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**Developing Cross Disciplinary Skills Through an Undergraduate  
Research Project**

**Joey E. Mehlhorn, Jason Roberts, Amanda Cain, and Scott Parrott**  
**Agriculture, Geosciences, and Natural Resources**  
**University of Tennessee at Martin**

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## **Developing Cross Disciplinary Skills Through an Undergraduate Research Project**

### **Abstract**

Undergraduate students can benefit from a research experience with a faculty mentor. Students perceived the research project and faculty mentorship as more beneficial than directed coursework. Mentoring is key to enhancing undergraduate research experiences, but the impact on time should be considered. Linkages between coursework and application should also be considered.

### **Problem Statement**

The benefit of developing research skills among undergraduate students has been well documented (Kinkel and Henke, 2006; Hammond, et.al. 2003; Woirhaye and Menkhaus, 1996; Blank, 1982). The main focus has been on the relationship between undergraduate research participation and the likelihood of attending a graduate program. The majority of studies have dealt with undergraduate students conducting research projects within their narrow academic discipline. One factor that has become increasingly important for career development is the ability for students to see problems from a broad point of view. Employers are looking for graduates that possess good communication and team skills and the ability to solve problems (Reaves, et. al., 2010). The use of undergraduate research projects can be used to develop these skills. This is especially important when trying to educate science-oriented students on the importance of economic decision-making. Many times, the economic rationale for a decision is a secondary consideration for students who do not view problems on a basis of profits and losses, as is the case in industry. The use of undergraduate research projects does require a learning curve for students and faculty alike. Many times, the only mentoring experience that a faculty member has is their personal experience from their graduate program through the thesis and dissertation process. This can be compounded if the graduate mentor was not involved in undergraduate teaching. Faculty that do not have access to or memory of how a “typical” undergraduate student

processes information and their work ethic can have a difficult time relating to undergraduates. This of course is not always the case, as many professors can recall influential mentors from their past experiences. Nonetheless, the methods used in mentoring a graduate student could certainly vary from that of an undergraduate student. Mentoring a student project can take a considerable amount of a faculty member's time. This can be especially taxing for faculty with high student contact hours through teaching and advising. As a result, it is important to develop an efficient method for mentoring undergraduate students through this process that is beneficial to both student and faculty (Harvey and Thompson, 2009).

It is important for students to take an active role in the education process. The use of undergraduate research programs to teach communication, critical thinking and problem solving skills is consistent with a student centered active learning environment (Thomas and Gillespie, 2008). In an attempt to better prepare undergraduates for the professional work environment the authors have attempted to develop a multi-disciplinary team approach to improving student problem solving skills through a mentorship based undergraduate research program. The approach seeks to connect students to a faculty mentor within the student's major discipline and a faculty member outside of the discipline. This cross-disciplinary mentorship has several advantages including broadening student perspectives, increasing a teamwork environment, and increasing faculty-to-faculty interaction. Faculty members like the students they teach can sometimes be guilty of not working well in teams. Any initiative that increases the collegiality among faculty members is welcome.

## **Issues with Faculty Mentoring**

Merriam- Webster's Dictionary defines a mentor as "a trusted counselor or guide" (Merriam-Webster's Online Dictionary). The idea of mentoring students is a daunting task for a faculty member to undertake. It becomes even more daunting as faculty members are being asked to essentially do more with less time. In today's university culture it is common for increased demands to be placed on faculty member's time. This can come in many forms such as increased teaching, increased class size, more research and outreach. As universities and state legislatures are looking more and more to results driven funding, faculty members must make a decision regarding their opportunity cost of mentoring students. Mentoring in the field of higher education has many definitions from the literature. Jacobi, 1991 provides an extensive review of the mentoring literature. The definition of mentoring that fits well into the idea of undergraduate research and advisement is given below.

"Ideally, a professor takes an undergraduate or graduate student under his or her wing, helps the student set goals and develop skills, and facilitates the student's successful entry into academic and professional circles" (Moses, 1989).

