2006-1447: RESEARCH IN THE UNDERGRADUATE ENVIRONMENT

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Research in the Undergraduate Environment

Abstract

The benefits of research experiences for undergraduates are significant. For many faculty, these were the experiences that convinced us to pursue further education and a career in academia. However, performing research at an undergraduate institution carries with it certain challenges. In traditional research institutions, doctoral students perform most of the research activities, led by the faculty. These students have completed at least their undergraduate courses and can be expected to remain on the research team for four to six years. In contrast, at an undergraduate institution students may start in the group with only one or two engineering courses completed, and will remain in the group for only two or three years. Other constraints at these schools are high teaching loads and limited research facilities. Because of these concerns, some faculty may choose to avoid research activities while others may perform only research that requires limited student involvement. However, as the primary focus at these institutions is the education of undergraduates, the ideal research plan will provide opportunities to include students significantly in the process.

One way to perform research with heavy undergraduate involvement is to select an appropriate topic and develop a stable undergraduate research group that builds and maintains knowledge over time. Such a research group requires tasks encompassing many skill levels, a steady funding source, and an orderly progression of short-term goals for each student. Web based communication and archiving tools can be used to share and pass on data, references and information. Selecting the research topic, obtaining funding, and initially training and organizing the student team are the major start-up tasks. The benefits for the students and the faculty member are worth these efforts.

Introduction

The role of research at a primarily undergraduate institution (PUI) is complex. Two decades ago, research was shunned by faculty at these institutions, who viewed that work as detrimental to their mission of education. Professional development was encouraged in other areas, such as laboratory development and teaching methods. At many PUI's, the reverse is now true. Externally funded research is seen as the path toward tenure (provided the teaching record is also solid), while other forms of professional development are not viewed as favorably. Fundamentally, whatever professional development activity faculty members pursue, it should aim to support the mission of the university. Our university's mission states, in part:

> "As a predominantly undergraduate, comprehensive, polytechnic university …, the mission … is to discover, integrate, articulate, and apply knowledge. This it does by emphasizing teaching; engaging in research; participating in the various communities, local, state, national, and international, with which it pursues common interests; and where appropriate, providing students with the unique experience of direct involvement with the actual challenges of their disciplines in the United States and abroad."

The priority of teaching first and research second is typical of a PUI. This paper summarizes the results of our investigation and experiences, highlights some of the unique challenges and suggests how best to pursue our professional development goals within this framework.

Benefits of Undergraduate Research

Undergraduate research presents opportunities to significantly enhance the education of participating students. It also offers a number of benefits to the supporting faculty, department, and college. The major benefits are summarized in this section.

For the Student

A number of studies have used student and alumni surveys to quantify the benefits of undergraduate research to the student researchers[1,2,3]. Their findings are summarized in this section.

Undergraduate research activities enhance student learning. Students who work on research projects learn by doing. They gain hands-on experience with research approaches and the scientific method. Research experiences provide the opportunity to apply classroom theories and assignments to the practice of engineering. Their increased knowledge enables them to converse at an advanced level about the discipline.

Student researchers gain a broad set of skills beyond their discipline. By observing how faculty are continuously learning, undergraduates begin to appreciate lifelong learning, whether or not they pursue post-graduate degrees. Former undergraduate researchers report improved critical thinking skills, higher self-confidence, and the ability to deal with open-ended problems. Research activities engage the students. They have the opportunity to be part of cutting-edge applications and advance the state of the art. This involvement sparks their intellectual curiosity and leads to greater involvement in the rest of their academic experience. Literature searching develops students as critical readers and thinkers. Paper preparation and presentation improve writing and speaking skills.

In addition to the research itself, the students benefit from a close interaction with other members of the research team. The connection established with a particular faculty member, and the close ties with both older and younger students on the project, creates an ideal mentoring environment. By working within a professional group, students learn to enhance their own professionalism and to work well in a team.

Involvement in undergraduate research activities has a positive impact on students' career opportunities. Student researchers have a higher retention rate and are more likely to continue into graduate school than their peers. A student research job improves students' marketability for employment in the field or graduate work—significantly more than other campus jobs.

For the Faculty

While not as widely studied as the benefits to students, working with undergraduate student researchers offers a number of rewards for the faculty member as well[4]. By working closer with certain students, and conveying higher-level skills than in the classroom environment, a

professor remains more intellectually engaged in teaching. The student researchers enable the teacher to remain connected to the current student generation, thereby improving their classroom teaching skills.

