What does it take to finish your graduate degree?: Issues, Challenges and Recommendations to the UP College of Science Graduate Program

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INTRODUCTION

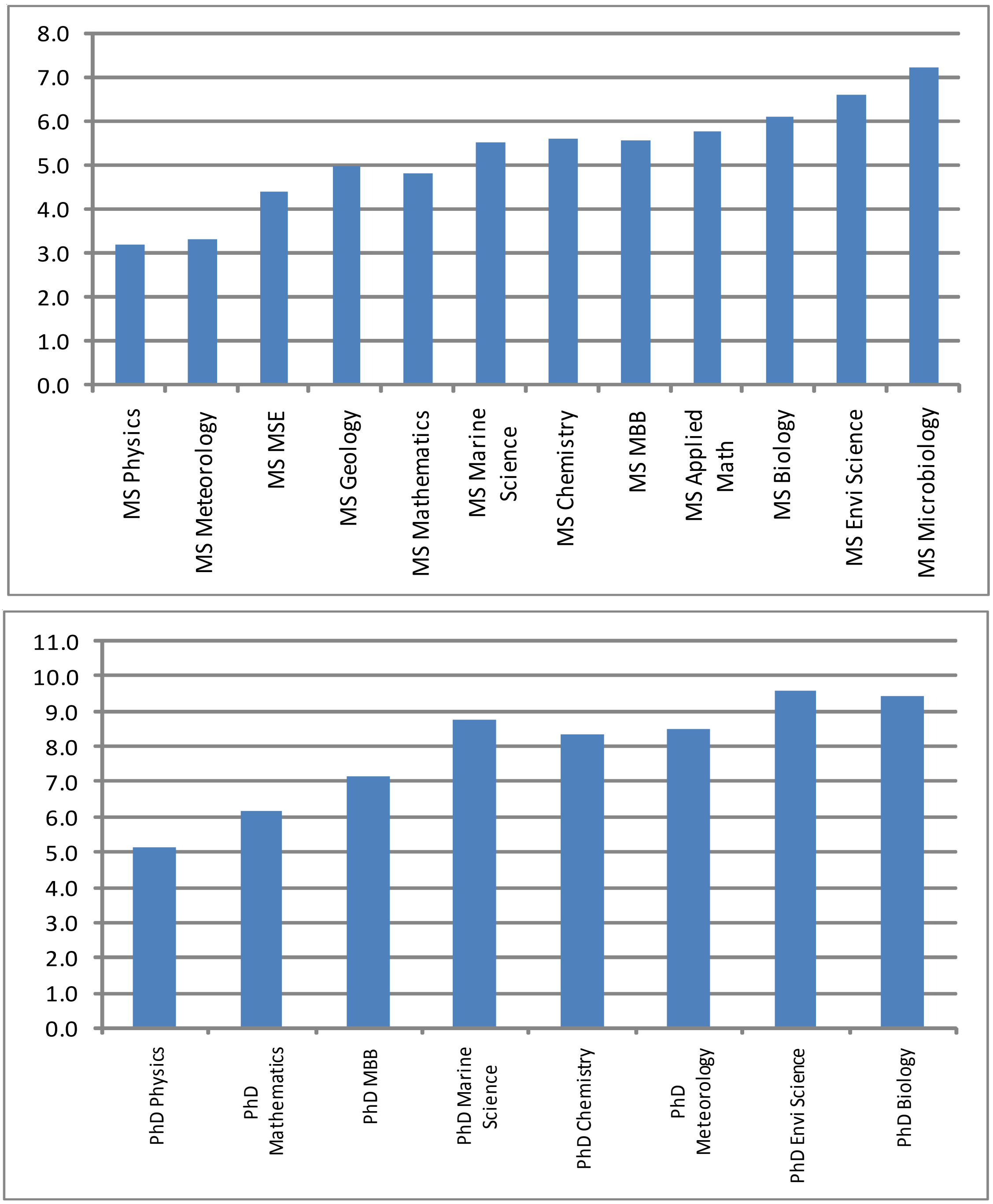
The percentage of a country's population having advanced degrees of learning, particularly in science and engineering, is often equated with the country's ability to sustain technological development and economic prosperity (Huang et al., 2009, CISCO, 2007). This as opposed to developing conventional sources of production, i.e. capital and labor (Pakes and Sokoloff, 1996). The Philippines has long recognized the S&T factor. It has embarked on several programs in the past to improve the capability of degree-granting institutions to provide graduate programs (faculty development, research and equipment grants). Numerous scholarships were also made available through the Department of Science and Technology (DOST, NSTA, ESEP, DOST-SEI, BCDA Fund, etc.) to encourage students to pursue their Master's and Doctorate studies. Partnerships (e.g., National Science Consortium, MOAs with foreign universities, SUCs, etc.) were built between institutions to encourage research collaboration and sharing of facilities. Together with these programs, it can be argued that attention should also be given to increasing the productivity of current researchers (Lacanilao, unpublished report). Ultimately, these strategies are aimed to increase the Philippines' ~7,500 S&T workforce and their output.

