

This issue of CDTL Brief on Undergraduate Research features some articles presented at a CDTL and USP workshop, "Undergraduate Research" an oxymoron? Can undergraduates do research?" on November 2005.

Is Undergraduate Research an Oxymoron? Can Undergraduates do Research? A Perspective from the Faculty of Science

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The experience garnered in the short time I was on my UROPS project, was a turning point in my education to science and research. (Carmen Low, a Faculty of Science Student, 2006)

Student testimonials like Carmen's leave no doubt that research projects are a rewarding experience for undergraduate students. Yet, relatively few students participate and many faculty members remain reluctant to offer undergraduate research opportunities. Here, I introduce the main research modules offered in the Faculty of Science (FOS) and use examples from my own experience to emphasise that undergraduate research can be rewarding for students and faculty. Lastly, I speculate on why such research is still not as popular as it should be.

Undergraduate Research Opportunity in Sciences (UROPS)

The main research module for science students is UROPS. Students select a research topic from the UROPS website and/or arrange for a project by approaching supervisors. Projects can be offered at the 2000- or 3000-level and the latter can last for one or two semesters. At the end of a project, students write a report which is evaluated by the supervisor and two external faculty members. Because this

evaluation has to take place prior to the reading and exam periods, UROPS projects commence during the semester break.

I have supervised 16 UROPS projects during my four years at NUS. The design of the projects has changed significantly over these years. First, I now prefer to offer 8-MC projects. Only one report is needed and research time is maximised. Second, I now pay even more attention to the design of the project. The topic should be closely related to ongoing work in the laboratory so that UROPS students can ask for help from fellow laboratory members. However, it is equally important that the project can stand on its own feet as it is difficult for a student to become enthusiastic about a project if it is only a minor part of a larger investigation. Technically challenging or risky projects are generally not a good idea and the latter requires an escape strategy in case a critical experiment fails. Lastly, I abandoned co-supervised projects, because faculty members are so busy that such projects carry the risk that neither supervisor feels responsible.

Independent Study Modules (ISM)

Three different kinds of ISMs provide an alternative to UROPS. Within the FOS, ISMs are only available to students in University Scholars Programme (USP),

Special Programme in Science (SPS) and those who maintain a CAP of more than 4.5. Some characteristics of ISMs include:

1. An ISM can 'ride on' an UROPS project.
2. ISMs can ride on an existing class (i.e. student will carry out a small research project in addition to satisfying the regular module requirements).
3. Newly designed ISMs allow one or several students to design their own module and find a faculty member who is willing to supervise.

I have supervised 13 students in ten different module-based and newly designed ISMs. From my experience, students taking module-based ISMs are often desperate to satisfy ISM requirements and I have stopped entertaining these requests because the results are usually mediocre. Student-initiated newly designed ISMs are a more interesting format. Students in such ISMs are generally highly-motivated, readily read the relevant literature and discuss it in weekly meetings with their supervisor. Newly designed ISMs are also an interesting format for students who want to do individual research, but are unable to start during the semester break as required by UROPS.

Honours Thesis

The importance of UROPS and ISMs becomes apparent in Honours projects—arguably the most important form of undergraduate research. Undertaking an Honours project is a very challenging task for students without prior research experience. Only students who have completed a smaller project previously will be familiar with how to conduct research, write a report/thesis and defend the results. I am therefore reluctant to accept Honours students without undergraduate research experience.

Undergraduate Research: Problems

Grading

One very difficult issue is grading. Most supervisors realise that students work much harder on their 4-MC research project than on a corresponding 4-MC module. The obvious response will be to reward the student by assigning a high grade, especially if the supervisor and student have developed a close working relationship and mutual respect. Grade inflation in UROPS is avoided by having two external examiners read the report and question the student for 30 minutes. Some departments nevertheless feel the need for curving which I find disrespectful to those faculty members who have already spent considerable time examining the project. The comparatively high grades for UROPS/ISMs are in recognition of the research's quality and

the time that the students have spent on their project. Let us encourage undergraduate research and reward where reward is due.

Time commitment

Supervising undergraduate students is extremely time-consuming. An undergraduate student may require extensive training but he may nevertheless only stay for one semester. The same training invested in a postgraduate student will yield better returns. I suspect that this is the main reason why most NUS faculty members do not supervise UROPS or ISMs. Furthermore, although most undergraduate students are capable of conducting high-quality research, few can write manuscripts that could be submitted to international journals. Thus, the supervisor will have to do most of the writing and finding time for this task is difficult.

Lack of credit

Most faculty members optimise their time investments by channelling resources into activities that are rewarded in evaluation exercises (e.g. annual reviews). Unfortunately, I have seen no evidence that supervising UROPS, ISM or Honours count toward any of the three evaluated areas (research, teaching, service). Furthermore, all undergraduate research modules are excluded from students' assessment. It is thus not surprising that most faculty members do not supervise UROPS or ISMs. The obvious solution is to give credit where credit is due. Students who have carried out undergraduate research projects are better qualified and more confident graduates and one can only hope that the evaluation system will be changed to more adequately recognise undergraduate mentoring.