Undergraduates can also bring 'fresh eyes' to a research project. Because they are less fettered by past experiences or the currently accepted theories and have less at risk if the research is unsuccessful, they are freer to push the envelope.

At a PUI, undergraduate research may be the only opportunity for a faculty to perform research. As a result, this research has all the benefits we know flow from continued professional development of faculty members.

For the College

Departments and colleges that support undergraduate research activities gain a number of benefits as well[4]. Undergraduate researchers are more likely to have a strong positive undergraduate experience, which may translate into becoming active alumni. External recognition of a program is another benefit of undergraduate research. The enhancement of a college's reputation carries with it improvements in the areas of student recruitment, faculty recruitment, and corporate donations. For state institutions in particular, an improved reputation may translate into additional government funding for undergraduate programs.

At a PUI, working with undergraduates may be the only way to get research projects done. As a result, undergraduate research directly contributes to the continued professional development of faculty, leading to actively engaged scholars. These research activities may also lead to improved department and college facilities, through the sharing of research-funded equipment.

Challenges at Primarily Undergraduate Institutions

There are many challenges for new faculty at any university when starting a research program. After a research direction is established, funding must be obtained, facilities located, and research staff identified and trained. All of these activities take time. Faculty time is already tight with teaching activities—especially during the first few years as faculty are developing new course materials. These challenges are exacerbated at a PUI.

Obtaining external funding at a PUI carries different hurdles than a research school. Major research funding does not tend to flow to schools that have not done major research in the past; so projects must remain modest in scope. PUI's typically do not have faculty research labs or start-up packages, so very limited facilities are available to start a research program. As a result, the start-up costs of the research may be higher than at research institutions. For many new faculty, there is no existing research group to join, so the faculty member starts from scratch. In addition to these external challenges, often the PUI is not set up to support the faculty in obtaining external research funds, as this may be a relatively new activity there.

Locating facilities for research is difficult at a PUI. Faculty must find a way to use undergraduate teaching laboratories for their research, or need to locate funds to outfit a new lab. If a new lab is to be developed, space needs to be identified. Space is typically at a premium, so this constraint alone can dictate the type of research to be performed.

Identifying assistants to perform the day-to-day tasks of the research project is one of the particular issues associated with a PUI, and is the main focus of this paper. The pool of research assistants includes undergraduate and a few master's students. Laboratory technicians are an additional possibility, although the research project needs to be relatively large and well funded to pay a full-time technician (and sharing technicians may not be an option at many PUI's). So, a typical PUI research project will use undergraduate researchers. The main challenges of working with undergraduates on research tasks can be summarized as follows:

- Students will be involved with the research for only a short time – ranging from three months to three years. To have a student on the team for three years, they must either start as a sophomore or stay on for a master's degree.
- In order to have the maximum time with a student, they must start on the research team with little or no engineering coursework completed. As a result, the student may have only completed some introductory classes.

With these challenges, the proportion of research time devoted to training (as opposed to advancing the project) is significant – up to 50% of a student's time will be spent learning *how* to contribute, rather than actually contributing. Since new students may not have the opportunity to work under a veteran student researcher (as in most research institutions), the burden of training and directing new students will fall fully on the faculty member.

The final major challenge to performing research at a PUI is faculty time. Regardless of the type of institution, all professors must deal with the split of their time between teaching, research, and service activities. Including undergraduates in research activities is often irrelevant to the academic reward system, despite the additional time it takes. In addition, at a PUI the amount of time allowed for research and service is significantly curtailed due to the high teaching loads[5]. For instance, the authors' teaching load is 12 units per quarter. Because of laboratory classes and office hours, this results in 20 hours per week of direct student contact time. When you add in time for lecture/lab preparation, grading, student advising, and department committee activities, this constitutes a 50-hour per week job. In order to have time to seek and obtain funding, locate facilities, and identify and train research staff, research is often conducted only during the summer. If research is to be conducted during the academic year, funding often is needed to 'buy out' of some of the teaching responsibilities (further increasing the project cost).

Successful Undergraduate Research Groups

Despite the challenges of performing research with undergraduates at a PUI, there are many examples of successful groups. Common traits or best practices can be identified from these groups[6,7,8]. These include an appropriate topic of study, on-going funding, clearly-defined individual goals, close faculty involvement, adequate training, continuity of team members, final documentation of individual results, and an on-going knowledge base.