The University of the Philippines Diliman College of Science (CS) has recognized one other problem in our quest to produce more MS and PhDs: the low rate of graduation among our graduate students. CS reported that for the period 2000-2008, a success rate of 50% and 34% is computed for PhD and MS students for finishing their degrees, respectively. However, Table 1 shows a more dismal picture. CS produces an average

Table 1. CS student record data for 2000-2010
Source: CS Graduate Office

Institute/ Department	Program	Average Student Population/Year	Ave # Graduates /Year
IB	MS Biology	28	8.1
	MS Microbiology	22	
	Ph.D. Biology	16	1.5
IC	MS Chemistry	99	5.6
	Ph.D. Chemistry	11	0.8
NIGS	MS Geology	39	3.2
	Ph.D. Geology	4	0
MATH	MS Applied Math.	81	16.4
	MS Mathematics	31	No data
	Ph.D. Mathematics	33	3.2
IESM/DMO-M IESM-ES	MS Meteorology	11	0.9
	Ph.D. Meteorology	7	0.5
	MS Env. Science	85	7.5
	Ph.D. Env. Science	45	1.6
MSI	MS Marine Science	54	4
	Ph.D. Marine Science	19	0.9
NIP	MS Physics	56	12
	Ph.D. Physics	24	3.3
NIMBB	MS MBB	34	1.6
	Ph.D. MBB	15	0.9
MSEP	MS MSE	19	1.8
	Ph.D. MSE	3	0.1

of 13 PhD and 42 MS graduates each year out of 177 and 559 students, respectively. Statistics from 54 U.S. and Canadian Universities suggest a higher PhD success rate of 55-64% for the Physical and Life Sciences (Council of Graduate Schools, unpublished report). An earlier study of ten prominent U.S. Universities reported a 58% success rate in their PhD programs (Nerad and Cerny, 1991). There are no definitive studies for European Universities but a 22-30% attrition rate for PhD students is what is often quoted (Park, 2005). There are also no statistics on MS students' success rate but most likely this is higher than that of the PhD programs.



Figures 1a and 1b. Data on actual number of years that students take to finish their degrees (Average for 2000-2008) (CS Graduate Office Data).

The time it takes for students to finish their degree in the College of Science is also a recognized problem. Most U.K. universities report a PhD completion time of 3.5-4 years (Swain, 2008) and is most likely the same with the rest of Europe, Australia and Japan. The U.S. average is 6.7 years for Physical Sciences and 7.0 for Life Sciences (National Research Council, 1995). However, one reason for this is that the first two years of the U.S. PhD program is entirely devoted to course work. Therefore, the dissertation research proper itself is 4-5 years. Again, no data is available for Masteral programs but the norm for International Universities would be 1-3 years. In CS, students complete their PhD program anywhere between 5-10 years. Graduate students finish their MS degrees in 3.5-7 years (Figure 1a and 1b).

