

Effectively Integrating Interns Into Research Teams

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Abstract—While interns are invaluable additions to teams by enabling focused work when other team members may be distracted with other duties, effectively integrating an intern for a short duration, such as a 12-week summer internship, can be challenging. With internships also serving an educational mission, balancing project impact against the best educational outcomes for students can be challenging. This whitepaper covers many of the challenges and testing solutions that may work for other teams as well.

Index Terms—Interns, short-term team member integration, mentoring, undergraduate students, graduate students.

1 Introduction

It is an oft spoken rule that students are the backbone of research efforts. Much of the work students do is extensive development and testing work critical for projects to make effective progress. However, students are not all created equal. Undergraduates generally have far less experience and knowledge than graduate students, not just technically, but also for problem solving and how to read and incorporate research into their work. Graduate students frequently have their own thesis research agenda driving their efforts. Using an internship to accelerate their time to graduation is a significant benefit few students willingly give up simply to earn a salary for a term. By adjusting the approach to the individual student based on their needs and knowledge, a better outcome for everyone can be achieved including more positive project impacts.

In general, graduate students are the first choice when looking for a research assistant for the summer. While they can bring higher productivity faster than most undergraduate students, qualified graduate students can be hard to find. Given competition between various employers, physical location differences, salary differences, research fit, potential to advance academic progress, and the student's personal preferences or requirements, finding and hiring a student is far from certain.

Undergraduates have many of the same requirements, but given the far greater supply, finding students can be easier—assuming some flexibility. Undergraduates most often are looking for work experience and try-before-you-buy experiences with potential long term employers as well as a good salary. As long as the lesser experience and education is acknowledge and some additional ramp up time can be allowed, undergraduates can be nearly as productive as graduate students with a little careful planning.

This paper examines the challenges students at different educational levels present when being hired as interns into a research team environment and also offers general best practices that can improve the experience and productivity for both the student and the mentors.

The rest of this paper is organized as follows. First in Section 2 is a discussion of how to find, recruit, and manage students independent of the project to get motivated, interested students. Then in Section 3 is a discussion of how to take those students and have solid, positive impact on your project for the long term. Finally, in Section ?? is a discussion of how these two efforts can pay off.

2 Managing Students

Finding effective ways to attract and making students productive requires a few techniques. A hands off approach may be appealing for a mentor's time management, but it may backfire. Instead, consider some guidelines about how to best engage with students of different levels.

2.1 Graduate Students

Graduate students can offer ideal candidates capable of picking up a project on day one and being productive for the summer with minimal supervision. That said, they are not supervision free for best outcomes. As with all less experienced people, getting distracted technically on bad directions or trying out known bad solution paths is a common problem everyone faces throughout their career.

The best outcomes with graduate students requires regular meetings that ensure the student is kept on track given the limited timeframes.

2.2 Undergraduate Students

While relatively plentiful, undergraduate students can be far more challenging to manage, but also far more rewarding to work with. Since they are starting at a relatively ignorant position, a mentor has the opportunity to help a student learn a tremendous amount in a short period of time and achieve a goal the student would have considered impossible at the beginning of the summer. Few experiences can be more rewarding academically than nurturing this transformation.

Given the challenges, far more supervision and more interventions are generally necessary. While it can be time consuming, students, seeing the daunting goal, they may be more willing to redouble their efforts to try not to disappoint their mentor.

2.3 Recruiting Students

Finding students requires carefully crafting a description of the job and what the responsibilities will be. The description needs to be intriguing as well as seemingly achievable. Writing these descriptions as a person long past their undergraduate days is a difficult task.

Anecdote: A student came to work with me because I spoke with her about graduate school at a job fair rather than offering her a job. She admitted she only understood 2 or 3 words in my job description, but decided to come anyway because of that singular interaction.

Students today are focused on impact in the world around them as much as money. Focusing on what impact they can have and then the technical skills required can be effective for students to be attracted to a job posting. It is essential to focus the application to suit the level of student being requested. Frequently, focusing on the research goals, as would be part of a grant application, is too far beyond the common understanding of students. They may look at it, say to themselves, “I have no idea what this posting is asking me to do for the summer”, and then move to the next posting.

2.3.1 Graduate Students

These students are looking for advanced work and can be expected to know what any topic in an undergraduate degree program might cover. For a Master’s student, they may be more interested in just making money working on an interesting project. Appealing to them requires an intriguing story with some interesting technology. These can be somewhat vague as a MS student maybe more adventurous.