Selecting a research topic appropriate for a group of undergraduates to handle is a significant challenge. It needs to have enough depth to contribute to the field (and engage the students), while not requiring substantial skills beyond the early engineering courses. In addition, the best topics can be broken into small pieces, so that individual researchers can successively advance

the work. Successful research groups are formed around such topics, and can grow over time as the research progresses.

The need for a reliable source of funding cannot be overstated. Student researchers can sometimes receive independent study credit for work completed, but a longer-term commitment deserves pay. In addition the research itself will require materials and equipment to fund, and these needs will change over time. The amount of funds required depends on the type of research and number of students, but some funding will certainly be necessary. To maintain a longer-term project direction, the funding source should be long-term or renewable.

Student researchers may work together on a team, but each should have their own specific tasks and goals clearly defined and written down. With all of the competing pressures of the student life, ambiguity of direction will result in most undergraduates foundering. There should also be realistic short-term (weekly and monthly) goals along with the overall project direction. This enables progress checks and gives a sense of contribution and satisfaction to team members.

Close faculty interaction with the students on an on-going basis is required to keep the students motivated and the research on-track. While clear initial direction and deliverables may be given at the outset, open-ended research will stumble on unanticipated challenges and opportunities that students may not be able to handle on their own. In addition, students may be initially uncomfortable with admitting their issues, so these need to be drawn out. Initially, meetings on a weekly basis are recommended.

Team member continuity and adequate training are closely related. Each student needs to have the proper skills for the job before they are tasked with an open-ended research problem. To ensure this, at first the faculty member must work closely with the students to discover what knowledge is lacking, and fill the gaps. However, due to the continuous turnover of students on the team (graduations, co-ops, internships, etc), a faculty member could easily spend most of his available time training new students. Instead, successful research groups take advantage of peer mentoring/training. In other words, experienced members of the research team are paired with new members to walk them through the challenges and make sure they don't get lost. Successful teams seek students who will remain on the team a minimum of two years.

Final documentation and an on-going knowledge base are also closely related. In successful undergraduate teams, each student is responsible for documenting the results of their work, usually in the form of a report or technical paper, along with a presentation. Ideally, this work can be presented externally and adds to the prestige of the group. In addition to providing a focus for the individual student and a publication opportunity for all team members, this requirement ensures that knowledge gained is not subsequently lost as team members move on. By requiring an external publication, the student results will be captured in a concise, clear format for later team members to reference. This requirement is also good training for the student.

Selection of a Research Topic

The scope and complexity of a research differs between a PUI and a research institution. The constraints of performing research in an undergraduate environment directly affect the topics that

can be researched effectively. Understanding these constraints helps identify the area and scope for successful research projects.

The limitation of undergraduate and master's students' experience and coursework limit their ability to contribute significantly to highly theoretical projects. While a master's student may have completed advanced course work, often undergraduate students participate in research starting in their sophomore or junior years, well before any technical elective courses. As a result, undergraduates are more successful in contributing to applied development projects such as experiment design and testing rather than theoretical analysis. A research topic that deals with purely theoretical high-level analysis may not provide any opportunities for the undergraduate student. This does not preclude approaching a technical research project. However it requires more supervision and guidance from the advisor. A research project should have a mix of theory and application.

Limited lab space constrains the size of experimental apparatus. Most PUI's were built for instruction and education with less emphasis on lab space for research projects. Typically, no space is provided for faculty research, unlike at a research university. Instead, research projects sit in the back of student labs or in storage rooms or even closets. Under these conditions experiments may need to be small in scale and portable so that they can coexist in a dual-purpose teaching laboratory.

Another factor that should be considered is external publication. The constraints already mentioned can direct projects toward applied development often in cooperation with industry. However this may create a conflict between industry's interest in protecting intellectual property and trade secrets and the university's interest in publishing results in conferences and journals. The promotion and tenure requirements at the PUI should consider this distinction and reward unpublished proprietary work as well as peer reviewed publications. If this is not the case then there is less incentive for the researcher to work with industry since publication can be delayed or blocked due to the industry's reasonable requirement to protect trade secrets.

