authentic labs and discussions with researchers they began to perceive science as a highly socialized and collaborative endeavor in a wide variety of laboratory environments.

The students typically could not picture a clear path to achieve a science career and the steps to achieve it. Through interactions with faculty and other scientists, students began to see practicing scientists as actual people who are simply farther along a similar journey in the sciences. Simultaneously, peer interaction provided another core aspect to progressing down a path. Initially, the students hesitantly interacted with each other, though they quickly began to recognize that many of the other students in the cohort were struggling with the same challenges, just in a different academic discipline. As the students progressed together through college their collegial relationships within the

cohort grew and they challenged each other to move further down the path. The students frequently cited “not wanting to let down their cohort members” as a reason for their own motivation. One scholar even indicated that her fellow cohort members provided a familial level of support when her parents, who are non-scientists, simply could not understand the high level of demand required by her studies. These experiences with practicing scientists and colleagues led to an increase in confidence in both themselves as scholars and scientists and increased their motivation to pursue a science career (Sweeder, et al., 2012). They also highlighted the important role of engaged faculty and peers in helping shape their futures.

The last weakness was knowledge about the breadth of career options available in sciences. Early in the program, it was clear that the students had limited visions of what a science career could entail. These typically consisted of doctor, teacher, or lab scientist (chemist, physicist, biologist, etc.). Yet even within these few fields, it was evident that these students frequently had a relatively weak understanding of what these careers entailed. Of course there is little reason to expect students to intimately know these professions. Through trips to museums, industrial labs, and academic labs, along with meetings with professionals and alumni, the students were able to better understand the huge range of career possibilities and find a field that aligned with their personal interests.

BROADER IMPLICATIONS

These deficiencies suggest steps for overcoming these common problems and in the process increasing the retention of students in science fields. The experiences of the students in this program consistently highlighted the need to humanize the sciences and scientists. As science educators we espouse our ‘ways of knowing’ through our classrooms and instructional laboratories, but it is quite likely that as scientists we often forget to share one of the most important... ourselves (Coppola, 2001) to model and reflect our chosen careers. By encouraging, nay, *forcing* these students to extend beyond their comfort zones and actually have them engage in discussions with science professionals, the students were able to humanize these scientists. This experience afforded the students the ability to begin to see reflections of themselves in these successful scientists. The students discovered that frequently the path from undergraduate student to successful STEM professional was not always linear, direct, or clear. The students remarked positively to hearing that these successful individuals they interacted with may also have been very unsure about what to pursue as a major as an undergraduate – often changing majors and careers along their journeys. Similarly, the students were frequently struck by the relatively common experience of many individuals jumping from one field or career to another in their 30’s, 40’s or even 50’s. Simply discovering that the choice of an academic major is not a linear determinant of the entirety of one’s life path was a significant revelation for many of these students.

Our work with these students has highlighted some of the key experiences that students need to encounter to be able to fully make an informed decision about their own career. Since potential STEM students frequently leave the field during the 1st and 2nd year of college (Seymour & Hewitt, 1997), it is imperative that higher education work hard to help students better understand the fields that they are considering, as this is when students are making key decisions about their collegiate career (Astin, 1993). This should involve bringing discussions of potential science careers into introductory classrooms. Additionally, faculty can share their own experiences (or those of former students) as a means for helping current students better understand not only the steps to move forward, but also the range of possible career directions to move. For this group of fifteen students, fourteen will graduate within four years and are planning on continuing to pursue a science career. The final scholar will graduate after a fifth year before embarking on her science career. Yet even these students highlighted the importance of engaging them early, with multiple scholars stating that they believed they would have left science without this program. Thus, we cannot wait until students begin work in labs or engage with faculty in smaller seminar settings to develop a deeper understanding of what it means to be a scientist. As Seymour and Hewitt (1997) have shown, by that time we already have lost many potential scientists due to misunderstandings.

ACKNOWLEDGMENTS

The authors would like to thank the Lyman Briggs S-STEM scholars for making this research possible. This material is based in part upon work supported by the National Science Foundation under Grant Nos. DUE-1022754 and DUE-0849911

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