This definition fits into the framework of what many faculty do when they mentor an undergraduate research project. It is as much about developing skills as it is about developing a relationship between the mentor and student. The relational aspects between faculty and student can help students see the importance of the subject matter. It allows the knowledge to cease to be something taught for an exam to something useful in the student's eyes. Most faculty would agree that their passion for their discipline was impacted by a mentor or previous teacher, not from reading a textbook or journal article. The human factor of the mentor relationship cannot be overstressed in the success of developing a successful undergraduate research program.

Mentoring can have a positive impact on both students and faculty members. The literature contains many positive impacts for students who participated in mentoring programs as students (Jacobi, 1991; Cox & Andriot, 2009; Crawford, et.al., 1996). The role of the faculty member in the mentor process is critical to the experience for the student. Faculty benefits for participating in an undergraduate research project can vary depending on the university structure. For example, some universities may encourage faculty members to participate in undergraduate activities. However, if the primary focus for tenure and promotion decisions is based on research output the decision to participate may stem from self-motivation. The amount of time needed to mentor a student can discourage faculty from participating, but the time factor alone is not the only possible reason given.

### **The Importance of Undergraduate Research**

The inclusion of undergraduate students in research projects is not a new concept in higher education (Craney, et.al., 2011). Undergraduate research can combine teaching and scholarship. Projects in multi-disciplinary departments can be very diverse as you bring together faculty from various disciplines. As a result, projects can combine tools and methodology from a variety of areas such as animal science, economics, and plant sciences. Research has also shown that participation in undergraduate research projects can increase student retention rates (Thomas and Gillespie, 2008). This is of particular importance as many states are using retention of students as the metric for funding.

Undergraduate research projects can also help students connect with a career path. This many times can be influenced by the faculty member's interaction with the student. The faculty to student relationship has been shown to impact the student

perception in a positive way (Lopatto, 2010). Undergraduate students many times do not fully understand their career paths until they have experienced a variety of courses in college. They especially do not understand the requirements of continued graduate education in their field. Many times students feel that research is only for students planning to pursue graduate work. The benefits to students from the scientific discovery process are not limited to graduate school bound students (Evans, 2010). Benefits of research projects include increased content knowledge, professional understanding of concepts, self-reliance, communication, teamwork and critical thinking skills (Curtis and Mahon, 2010; Lopatto, 2010).

### **The AGN Fellows Research Program**

An undergraduate research program (AGN Fellows Research Program) was started in 2010 at the University of Tennessee at Martin. The program was designed to help undergraduate students enrolled in agriculture, geosciences, and natural resources to gain skills in the area of research. Scholars are connected with a faculty member to conduct research after they have completed the fellow's research classes. This is by design to give students a foundation to conduct research. The fellow's coursework is in addition to the student's required courses for their selected major. In other words, a student will take additional discipline specific and statistics courses to add depth to their knowledge for research. The program was designed after the University Scholars program that currently exists on campus. The program was selective in nature and available to students who had completed 28 hours of coursework and maintained a GPA of 3.00. Students who applied must submit three letters of support from an agriculture, geoscience, and natural resources management faculty member. Once selected, scholars must maintain a GPA of 3.00 and remain in good standing with the university to

continue in the program. Since the inception of the AGN Fellows program, the response from students has been positive. The largest student group participating is from the animal science undergraduates. Currently, half of all AGN Fellows scholars are majoring in animal sciences or veterinary sciences. The completion requirements are given in table 1 below.

<b>Course</b>	<b>Outcomes</b>
FRP 201 Research Seminar (1 hour)	Introduction to scientific method The land grant system Verbal persuasive presentations Debate skills Professional etiquette
FRP 202 Research Seminar (2 hour)	Ethics Asking questions and formulating hypothesis Data analysis techniques Exhaustive literature review Writing scientific papers
FRP 301 Fellows Research Methods (3 hours)	Develop methods to collect data Using statistics effectively Communicating results through written, oral and poster formats Sharpen critical thinking skills
6 Hour research topics	Direct mentorship of a project with a faculty member from a discipline specific field. (Agricultural economics, animal science, plant science, etc.)