Sources of Funding

Once an appropriate research topic is selected, obtaining funding for that research is the next task. As discussed above, a successful undergraduate research group needs a reliable, on-going source of funding. This section identifies possible funding sources.

There is some good news: Because PUI's typically have a relatively low indirect cost rate, and undergraduate student pay rates are lower than graduate students (who often require a full stipend in addition to tuition costs), funding requirements for undergraduate research may be less than for research at a doctoral institution.

However, there is also bad news: These trends are offset by the fact that the PUI's have limited facilities to begin with, so funding must provide all of the equipment needs for the project. In addition, major sources of research funding often are directed toward institutions that have done this research in the past. Unfortunately, that means that undergraduate research is limited to smaller grants, and so a greater percentage of a PI's time may be required to obtain reasonable levels of funding to support the work.

Internal Funding

Because of the lower cost of doing undergraduate research—and the benefits to the students, faculty, and college—some PUI's offer funds to support at the least the start-up efforts of these research groups. At our university, the following options are available:

- State Faculty Support Grants – These are small grants (up to $5000, or 50% release time) to support faculty development. For a well-chosen research topic, these funds may be used to perform small studies. They may also support pre-studies before submission of a larger external grant proposal.
- Release Time for Proposal Preparation – Periodically, colleges may offer time off from teaching to allow a faculty member to prepare an external grant proposal.
- California Central Coast Research Partnership – The university, through a broad grant from the Office of Naval Research, provides funds for faculty to perform industry-related research in support of a proposed research park. Since the competition is limited to university faculty, the success rate is high. In addition, projects that include undergraduates in the research activity receive special attention.

Although these examples are specific to our university, similar programs exist at many PUI's. It remains the responsibility of the individual researcher to seek them out, and of the university administrators to develop them. The major downside of these funds is that they tend to be short-lived. However, when properly used, they can provide seed money for pursuit of other grant opportunities.

Private / Industrial Sponsorship

Undergraduate research and industrial sponsorship fit well together. Industrial donors often have an interest in providing modest support to the educational mission, and an undergraduate research program is a good opportunity to see visible results from that investment. Donations of this type to a PUI can broaden a larger company's educational investment portfolio, and provide a cost-effective means for a medium-sized company to contribute. In addition to donations, corporate-funded research grants are a good way of meeting the applied research needs of medium-sized companies. Because the research is typically not cutting edge, and funding is relatively small, this type of applied research is not highly valued by research-intensive institutions.

Although new faculty members typically cannot influence corporate donations, institutions can solicit undergraduate research donations from their corporate sponsors, especially those that recruit their graduates. Former students employed at the company—especially those who participated in undergraduate research—are a good resource for starting that discussion. When these arrangements are made, they can benefit a number of faculty over time.

Seeking applied research funds, especially from local industries, is an activity that can yield high returns for faculty. Although this research is not as open-ended as other types, it still offers many of the same benefits to the researchers (both student and faculty). And, because it is closer to the application of engineering, it may be even better training for students who choose employment over graduate school. Another benefit of this sort of research funding is that it may

dovetail well with existing engineering classes. Many engineering programs offer a capstone design project class, including the design, construction, and testing of a product to meet the needs of an industrial sponsor. Connections made through this class may lead to applied research projects for the faculty.

As with internal funds, industrial funding tends to be short-lived (usually one year, possibly renewable). However, once a relationship is established, obtaining future grants requires less effort. If several different sponsors can be found, some continuity in funding may be assured (albeit without the desired continuity in the specific research area).

Federal or Foundation Grants

Federal or foundation grants provide a major improvement over internal and industrial funds, since they typically are longer-term or renewable. This provides the continuity in funding that is desirable for a strong research group. However, the PUI investigator is often at a disadvantage when competing against research institutions for federal or foundation research funds. In these circumstances the financial (higher start-up costs and the need to buy-out of teaching), time (research may take longer due to teaching loads and a constantly-changing team), and research experience (research funds tend to go to schools with a proven track record of research) factors may make a PUI less competitive. Despite these concerns, there are a number of federal opportunities that are highly suitable for these institutions:

- Experimental Program to Stimulate Competitive Research (EPSCoR) and Institutional Development Award (IdeA) – These programs, offered by many federal agencies, focuses on directing federal research funds to states that traditionally have not received these funds.
- NIH Academic Research Enhancement Award (AREA) – This program focuses on "research in educational institutions that provide baccalaureate training for a significant number of our nation's research scientists but that have not been major recipients of NIH support."
- NSF Biomedical Engineering Program and Research to Aid Persons with Disabilities Program (BME/RAPD) Undergraduate Design Projects, NSF 03-560 – This program includes a component to engage undergraduate students in designing innovative products to aid persons with disabilities.
- NSF Research Experiences for Undergraduates (REU), NSF 05-592 – This program provides supplemental funds to include undergraduates in research projects already sponsored by NSF.
- NSF Research in Undergraduate Institutions (RUI), NSF 00-144 – This program encourages NSF-sponsored research at PUI's. A professor can propose research to any open posting, and jointly submit that proposal to this program.
- NSF Undergraduate Research Collaboratives (URC), NSF 06-521 – This program encourages joint submission of research from different types of institutions, with the aim of engaging PUI's in collaborative efforts with research institutions.
- STTR (Small Business Technology Transfer) or SBIR (Small Business Innovation Research) – These programs, offered by many federal agencies, encourage collaborative research between industry and academia. Since applied research can work well with undergraduates, it is a good opportunity for PUI researchers.

In addition to the specific programs listed here, PUI researchers may find that an ideal source of funding is collaboration with a research institution. Through collaboration, both institutions benefit: the PUI gains access to facilities and funding, while the research school gains access to a set of potential future graduate students.

Organization and Training

The nature of research in the undergraduate environment requires organization and training strategies that are different than that in the traditional research university. In an undergraduate environment a typical research team will include both master's and undergraduate students. Shorter student tenure, less experience, and scarce resources must be considered.

The incentives for undergraduates to do research must be understood. In some cases research projects can be incorporated into coursework so that the students receive course credit and/or pay for their work. In other cases students engage in research projects motivated more by the experience (and pay) and receive no course credit. In the latter case there is less control and incentive in the form of the threat of a bad grade to motivate and manage the student's work. A good student will devote the appropriate time and effort to the project and expect to receive valuable experience that can be listed on their resume or graduate school application. However, when there is little or no consequence of failure, a less motivated student may initially commit to a task but not follow-through when time is short due to the demands of class work. This can affect the results of the other student tasks as well as the overall research objectives.

One of the objectives of research in the research university is to teach students how to define a problem, identify the scope and find their own way toward a solution. The first half of a master's thesis may be dedicated to identifying the problem before the work even begins. Because of the short tenure of students in the undergraduate environment there is less time to let the students find their own way. The scope and methods of a project need to be well defined so that students can make progress. Short duration tasks with well-defined deliverables are best for undergraduate students. Master's students have more time to perform self-directed work and develop their own scope.

One strategy to help undergraduate students is to pair them with master's level students or more senior undergraduates. An ideal team includes one master's student for every two or three undergraduate students. The undergraduate students can pattern their work after the master's student and go to them for help in more technical topics. This structure is similar to master's students working with Ph.D. students at a research university but on a smaller scale.

One of the consequences of the student's short tenure is that there is less incentive for a professor to invest significant time in training them as compared to a Ph.D. student. At a research university a graduate student usually becomes productive in the form of producing work on their own and publishing near the end of the master's degree. An advisor invests time in training the student at the master's level with the expectation or hope that they will continue on a Ph.D. and the invested time will be repaid by a self-directed Ph.D. student. At an undergraduate university by the time a master's student becomes productive they are usually near the end of their degree and moving on. With heavy teaching loads a professor has even less time to train researchers

and receives little long-term return on the invested time. This makes selecting team members that are highly motivated and mature extremely important. It also means establishing a self-perpetuating training program within the group is nearly essential.

Ongoing Documentation – Information Management

In research universities, graduate students work continuously on a master's or Ph.D. topic for years. Typically results are documented in a lab notebook, in binders, on computer disk, etc. The accumulation of data, experimental processes and knowledge in general is the responsibility of the student. Typically information is shared to the advisor or team during weekly meetings, through progress reports and finally in the form of publications. This model is based on the assumption that one person or a close-knit research team performs the work over a long time.

In an undergraduate environment the typical student works on a research project for a shorter period of time. A master's student may work on a project for 1 or 2 years. An undergraduate student may work on a project for 1 year or as little as one term. A long-term project may incorporate the work of many students each working a short time on a piece of the project. In this environment the accumulated information process requires a different model. When information is spread between many notebooks, binders, or computers, care must be taken to ensure that all the efforts are not wasted due to disorganized information management. Data security must also be considered.