PhD students are looking for a solid fit to their research. Having a solid research statement and what kind of work desired is key to a good fit. Offering flexibility to suit the project to better match the student’s interests is a strong attractor. Often, having a generic posting and working relationships with faculty or students directly are the best way to fill these slots.

2.3.2 Undergraduate Students

Most undergraduates that can be productive have usually finished their sophomore year at least. At most four-year programs, that would encompass the majority of general, required classes and many of the introduction classes for the major. Beyond that, it is unlikely the student will have any particular specialized knowledge. In spite of this, undergraduates are still very much in a production work mode related to their school work making them ideal candidates to give tasks to where focus is needed more than deep thought.

The lack of specialized knowledge just means they need some time to learn. In general, undergraduates will get a lower pay rate for the summer compensating for the reduced productive time. For example, if they cost one-third less than a PhD student and they can be productive for 8 weeks instead of 12, that might be slightly better than the PhD student that needs a few days to a week to get going.

2.3.3 Discussion

No matter the level, having an accessible job description is key. Find students at the target level and have them review your posting and see what feedback they give. It may be surprising how many, “what does this mean?” and, “I don’t know what to expect with this” sorts of responses will be generated.

2.4 Motivating Students

College students, with rare exceptions, are motivated for delayed gratification and have strong skills in effort/reward trade-off evaluation. As part of an internship, particularly if a job after graduation might be possible, the students see the short term extreme effort as worth the potential long term position at a job they will love. Revealing to the student what that job will really be like is not always a consideration. There are other things that can be done to motivate students beyond the promise of a job.

2.4.1 Empowering

Few students before late in their PhD studies gain much authority over what decisions are made and control over what is done. One proven terrifying, but exhilarating, approach is to empower the student with full “control” over the project direction. It is terrifying because they expect direction, but exhilarating because no one has ever trusted them making decisions before. A good guideline for empowering students like this is to require evidence for why any decision should be tried. As long as the decision is not known to be a poor approach, let the student pursue the direction. It may not be what the mentor would have done, but it may prove to reveal new insights previously not considered.

Another potentially ignored aspect of empowering students is to allow them to shift their working hours to something most comfortable for them. Within reason, meaning at least partially during normal business hours, there is little reason to deny the request. Students know when they are most productive. Requiring them to work at specific times is robbing the project of maximum productivity. Require the student meets program goals, such as attending meetings and presentations, but allow flexibility.

2.4.2 Let Students Struggle

Learning how to solve a problem through trial and error and through Internet searches is a rite of passage for learning how to be productive in a field. Short-circuiting this by prematurely helping a student past a problem hinders the learning process. However, this must be balanced against the tight 12 week timeframe.

A workable best practice is to have a student try to work through a problem for 1 day (elapsed time rather than working time) before stepping in to help. This lessens the burden on the mentor while not burning too much time with learning how to solve a problem. Most of the time, the student will figure out what to do. In some cases, it will require deep side-by-side work to figure out how to address the issue. This usually happens because the surface view of the problem hides the true complexity.

2.4.3 Active Mentoring

Daily short meetings are crucial to keeping track of what is going on and what problems are occurring. The Scrum idea of a stand-up meeting to keep it short is the right base idea. However, to make this effective, the meeting time may vary from 5 minutes to 5 hours, depending on the need. For example, If the student is heads down hacking code making good progress, do not interrupt the work to see where they are. Few things are bigger productivity killers than taking someone out of “the zone” to do some other activity.

If the student has been struggling for a day on a problem, then consider stepping in. Try to offer suggestions and hints rather than solutions to preserve the educational experience as much as possible. These are the times that “teaching moments” occur. When the student can express that they really don’t understand what to do and can’t figure it out, the meeting time can be most productively used.

2.4.4 Career Planning and Advisement

Students may not want to work specifically in your area once they graduate. Finding who best matches their career aspirations and arranging a meeting for the two of them is a good way to help student address their career planning goals of the internship while still addressing project needs.

If a student does not want to work directly in your area, it is actually a positive reflection on the mentor because the student wanted to work with them in spite of the poor fit for their long term goals. Pay back that respect with helping the student get good, first hand exposure to what they think is their desired career path and how best to get there.

3 Incorporating Project Elements

Given effective interaction with students, potentially using techniques like those described above, finding effective ways to incorporate a student into the project is essential.

3.1 Reproducibility Frameworks

While reproducibility is a growing concern, frameworks, such as the Popper Convention [?] can accelerate incorporating a new student as well as offering reproducibility features necessary for many research paper submissions.

For example, if the project already is using Popper, a student can easily build the project elements on a new machine without having to figure out odd build dependencies and other platform irregularities. If the project is not incorporating these kinds of features, it is an ideal time for someone to develop the integration. The student can learn how to build and manage the project leaving the project in better shape once the task is complete.