Table 1: Course Description of Fellows Research Program

### **Data and Methods**

The University of Tennessee at Martin initiated a Fellows Research Program in the fall semester of 2010 to expand and diversify student academic performance. The program focuses on directed coursework, faculty mentor relationships, and a research project. Students were selected based on a selection criteria associated with grades, faculty nomination letters, and a student application. Students must have completed less than 30 hours of coursework to ensure that students had enough academic time left to complete the program. The program was based on a three-year commitment between the student and the faculty mentors. Eight students were selected to participate in the

inaugural class. The primary focus of this project is to look at the impact of an undergraduate animal science student who chose to look at economic aspects of a stocker cattle research project. The primary source for data was solicited through a qualitative interview with the participating student. The interview focused on open-ended questions seeking to determine the impact of the project on the students' understanding of economics and the role economics plays in the animal industry. The interview was conducted during the final stage of the student's research project, prior to the required student presentation of results. The interview focused on values and opinions of the participating student to determine the student experience gained from the undergraduate research project.

The students' faculty mentors included an agricultural economics professor and a veterinary medicine faculty member. The student had previously only taken one introductory course in business so this posed a unique challenge or opportunity in the development phase of the research project. Since the program seeks to foster active student learning the project development phase was an excellent opportunity for faculty and students to learn from one another. Faculty and student feedback was solicited to help improve future research projects in the program. Responses from faculty were solicited with respect to time commitment, perceived effectiveness, motivation issues and expected outcomes. A fifteen-question survey was administered to faculty in the agriculture, geosciences, and natural resources department. All survey responses were aggregated together for analysis.

### **Results and Implications**

Data indicates the program was received in a positive way from the perspective of both the student and the faculty involved. The qualitative student survey questions

are given below in table 2. The interview questions were given to guide the discussion, follow up question were given to the student to clarify responses and dig deeper into the student perceptions of the experience.

What is your major? Why did you select your major? What is your career objective? Why did you choose to enroll into a university honors program? How did you select your professor/mentor for your scholars project? Approximately how much time (in hours) have you devoted to your scholars project? Do you feel that the scholars project will benefit your career goals? From your scholars project experience, have you gained a better understanding of how business decisions impact the cattle industry? How can this information help you in your career goals? Did the scholar's project enhance your classroom experience? What has been the best part of your scholar's research experience? What has been the worst part of your scholar's experience? What is the greatest benefit to you from enrolling in the scholars program?
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Table 2: Probing Questions for Student Interview

### **Student Perceptions**

The student was interviewed at the completion of the written project for the scholars project. The questions are given in Table 2 above. The student felt that the opportunity to conduct research would be beneficial to her as she applied for veterinary school. Before starting the research project the student had already decided to pursue a veterinary medicine degree with the option of possibly earning a Ph.D. as well. The research program was beneficial to the student in preparation for a research-based program. The student stated that the project introduced her to the research process and helped clearly define her career goals. This is to be expected since students will likely be either excited about research or not interested after an experience. The component of learning cross-disciplinary skills through the project was of interest to the authors. When asked about developing business skills as a result of the project the student

confirmed the initial thoughts by the authors. The students stated that the project helped her to think critically about why and how decisions are made regarding costs and returns. The issue of risk management also was common in the student response. The linkages between risk management and the financial returns to producers became apparent during the course of the project. The student also noted that the project helped her to better integrate different areas of study in order to analyze the topics that she was presented in the classroom. Undergraduate research projects can be useful in helping students assess problems from a critical point of view. Research leads students to ask the question of why something works. This discovery to learn why will be beneficial in all areas of study for the student. The student also indicated that the individual relationship developed between faculty and student through the mentorship process was helpful. Many times students learn more from being around and interacting with faculty one on one than they do in a classroom setting. These personal relationships can help shape the student's career goals as they learn more about the faculty member's field of study.

