

Involving Freshmen in Undergraduate Research

Emily Balcetis

Ohio University

The 1980's ushered in a paradigm shift, altering our perception of what factors constitute excellence in post-secondary education (Kojatic & Kuh, 2001). Previously, many academics thought that the quality of education provided by an institution of higher learning was inextricably linked to institutional resources and reputation. However, the *Involvement in Learning Study* (The Study Group on the Conditions of Excellence in Higher Education, 1984) challenged this view by suggesting that the quality of education is directly linked to good educational practices that stimulate student engagement (Astin, 1993; Kuh, Pace & Vesper, 1997; Pascarella et al., 2006). Student engagement enhances the development of critical thinking skills (Pascarella, Palmer, Moye, & Pierson, 2001), as well as openness to diversity and challenge (Pascarella et al., 2006).

A number of practices in undergraduate education can promote student engagement, and include student-faculty contact (Anaya, 1999; Avalos, 1996), cooperation among students (Cabrera, et al., 2002), active learning (Kuh et al., 1997), prompt faculty feedback to students (Feldman, 1997), and exerted academic effort (Astin, 1993; Hagedorn, Siadat, Nora, & Pascarella, 1997). One way to integrate these practices is to involve undergraduate students in research. At many schools, this is accomplished through courses in research methods (Grover & Weaver, this book), advanced lab courses (Wozniak, this book), independent study (Burns, this book), and capstone experiences (Schwartz, this book). All of these experiences are primarily available to upper-division students. In this chapter, we will explore the possibility of providing these same experiences much sooner in the undergraduate student's program of study.

Recent inquiries have demonstrated that the first year of university or college maintains a critical influence over long-term student retention (Blythman & Orr, 2003; Trotter & Roberts, 2006). Given the importance of the first-year experience in retaining students throughout a post-high school education in its entirety, our goal is to explore one factor that can improve the first-year experience. In particular, we will discuss how small group research can serve this goal. Instructors concur that small group learning

Richard L. Miller

University of Nebraska at Kearney

contributes to retention (Taylor & Bedford, 2004) because the quality and intensity of student engagement with such university experiences improve student outcomes (National Survey of Student Engagement, 2001). In particular, Demoret and Miller (2007) have shown that involvement in undergraduate research is significantly more engaging than attending ordinary lecture and/or discussion classes. Throughout this paper, we will discuss how small group learning can be implemented in research labs and the specific benefits of small group research that contribute to engagement. In addition, we will discuss the problems that arise during small group research and provide suggestions for how to avoid these common pitfalls.

Designing a Research Program for Freshmen

Ten years ago Emily Balcetis was a freshman honors student enrolled in introductory psychology, and I (Rick Miller) taught a social psychology course for juniors and seniors that included a lab component (see Wozniak, this book). It occurred to me that it might be fun to invite the honors students to join the seniors in my lab. Emily was the only student to avail herself of my offer and she and a senior conducted a study on cognitive wayfinding that was published in the *Psi Chi Journal of Undergraduate Research* (Balcetis & Linder, 1998). Based on this positive experience, I repeated my offer most recently by inviting all of the students in an honors section of introductory psychology that I taught to conduct research. In this experience, I invited senior psychology majors to pair with my honors students, who were mostly non-majors, in conducting an independent research project, chosen by the students. All of those eight projects were presented at a regional conference and one has been published in a student journal. Currently at UNK, we have a formal program, the Freshman Apprenticeship Program that seeks to involve first-term freshmen in collaborative research projects with faculty. Our program is similar to a number of other programs at colleges and universities around the country that seek to promote

student engagement through collaborative undergraduate research. In recruiting freshmen into such programs, many schools target particular types of students, including those admitted into honors programs, those who are at risk, those who are from underrepresented groups, or those with clearly defined career goals.

The University of Wisconsin-Eau Claire's Blugold Fellowship program (see Lind, this book) provides twenty incoming freshmen with the opportunity to work about five hours a week as assistants to faculty engaged in ongoing research. Students receive a \$1000 scholarship and a \$1200 stipend, which is renewable in their sophomore year. Interestingly, the funds for this program are provided out of student fees voted upon by the students.