3.2 Version Control for Everything

Version control systems long used for source code management have been used for many other artifacts in recent years. The ability to isolate changes and rollback changes to a known “good” point are key features making these tools generally useful rather than just source code management systems. These tools have permeated environments far

removed from source code. For example, the Dungeons and Dragons Fifth Edition rules documents were managed through version control and issue tracking. The issue tracking systems can be used as a way to track what should be worked on and to track progress. They also offer integrated document management using markdown or html making nicely formatted documents an integral part of the version control system itself. Judicious use of pull requests offers a way for multiple people to work fully independently on the same base minimizing interference. Overall, if it exists, it should be in version control.

The one exception is large data files. Unfortunately, files over 150 MB tend to be prohibited in many version control systems by default requiring special handling. Tracking these artifacts using similar versioning techniques is still critical and alternatives should be employed. Git large file support is one option. A separate system, such as Confluence, may be another. Some centralized system that versions and is not singularly accessible to the student is all that is required.

Through version control, a student can now have a one-stop-shop for everything project related. By encouraging a student to improve documentation when they find gaps to discover what they need, the system can be improved. It may seem to the student that they are just learning the project, but they are improving the project as they learn. Double win!

3.3 Assign Meaningful Tasks

For a student hoping for an impactful internship, being asked to file papers or a similarly less skilled required task is a motivation killer. Instead, consider “nice to have” features and aspects of a project that offer a student a place to contribute with value that is outside of critical path. Few mentors are willing to risk project schedule by giving critical path tasks to unknown students. This is fully understandable, but is not an excuse to give students tasks that less skilled resources could perform.

If it is absolutely necessary to assign less meaningful tasks, offer a “when you get this task we REALLY need done, we want you to work on X” carrot. Students will understand the need to get through a tedious task and will work hard to get it done quickly and efficiently to get to the more interesting work. Remember that students want to have impact.

3.4 Make Students Full Team Members

Regular project meetings happen and students may or may not be requested to attend. It is better to spend the little bit of time to have students attend, if possible, to make them feel part of the team. Further, as the meeting leader, make a point of soliciting input from the student based on what they have done and seen. It may be minor and they may not be comfortable sharing, but seeing their opinions and knowledge be considered is a big confidence booster. That sort of boost increases motivation and productivity.

3.5 Have Students Write Papers

Research papers and reports are a typical output for a summer internship at a research institution. Even for

undergrads, making them in charge of presenting a report on their work helps them learn how to write better and how to think about their work in a methodical way. Start the term by informing them that this is an expectation. Have the students take notes, in a version controlled document, about everything they do that will later form the outline for a report. Work with them periodically to review their notes and help them work towards the final report. The last week or slightly more should be dedicated to finishing the report and having the student present their work to the team.

Even if the paper ends up being just a short paper, getting a peer-reviewed publication from a summer is a great accomplishment that can accelerate a student's school progression or even help them get into graduate school. When possible, try to offer the student example papers to emulate and offer feedback rather than editing. This achieves the student being a legitimate first author and they also learn the most possible. Letting them both earn and be first author is a great honor that no junior student expects. Helping them achieve that is another confidence booster.

4 Discussion

The goal of the efforts described in this paper are to make interns more productive parts of a team and to increase the value of their participation. All of the recommendations in this paper are the product of my years of experience in mentoring student interns in numerous of contexts and projects. While I do not claim to have the definitive answer for how best to integrate students into research projects, my hope is that this experience report will contribute to the broader discussion on how to strengthen research teams through incorporating interns. Internships are formative experiences for students to learn the skills and perspectives needed to participate in the scientific enterprise. As team members, students also make vital contributions to research projects, and positioning them for success benefits everyone involved. I have found that the strategies presented in this paper can yield happy, productive students with solid, lasting project impacts. As a researcher, every student I have ever paid has managed to develop sufficiently to generate a peer reviewed publication at an external venue based on the internship work. They have also left a code base, scripted tools, and full documentation about everything they did enabling me to build on their work for future projects. This includes four undergraduates students and more than six graduate students so far.

5 Conclusion

Through careful job posting guided by students for students; short, but frequent interactions; and empowering students with authority (under supervision) can create a positive environment making students as productive as possible.

By using reproducibility tools to script and document everything; modern version control systems for everything including issue tracking; assigning meaningful tasks to engage students; including students in all team meetings;

and having students write reports on their work, interns will become a part of the team, be productive, and offer a legacy others can build on without difficulty.

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