The importance of teaching students to see problems from many points of view is critical to the success of students. In most university settings students are focused on a single curriculum and can many times develop tunnel vision about how the discipline fits into the overall system. Involving students in multidisciplinary projects can allow them to see the problems from multiple points of interest. This is certainly common in the real world where producers must be adept at all aspects of the business. For example, a cattle producer is most likely responsible for developing herd health plans, understanding shelter and pasture management, and also responsible for marketing the livestock to make a profit. Most producers do not have the luxury of choosing to only

focus on one task. These projects can help students become better team players when working with a group.

### Faculty Perceptions

Faculty were surveyed regarding their perceptions of the mentoring undergraduate student research projects. Fifteen questions were asked and 11 faculty surveys were completed. Faculty gave conflicting responses to the questions related to the time necessary and the actual time spent mentoring students in undergraduate research projects. Table 3 and 4 below give responses of faculty. Only 3 responses stated that they spent more than 15 hours of direct contact with students conducting undergraduate research projects. However, 8 responded that they felt that it would take over 21 hours to effectively mentor an undergraduate student research project. The difference may be explained by the diverse projects that the students are involved with. Projects ranged from time intensive projects such as caring for animals and taking measurements with field crops and some used secondary data and required little fieldwork.

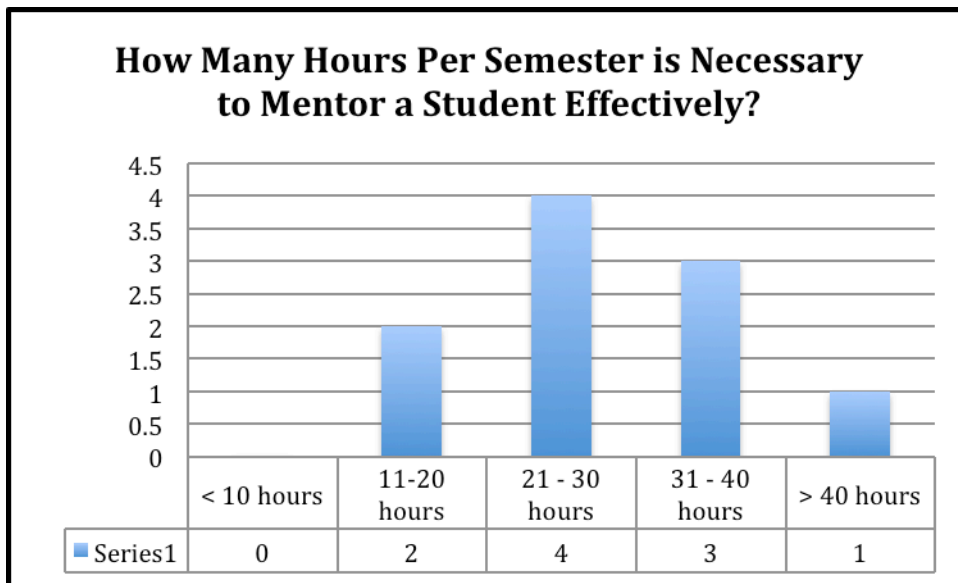


Table 3: How many hours per semester are necessary to mentor a student effectively