Several studies have been undertaken in the U.S. to study the attrition rate and length of graduate programs (NSF, 2005). It should be noted that attrition per se in a graduate program may not automatically be viewed as a negative trait. Examples cited in the NSF study include students who transfer programs, students who gain employment during his/her graduate training and other reasons that increased the productivity of an individual despite not completing his/her studies. Therefore, what is important is to look into specific reasons or factors (herein called *attrition/delay factors*) why graduate students are not able to finish and/or take a long time to finish.

The main objective of the present study is to uncover institutional, programmatic and personal factors that represent hurdles in successfully finishing a graduate degree. A questionnaire for CS faculty and graduate students was distributed in 2010. A total of 83 respondents (faculty and students) participated in the survey. The questionnaire contained inquiries on the respondent's details (Institute/department, years of teaching/years of graduate studies) and four questions:

- What do you think are the main reasons why it takes graduate students more than the prescribed number of years (MS 2 yrs, PhD 4yrs) to graduate?

- How do you define an MS Thesis?

- How do you define a PhD Dissertation? What's different from an MS Thesis?

- Can we use any quantifiable indicator to know when a student has finished an MS Thesis/PhD Dissertation?

Two of the questions explore one previously identified attrition/delay factor which is how the faculty as adviser, reader or thesis examiner gauges the quality of student research. To complement the survey, interviews were conducted with faculty members from several CS Institutes who have consistently guided students in finishing their degrees.

RESULTS AND DISCUSSION

All answers (coming from both faculty and students) to the first question pertaining to the delay factor are combined and summarized below. It is recognized that these factors are overlapping and interrelated; however, discussions will be separated for convenience into the following headings: Student, Adviser, Field of Study and System Factors.

Student Factor

- Poor focus among students
- Social obligations of students are prioritized over their studies
- Graduate students are often employed full-time
- University-employed students (as Research Assistants) often do research for their supervisors that is not part of their thesis research
- Students coming from other schools and/or from an undergraduate course that is different from their graduate course will take a longer time to finish (need for more coursework and longer training)

Most faculty respondents noted that the main reason for attrition/delay is that graduate studies are not the main priority of students. Students have other commitments (full-time jobs, family and other social obligations) which hinder them from taking more course work each semester and starting/sustaining their research. Even those employed by the University also argue that their workload prohibits them from focusing on their graduate research. This is one glaring difference with major Universities abroad wherein there are more full-time students than part-time students.

One other factor that was cited by respondents is the lack of preparedness of incoming students to conduct research. In particular, NIP respondents cite the generally faster finishing time for Physics students who did their undergrad in UP because more often than not, these students have already been exposed to research groups (and may have even started their graduate research) during their undergraduate years. This as opposed to students coming from different BS programs or from other Universities and therefore more training is required.

Adviser Factor

- Mentoring skills are not present
- Considers advising too much workload with little reward and therefore tends to limit either the number of students or the amount of time they devote to students
- Retains students for an extend period of time to have people work on their research/consultancy work
- Sets research standards too high

Arnold et al. (1986) in their survey on graduate student attrition in the U.S. cites as the primary source of dissatisfaction expressed by students is their perception that the faculty was not approachable. This is a genuine concern of students but obviously being “unapproachable” needs to be further defined. Graduate research can be regarded as a partnership between student and professor. This relationship can vary from having the student work on a specific topic as his thesis within the professor’s current research (much like having an employee-employer relationship) to a totally new topic but within the general scope of the professor’s field of expertise (equal partnership or independent research with some guidance). The type of relationship leads to how much involvement the faculty will have in the student’s research activities. However, what should be common in the relationship (regardless of type or extent) should be a set of responsibilities that determine expectations of both parties. This includes regular meetings or consultations and a time-bound schedule that each party should follow.

Mentoring students in U.P. is also regarded as an arduous task with very little benefit to the faculty. The current CS Merit Promotion System only puts 15 points per PhD (8 pts for MS) student graduated. In comparison, an ISI publication is given 90 pts. One promotional step is about 80 pts. CS is trying to correct this by giving more weight to successful mentorship (1 full step per PhD mentored; ¼ step per MS mentored) in the latest proposed CS Merit System.