The internet and web based tools offer an excellent solution to this problem. An enterprise wide system such as Blackboard or any of its competitors such as eCollege, SunGard SCT or WebCT can be used as to provide a virtual binder, control access, and provide file security and backup. Blackboard is designed to be used in a classroom environment to post course information, syllabi, grades, etc. However it is also well suited to managing information on research projects. Blackboard provides different levels of security so that access can be given and removed as needed. It can be used as a mass storage site for data that must be shared across a large and changing team. If students store all data on the Blackboard site as the master source of information then the site begins to grow and becomes a rich resource of information. This eliminates the possibility of data being lost when a student leaves the project and fails to pass off notebooks or binders. Blackboard is also normally maintained in a secure environment with regular backups so that there is little chance of data being lost even in the event of a catastrophe such as a lab fire. With remote internet access data can be posted to Blackboard from any lab, university, co-op company, or student's home. This easy access promotes the habit of using Blackboard as the storage location for all original files. Internet access also encourages new members of the team to review the previous work and reduces startup time and eliminates duplication of work.

Similar results can be obtained by using various web tools or FTP sites, however the convenience of the well designed and engineered features of a system such as Blackboard allow the team to focus on the research and not on information management and web tool development.

Implementation

Some aspects of the path outlined in this paper have been put into place within the authors' own undergraduate research projects. The observed benefits and limitations of this implementation are discussed below for each suggestion:

- Research Topic Selection – The authors have started an applied research program investigating the use of remote sensors for vehicle pre-crash detection. This topic is relevant to both industry and government, offers a range of tasks with varying levels of complexity, and is of interest to undergraduates. It has the added benefit of being a multi-disciplinary study, which is of increasing importance in engineering education. However, experience has shown that most aspects of the work require upper-level undergraduate courses as a foundation. As a result only junior and senior undergraduates and master's students have been recruited for the project.

- Funding – This research program has been funded by two different sources – the C3RP program mentioned above, and a Lockheed Martin donation. Although these sources have provided some start-up funds, a search for long term funding to ensure project continuity is ongoing. Securing funding currently requires the majority of the investigators' time—leaving less time to contribute to the technical aspects of the project.

- Organization & Training – This research has been successfully organized along the lines outlined in the paper. Students have been selected by a combination of direct contact (from within classes) and job postings. Students receive a mix of pay and course credit for their work. Each student in the project is given a specific task and timeline for completion. They work together as needed to complete the tasks. Students with more experience on the project have acted as informal mentors and guides to the newer students. However, even with these guidelines, one student quit the project without completing the assigned work even though he received a failing grade for course credit. As a result, we have had to find another group to complete that work, which has delayed the original schedule for testing.

- On-Going Documentation – This research project uses Blackboard as the repository of knowledge. Students are continually reminded, "If it's not on Blackboard, then it doesn't exist." Although this reminder is sometimes necessary, the resulting documentation has been successful and newer team members have been able to mostly train themselves by reading about what already has been done. Data collected in Blackboard has also made preparation of publications easier.

It remains to be seen if this approach will result in a highly successful completed research program. However, the initial results have certainly made it possible for to pursue research and involve undergraduates in the process. This is encouraging and the authors will continue to monitor and adapt the approach as the project continues.

Conclusion

Traditional teaching universities are engaging in more research than in the past. In these primarily undergraduate institutions, however, the approach to research is necessarily different

than at a research university. There are a number of constraints placed on faculty at an undergraduate university, including limited resources such as funding, space, and equipment for research activities. High teaching loads restrict the time available to perform research. When working with undergraduates, shorter student tenure, younger students, and higher turnover necessitate more training and careful information management. Faculty face funding challenges such as higher start-up costs and a less-established reputation at funding agencies.

There are ways to deal with each of these challenges. A successful undergraduate research group can be developed when a research topic of appropriate nature is selected, a source of on-going funding is identified, a system for training new team members is in place, and an established procedure for documenting results is followed. In this way, undergraduates can provide incremental steps toward a longer-term research goal without adversely affecting the faculty's workload. Implementation of this process has been successful in supporting the authors' own research activities.

When these issues are addressed, a robust research program can be cultivated that benefits the students and faculty while supporting the mission of the university.

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