The University of Missouri's EXPRESS Program (Exposure to Research for Science Students) is specially designed for freshmen who are from ethnic groups underrepresented in the sciences. This program provides an hourly wage for students who work 8-12 hours a week in collaboration with a faculty mentor. The program also provides a variety of supplemental activities, including weekly workshops on such topics as: how to study, preparing for graduate school, and career options in the sciences. Students who are eligible for work-study funds can apply that eligibility to the EXPRESS program.

Utah State University (see Kinkead, this book) has a "Research Fellows" program that provides a \$1000 stipend for students selected to work on a research project with a faculty mentor. This program is for highly focused students who come to school with a clear sense of what they want to accomplish. Selection is based on an essay and educational and career goals and an interview with the Council of Associate Deans who match the students with active researchers. Several schools have implemented summer research programs for freshmen. The Honors College at Virginia Commonwealth University has two programs. The first is a research institute that introduces new students to research concepts and methods from a multidisciplinary perspective. The objective of this program is to foster an academic culture where students actively develop skills and learn the value of conducting research early in their college careers. The second is a program that provides the opportunity to work collaboratively with faculty on a research project. In addition, seminars are conducted that teach computer technology skills, research and writing skills, and strategies for academic and career success.

Similarly, the College of Natural and Agricultural Sciences at the University of California-Riverside has a program called CNAS Scholars

Summer Research Internship. In this program freshmen participate in an 8-week paid summer research internship. This program is considered a full time, 40-hours/week job, although the exact schedule is left to the faculty mentor to work out. The program also has a weekly luncheon with the College Dean where the students discuss their research with other students who are also working in the program. A report of the results of the research is required at the end of the summer, and students typically present their research at a conference.

The Research Apprenticeship Program at the University of Nebraska at Kearney provides opportunities and funding for incoming freshmen and their faculty mentors to engage in a wide-range of research activities. Selection for participation is based, in part, on an essay that answers such questions: What would you choose to do if you have earned your university degree and have the opportunity to design and market a new product, solve a great mystery of the universe, or find a solution to a significant social challenge, and describe why? Often, the freshmen chosen for this program join a research team that includes upper-division students, which provides additional learning experiences and peer mentoring for the freshman. Each of these programs employs features that you may find valuable in setting up a similar opportunity at your college or university.

Benefits of Small Group Research for Freshmen Students

Freshmen students can benefit from such research experiences in several ways: gaining in-depth knowledge in their chosen field early in their academic career, building strong connections to faculty, becoming better prepared for graduate school, gaining confidence and experience, improving their writing and presentation skills, creating a sense of professional identity, as well as engaging in activities that are intellectually stimulating.

Educational Gains

One of the most obvious benefits is the educational gain that working in a research lab provides for the Freshmen, especially when paired with more advanced students. For example, group learning enhances reasoning and higher order thinking (Blumenfeld, Marx, Soloway, & Krajak, 1996). Given the personal responsibility that must be assumed by members of a research collaborative, group work promotes deeper cognitive processing

through rehearsing, organizing, and integrating information. When students connect and integrate ideas, elaboration is needed (Blumenfeld, et al., 1996). Within the group setting, students are required to articulate to others what they know and have learned. Advanced students can model this behavior for the Freshman who in turn can demonstrate their developing skills. In addition, students learn to address probing questions and to withstand challenges to their thought process, which are sometimes more easily coped with when the challenges are from other students, rather than the professor. Successfully participating in this type of interaction strengthens and verifies students' personal knowledge.

Social and Personal Development

In addition to the educational gains of small group research, students also experience personal growth. Small group research fosters a sense of identity and belonging (Jacques, 2000), which is an important factor in student retention (Gardner & Jewler, 1992). This sense of belonging is particularly important for first year students who are experiencing several changes in their lives. From our experience using small group research, we have found that such opportunities allow students to develop interpersonal skills through collaborative problem solving, in addition to presentational and communication skills. These broad skills that cannot be developed in isolation but that require feedback and interaction with others are ones that are beneficial outside of the particular research project in which the student is engaged.