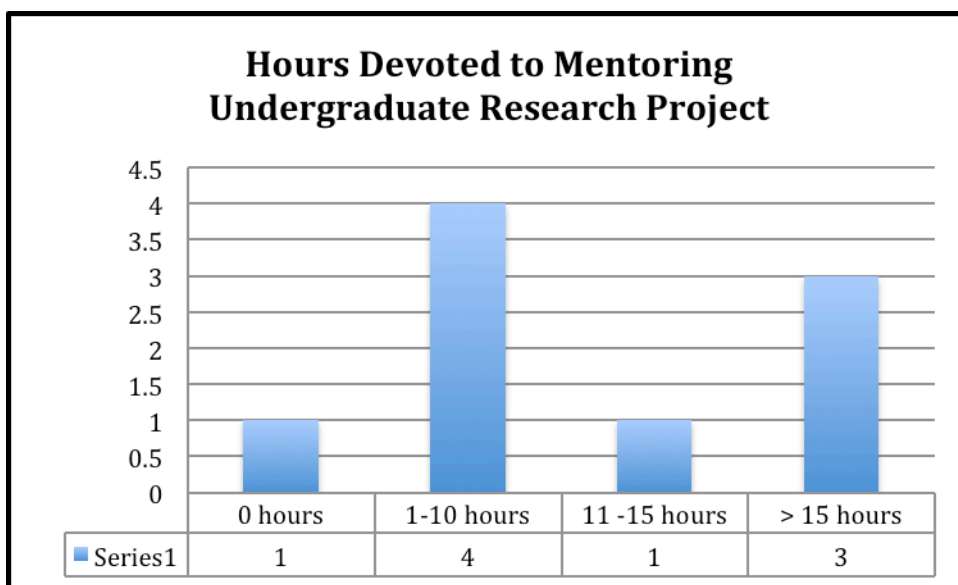


Table 4: Hours Devoted to Mentoring Undergraduate Students

Seven faculty responded that they did not have enough time to mentor a student given their current teaching/research responsibilities. This was to be expected with the increased responsibilities on faculty. All faculty who responded were teaching a minimum of 12 hours of coursework per semester. The time issue could be resolved if students participate in current projects that the faculty member is already involved in as part of their responsibilities. The issue of faculty time is not a new one. As university budgets continue to become more restrictive, faculty will be asked to do more.

Faculty felt that undergraduate research projects were beneficial to the student's education. The results of questions dealing with perceived benefits are given in Table 5 below.

Benefit to Student	Yes	No
Understanding of Complex Problems	9	1
Pursuing a graduate degree	11	0
Chosen career field	10	1

Table 5: Perceived Benefits of Multidisciplinary Projects

The undergraduate research projects were perceived by faculty as beneficial for students. The findings showed that all faculty felt the project would be helpful for a

student seeking to pursue a graduate degree. Exposing students to the research process will let students get a feel for the research requirements of a graduate program. The research component is also beneficial to student planning on entering the workplace. Faculty felt that the project would increase critical thinking skills and help in the student's career.

Faculty were also questioned about the impact of mentoring on their personal careers and the results are given below in Table 6. Receiving a stipend in order to mentor a student did not influence faculty. An incentive would be appreciated but a lack of a stipend does not appear to deter faculty from participating. Faculty also felt that the mentoring was personally and professionally rewarding. However, this is a vague question that would need to be followed up on in a more detailed interview to adequately assess the response.

<b>Faculty Benefit</b>	<b>Yes</b>	<b>No</b>
Monetary award importance	11	0
Personally Rewarding	11	0
Professionally Rewarding	9	2

Table 6: Faculty Benefits from mentoring Students

## **Conclusions**

Students and faculty did tend to perceive the research project and faculty mentorship as beneficial. There are several areas that need improvement. More can be done to relate the coursework to the actual selected research project of the student. This is a challenge when dealing with a one size fits all research methodology courses for students from multiple academic areas. Faculty and students have also indicated the need to expand the program to include an industry mentor in the future to improve the experience. The use of an industry mentor would bring increased experience and networking opportunities for students, but it would also increase the administrative

load of such a project. Again, there are many important aspects of mentoring that need to be considered when developing an undergraduate research program experience. One helpful piece of advice would be to involve faculty in the planning stages of any program that you plan to pursue. Faculty and student buy-in is essential for the success of any program.

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