Students employed as University Research Assistants (URAs) enjoy the full benefit of working in the lab where they will also be doing the analysis for their own work. It also provides an environment that makes daily interaction with their adviser possible. Two respondents believe that a conflict of interest may exist in that a professor/supervisor would tend to retain good URAs in their lab to do other research/consultancy work at the expense of these researchers not finishing their degrees on time.

Lastly, a common response of faculty and students is that the standards set for an MS thesis or a PhD dissertation is often set too high that finishing within the prescribed period is almost impossible. Both faculty and student realize that both can be guilty of setting out a target research output that is too much. Moreover, the final research scope and depth are determined by a panel during the thesis proposal defense. In all stages of research formulation, the qualitative evaluation of a study’s merit as to whether it is “enough” for an MS or PhD research can be very arbitrary. On the other end of the spectrum, this uncertainty can also lead to PhD dissertations which can be doable within four years but may be lacking in substance. The solution to this dilemma is to set out clear guidelines on research scope and depth. This is discussed in the next section.

Field of Study Factor

- No facilities to use
- No funding
- Discipline-specific attrition/delay factors

In general, advanced research in physical and life sciences will require sophisticated analytical instrumentation which may not be available to students for various reasons. This needs to be corrected at the stage of research formulation wherein the procedures and techniques to be considered are only those that available facilities can perform. A related issue to this is funding and that the scope of a study must somehow be limited with the available budget. Moreover, while many respondents cited that funding is a major factor in completing their graduate research, surprisingly, funding is not an issue across all CS Institutes.

Each discipline cited an attrition/delay factor that is specific to its own field of study. Test organisms in the life sciences include culture time, organism mortality and other biological processes that make research run longer. Laboratory-based research is also thought to run longer when results are contrary to what was initially expected. Setting up of new runs and repeated calibrations contribute to delays. Lastly, field-based studies take a long time as these are seasonally scheduled. Some sampling programs also need to be conducted over two to three years.

System Factor

- No clear guiding system for students (no advising during early years, no progress tracking system for latter years)
- Maximum Residency Rule (MRR) is not enforced
- Change in thesis/dissertation adviser and/or topic
- Difficult process/requirement in the program
- Scope of work in MS or PhD thesis is poorly defined

System factors are attrition/delay causes due to the lack of institutional rules in place. This includes the absence of a time-bound guiding system for students. Under this is the practice of assigning a program adviser for first and second year students. A program adviser is tasked to only advise the student on what courses to take, effectively allowing the student to postpone any research work that could have been started in his first year. The practice of defending a research proposal after data gathering has been done also contributes to delays. Graduate students wait till their 3rd or 4th year before defending their proposal. In MSI, proposal defense is apparently one of the most difficult requirements in the program such that students wait until their 4th year to do this. Time-bound deliverables should be adhered to (e.g. proposal defense on the student's 2nd year).

A guiding system in place should also effectively match students with advisers to decrease the possibility of changing topics and mentors midstream. Lastly, as what was mentioned in the preceding discussions, the scope of an MS or PhD research should be properly defined; if possible not by standard institute guidelines.

RECOMMENDATIONS

Three recommendations are herein forwarded:

1. Create a Mentoring Program
2. Level-off on the scope of a Masteral thesis/Doctorate dissertation
3. Provide indicators of "being done"

Mentoring Program

A Mentoring Program starts with the preparation of students even before they enter a graduate program. The practice of NIP in immersing their 4th and 5th year undergraduates definitely helps the students focus on their research interests early on. This should be adopted by other Institutes. For Institutes without the luxury of having an undergraduate program, it is proposed that lab immersion for students be done during the Summer prior to their official entry to the program. The key is to have students start their research as soon as possible. More importantly, the Institutes' policy for accepting students should be revisited. It is recommended that CS Units only allow entry of students with an accepting research adviser (as what is common practice in international Universities). Each unit must then set a minimum (and maximum) number of students being advised by each faculty at any given time. The process of accepting students would then include meetings with potential advisers before June. Lastly, this requirement also means that students must have a clear idea of at least a field of study to be able to be assigned to an adviser.