Finally, small group research confers benefits to social development (see Blumenfeld et al., 1996). In particular, students are required to develop and use perspective-taking strategies in order to develop a project that reflects the combined interests and efforts of all group members. In doing so, students learn how to accommodate others' ideas, how to adapt the divergent perspectives of each group member in order to produce a cohesive project. Beyond this benefit, students learn acceptance of others. Students develop tolerance for divergent opinions and diverse styles of working, skills that will be beneficial during the remainder of their college experience and beyond.

How to Optimize the Benefits

Suggestions for group formation

Our primary suggestion for instructors interested in implementing small group research that involves

freshmen is to use a *peer-scaffolding* approach. Within this paradigm, novice students are paired with relatively more expert partners to accomplish a single goal such as developing and conducting an experiment. Pairing students with different levels of experience is beneficial for both partners. Novice researchers develop beneficial learning styles within the project, which are likely to persist after the project ends (Lai & Law, 2006). Second, we suggest instructors assist students in determining or assuming a specific role in the group. Assisting group members' decisions regarding roles will reduce the possibility that a sense of personal responsibility will be diffused. In addition, roles increase perceived group efficiency (Strijbos, Martens, Jochems, & Broers, 2007) thereby making satisfaction with the group experience more likely.

Third, we suggest that group membership be diverse rather than homogeneous. Consider having students work with others who they do not know and avoid forming partnerships with close friends, romantic partners, or selecting a group based solely on gender. The benefits of diverse group membership are clear. Increasing diversity in the group can lead to more effective groups when measuring final project grades and group cohesion (Lee & Farh, 2004).

Suggestions for project creation

We suggest structuring the research project in a way that maximizes students' sense of independence. As an instructor, it is important to keep the research questions that students explore open-ended so that they might independently develop the specific empirical hypothesis. The answers to the research question need to be unknown. In other words, the strategies, paradigms, and approaches that will be used to answer the empirical question will be determined as a part of the research process. Allowing students to freely develop their interest and their approach will improve group and personal satisfaction with the research experience

Problems that Arise in Small Group Research

Simply placing students into groups does not guarantee quality collaboration (Soller, 2001). In fact, the problems that arise during group work often leave instructors wary about implementing group work in the future and students nervous and uncomfortable about participating in such a project. In one case, when given the choice, 79% of students wanted to participate in a group "real world" marketing research project rather than complete a similar one alone

(Ryan & Ogilvie, 2005). Unfortunately, only 52% maintained this preference by the end of the semester-long experience. Interestingly this preference shift is in large part attributed to logistical problems in working with others. Given the appealing nature of group work for both instructors and students (at least initially), we will discuss common problems in the freshmen/senior collaboration and offer some specific strategies that might be employed to address problems.

Social loafing

Although a potentially profitable experience, the benefits of group work decrease when the distribution of work within groups is unfair (Karau & Williams, 2001; Liden, Wayne, Jaworski, & Bennett, 2004). Social loafing, or the tendency for members to offer less effort when working with others, predictably occurs under the following circumstances. Loafing increases as group size increases (Latané, 1981) and when the potential for personal evaluation is reduced (Kerr & Bruun, 1993; Williams, Harkins & Latané, 1981). In addition, it is tempting for Freshmen to defer to more advanced level students.

In order to decrease the likelihood that social loafing will occur in group research, we suggest limiting the number of people involved in a single project. In addition, we suggest increasing the sense of personal accountability to reduce the likelihood of social loafing (Slavin, 1990). We suggest having members present different aspects of the project to the larger class each time the class meets. Importantly, group members should vary what aspects they are responsible for presenting from week to week. Giving the Freshman students reasonably challenging tasks that can be accomplished within their level of skill is a good way to ensure full participation. Also, allowing group members to evaluate each other's contributions promotes a sense of fair play within the group. Finally, instructors might consider having an end of term presentation that is co-delivered by all group members.