Undergraduate Research: Rewards

Albert Einstein said "not everything that can be counted counts, and not everything that counts can be counted" and many rewards from supervising undergraduate research fall into the former category. What could be more rewarding than seeing students getting excited about research? Experienced and enthusiastic undergraduate students are assets for any laboratory. My current Honours students joined the laboratory several semesters ago and carried out several UROPS or ISMs before embarking on their Honours projects. My current batch of Honours students is again recruited from within the laboratory and, given their prior research experience, they will be able to conduct sophisticated research. For example, five of my students recently presented 30-minute talks on their ISM/URPOS projects at an international conference in Norway. They won four of the top five

prizes in the student competition although they were competing with postgraduate students.

Conclusion

There are numerous opportunities for undergraduate research in FOS. For example, an USP student can take up to four UROPS/ISMs before embarking on his Honours thesis. Few universities offer such a variety of opportunities and one can confidently conclude that

at NUS the technical machinery for undergraduate research is in place. But this machinery is only utilised by few faculty members and not many students have the opportunity to engage in research. What is needed is to fine-tune the system to encourage faculty participation and give credit to faculty members who are willing to invest time in supervising undergraduate research. ■

ISM: 7 Rules of Successful Undergraduate Supervision

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Independent Study Modules (ISMs) and Undergraduate Research Opportunities Programmes (UROPs) in their original form were highly intensive, self-directed projects pursued by undergraduate students in University Scholars Programme (USP). With inputs and guidance from a supervisor (usually a lecturer with cognate interests/expertise in students' chosen field of research), many bright and highly-motivated students have done very promising research work that exposes and primes them for graduate work.

In the Department of Political Science, students normally choose a topic, approach a lecturer who has to agree to supervise him/her, and then submit an ISM paper of some 5,000 words at the end of one semester of research work.

However supervisors may already have several PhD, Master's and Honours students in addition to their own research, teaching and administrative responsibilities. Thus most supervisors are usually left with very little time for undergraduate research, and can typically take on no more than one or two ISM students per semester. In view of these constraints, I have found the following checklist useful in helping me decide whether to accept students who approach me to supervise their ISMs:

1. Choose Only Very Motivated Students

There is nothing worse than accepting an unmotivated student who wants to do an ISM only because it is a requirement. I usually ask potential students for as detailed a research proposition as possible. They should be able to at least identify a research question or puzzle

that interests them and have some ideas of the leading arguments in their field of research.

2. Accept Only Do-able Topics

Some topics are just impossible to do within a semester (the usual duration of an ISM in the FASS, although other faculties may have topics that stretch over a full academic year). Thus, the lecturer may have to advise students to trim down their research objectives or scope of work.

3. Meet Students for a Getting-to-Know-You Interview

This is an important means of getting an idea—after the initial round of emails (if approached by a student one does not know)—of students' time and academic goals/constraints.

4. Group Students

If a lecturer is approached by more than one student and there are students with similar research interests, it is often feasible and productive to group these students so that they can meet together with the lecturer. I did this once with a student who was doing research on the integration of Turks in Germany, and another who was working on the position of France in the EU after the "No" result on the European Constitutional referendum in 2005. Both students found it meaningful and productive to meet me together and even shared some of their research findings and readings between themselves. It was a win-win situation for all.

5. Postpone if Necessary

There may be some semesters where the lecturer is burdened with more responsibilities than he/she can handle. In such cases, it would be wise to suggest to students other supervisors whom they could approach, or postpone the project to another term. It is better to be able to devote quality time and attention to students than to take on too many ISM projects only to give them all half-hearted attention.

6. Draft Writing

Unlike the normal practice of producing only one term paper at the end of the semester in some faculties, I have found it useful to make students prepare short (1–2-page) outlines (e.g. list of references) *before* they embark on actual research, and then to produce at least one draft of their paper before submitting the finalised product. This not only ensures that students are familiar with important scholarship in the field, but also helps them make informed and critical decisions about which lines they would like to pursue in graduate research, and produce original and creative work.

7. Question Thoroughly

In humanities and social sciences at least, much of students' learning experience lies in working through questions of methodology and epistemology that the supervisor should be posing as the project/essay develops. Such training would prepare undergraduate students for research work at a higher level (e.g. Honours, Master's and PhD).

Conclusion

The ISM is an invaluable undergraduate research training programme. In supervising undergraduate research, supervisors can benefit from the exposure to bright and potential Honours and postgraduate students particularly if their research interest coincides with the supervisors'. ■



The Centre for Development of Teaching and Learning (CDTL) engages in a wide range of activities to promote good teaching and learning at the National University of Singapore, including professional development, teaching and learning support, research on educational issues, and instructional design and development.

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