Second, every Institute must include a student tracking system wherein semestral milestones are established. This is regularly checked by the Unit and that students/ advisers are warned for not complying with time-bound requirements. This includes the adherence to MRR rules.

Training through workshops and instituted CS classes are recommended. CS can develop a workshop on mentoring for new CS faculty. For graduate students, it is proposed to have a CS-wide course on graduate research guidelines, research techniques, oral and writing skills. This will also serve as an opportunity for students to meet other students and faculty across CS which may lead to collaborations and interdisciplinary studies later on.

Scope and Depth of Research

Defining what is “enough” for a Masteral or Doctorate research is extremely difficult. The UP Faculty Manual (2003) defines a Masteral Thesis as “original and significant research or creative work”, while a Doctoral Dissertation is closely defined as “original, significant, independent scientific research or creative work”. Note that the word “independent” is the only difference between the two definitions. Furthermore, according to the Faculty Manual both MS and PhD research should also:

1. show the student’s capacity to make a critical evaluation of previous work done in his/her chosen research topic; and,
2. demonstrate his/her ability to present research findings in a clear, systematic, and scholarly manner.

Obviously, this definition does not help us much in defining significant research. A rubric in defining the components and their scope and depth is given in Table 3. This is drafted to apply to all natural/applied sciences but each Institute may further refine this to cater to their own specific fields.

What this rubric aims to do is to standardize our evaluation of research significance. It can be used as a guide during research formulation and during the thesis/dissertation proposal defense.

Provide indicators of “being done”

All research studies conducted appropriately should inevitably lead to more questions that need to be answered and provide insights on where new findings put forth can be applied to. This very nature of scientific research makes it a continuing process. Therefore, it is important to set indicators of when a research done as an MS or PhD requirement can be stopped and succeeding investigations are considered beyond the scope of the degree to be granted.

In many international Universities, the main indicator of “being done” is tied up to the publication of a student’s work. Publication through a refereed evaluation process is a tangible indicator of a research that has attained some level of significance. It is therefore proposed to institute such milestone as a prerequisite to a student’s graduation (Table 3).

A publication requirement will not only fix a tangible goal for students/advisers but also provide some form of quality assurance to the research we produce. This will also partly solve the earlier argument of increasing our S&T productivity. Lastly, this should also encourage more mentoring because any publication done by an adviser’s student will likewise be credited as part of his own research output.

Complimentary to the MS publication requirement should be the strengthening of university-based (e.g. Science Diliman) and national scientific publications. Efforts to increase the number of issues and an efficient review process (within 6 weeks of article receipt) should make local journals an attractive publication alternative.

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Table 2. Matrix of proposed graduate research scope and depth

Component	MS Thesis	PhD Dissertation
Methodology	Use of existing/established techniques	Use of novel or revised, existing techniques
Data	Primary and secondary data	Mainly primary data
Data validation	Proof of some statistical validity	Extensive statistical treatment of data
Data analysis	Samples may be analyzed by 3rd party	Samples must be analyzed by the student
Experimen-tation	Recognition of all variables in the experiment. Testing of at least 1 variable	Recognition of all variables in the experiment. Testing of at least two variables
Hypothesis	Does not need to prove a hypothesis. Negative results acceptable.	Needs to prove a hypothesis. Positive result required.
Research scope/ depth	Replication of a theory to a new area, organism, material or process	Testing of alternative aspects of a theory on to a new area, organism, material or process
Evidence of Mastery	Provide evidence of mastery of tools and understanding of relevant theories	Contribution of international significance through the development of new tools or new theories
Other require-ments	At least one National/Inter-national conference presentation	Conference presentation of 2 chapters of research. ISI Publication

Table 3. Proposed presentation and publication requirement

Degree	Presentation	Publication	Authorship
MS	In at least one national or international conference	In at least a local scientific publication or full paper in a Conference Proceedings	First author in one of the publications or co-author in an ISI publication related to his study
PhD	In at least one international conference	In at least two national or one international publication or one ISI publication	First author in one of the publications

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