Poor time management

Certainly, it is well recognized that individuals are unrealistically optimistic when predicting how quickly they will meet a deadline or accomplish a task. For Freshmen, coming straight from the high school experience, the more stringent time lines required in college can be unexpected. Unfortunately, the unjustly optimistic timeline developed for one's own goals extends to predictions that groups make about their timelines as well (Buehler, Messervey, &

Griffin, 2005). In fact, the inability to meet deadlines is more pronounced after group discussion of timelines than after individual consideration. These mis-estimations occur in group discussions because members tend to focus on factors promoting successful task completion and do not spend enough time considering the potential problems, which leads to an overly optimistic outlook. The end product is that group work may in fact be procrastinated to a greater degree than had the project been completed by an individual.

To reduce the likelihood that time management issues arise, we highlight the importance of providing structure as efficient interaction does not just happen, but rather must be intentionally designed (Soller, 2001). To avoid the potentially harmful planning fallacy, we suggest having groups not only plan for success but also establish contingency plans in case short-term deadlines are not met. Groups might brainstorm a timeline for successful completion, but also predict the pitfalls along the way.

Negative Social Outcomes

Although small group research can confer social and developmental benefits, pairing novice and relatively expert researchers might create negative social outcomes. For instance, novice students might be socially stigmatized (Blumenfeld et al., 1996). When novice and more senior students are matched, status differences can be exacerbated (Blumenfeld et al.). Novice students may be more timid in the presence of an older, more experienced student and feel inhibited about voicing their opinions (Crozier, 2004). Their lack of participation then may be an additional source of stigmatization or frustration to other members of the group.

We suggest offering a variety of venues for discussion outside of the classroom to reduce the inhibition that often prevents shy students from contributing. We have used internet blogs as a way to foster contributions from students sensitive to power differentials. This forum encourages continued debate between group members and between research teams. Students develop writing and critical thinking skills while providing an increased sense of anonymity and decreased feelings of anxiety given the lack of urgency or time constraint for offering a contribution. Additionally, students receive feedback from multiple sources while feeling a part of a larger scientific and intellectual community from the safety of their own home. Increasing variety in presentational outlets provides students with different avenues by which they might develop the communication skills and the personal knowledge

that they need in order to feel comfortable as a full group member.

Questions to Ask When Creating a Program

In creating a freshmen research experience, there are a number of options and several questions that should be addressed. First, which students are to be provided with the opportunity: honors students, students at risk, or anyone showing an early interest in research? Second, what form should the program take: Spring semester, when the students have adjusted to the campus environment, full academic year beginning in the Fall, or summer only? Third, what funding sources are available to support the program: grant overhead, student fees, re-allocated internal funds, external grants? Fourth, in addition to collaborative research, what other activities do you want to provide to the freshmen: seminars, workshops, regular team meetings, and opportunities to meet with administrators? Fifth, how will you disseminate and showcase the students' accomplishments: conference presentations, student research journal, on-campus student research day, and posters on the hill? Sixth, what incentives are available to faculty to encourage their participation in the program: stipends, course release, credit towards promotion and tenure? Seventh, how will you assess the value and success of the program, and what measures are likely to show differences between those who are enrolled in the program and those who are not: student engagement, retention, achievement, aspirations? Finally, what opportunities exist on your campus and community that lend themselves to research activities conducted by freshmen? Many of these issues have been addressed elsewhere in this book, and we encourage you to read about how others have answered these questions.

Summary

The first year experience for undergraduate students serves as a foundation for the years of university education that will follow. In this chapter, we presented a strategy for improving that first year experience—engaging the students in conducting empirical research. We discussed a number of roles students can assume and approaches faculty can take to improve the quality of the first year experience by involvement in research. Although the approaches are plentiful, it is important to create ways of integrating freshmen into the research enterprise that takes advantage of the students' and the other group members' strengths while minimizing costs. In this

chapter, we described the educational, social, and developmental gains that can be bestowed upon both novice and more seasoned undergraduates when freshmen are involved in research. In addition, we suggested some strategies to assist in optimizing these benefits including attention to the process of research group formation, and project selection. In doing so, we additionally highlighted some potential problems one may encounter when novice students become involved in research including social loafing, time management concerns, and social costs. With attention to and consideration of these issues, we believe that a program committed to undergraduate research can create a positive environment that benefits both students and faculty.

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