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EDITORIAL

The Importance of an Undergraduate Thesis

Completing an undergraduate degree in physics or applied physics in the National Institute of Physics (NIP), College of Science, UP Diliman requires passing a thesis examination, where a student presents orally his or her research work to a panel that is composed of his or her thesis supervisor and two other members who are at least holders of a Master of Science degree in physics or related fields. The panel composition is determined *en banc* by the Graduate Committee consisting of all regular PhD faculty members of NIP.

Because no two students would work on the same topic, the experience that is gained in doing a thesis is unlike that of enrolling in an electromagnetism or quantum mechanics course where everyone in class is asked to answer the same set of questions. Defending a thesis to a panel of experts is a memorable rite of passage that could not be emulated by doing an individual class project—no matter how abstruse the subject matter is or inspiring is the instructor. Undergraduate thesis work is a crucial component in the training of a young person who wants to become an independent scientist and a successful mentor.

The undergraduate programs are designed for completion within five academic years, and it is in their third year of study that students apply for membership in one of the research programs undertaken by NIP in the areas of condensed matter, instrumentation physics, photonics, structure and dynamics, and theoretical physics. Acceptance in a program is prerequisite to getting a thesis supervisor who is a full-time PhD faculty member. Typically, a student toils for almost three years in the research laboratory of her supervisor before being deemed ready to defend her undergraduate thesis.

As a *bona fide* laboratory member, a student is duty bound to actively participate in a number of research related activities like regular (weekly) research meetings and group seminars—in addition to performing other assigned chores that should be done in order to keep the laboratory facilities operating reliably and safely to the benefit of all members. These facilities include not only delicate research instruments and experimental set-ups but also the inventory of supplies and materials, the growing collection of theses, dissertations, and reference materials—as well as the kitchen and the seminar room. Through enthusiastic engagement with seniors, a new member will learn about the code of responsible conduct in scientific research and the best practices for establishing and maintaining a nurturing environment that enables everyone in the laboratory to produce. Best practices and proper behavior are honed over time and handed down from one batch of student-members to another.

Singular *eureka* moments that lead to crucial turning points in a research endeavor often happen in a laboratory setting rather than in a classroom where you have to pay attention to the lecturer. These epiphanous episodes may be triggered by a cursory inquiry of the supervisor during a research meeting, a plain comment of a fellow member during a break from a tedious experimental run, or while listening to a seminar presentation. While impossible to predict when do such serendipities happen, they are likely to favor those who are hardworking, motivated, and skillful.

Research meetings are conducted regularly to help ensure that steady progress is achieved. They are not dreaded times for listening to platitudinous *sermons* but rather anticipated occasions for incremental self-improvement as scientists. They become worthwhile when the supervisor and his or her advisee act as research partners playing complementary roles in the quest to understand how Nature works. A responsible supervisor would generously share his considerable technical expertise while dutifully alerting his advisee of the possible mistakes and pitfalls that can slow down her research progress. On the other hand, an advisee always remains enthusiastic, hardworking, and reliable in providing results of increasing accuracy and precision.

In the laboratory, the student will learn first-hand about the operational meaning and practice of self-regulation in the scientific community. A research problem is worth pursuing if it is not yet adequately solved and a claim to a

scientific discovery or invention is taken seriously only if it is original, novel, and scientifically meritorious. The aforementioned criteria are deemed satisfactorily met if the research findings are published in a peer-reviewed journal. The premature posting of raw data in the social media is grossly inappropriate, no matter how many avid followers that such release is likely to gather.

Students should be taught early on that only those who have made substantial contributions to the conception and design of the research endeavor, the acquisition of data, or analysis and interpretation of data would qualify as co-authors in the ensuing scientific report. Substantial contribution is best ensured if only those who regularly participate in research meetings are considered for co-authorship. All co-authors are involved in the manuscript preparation and shall approve the final version that is published.

Laboratory training is not only concerned with teaching a sophisticated computational method or mastering a delicate measurement technique. It also educates the student about the acceptable ethical behavior of a scientist and the importance of developing a clear understanding of what constitutes a research misconduct or a questionable research practice—and why committing them would set back the science community and undermine public trust in the capability of the scientific enterprise system to provide the most sensible solutions to the difficult questions facing the world today.

The NIP was established from the Department of Physics on March 23, 1983 through Executive Order No. 889 that was issued by then Philippine President Ferdinand Marcos. Before evolving into a national institute, the department was offering an all-coursework four-year BS Physics program without an undergraduate thesis requirement. Its graduates were not afforded an opportunity to do supervised research work and were unable to develop a particular skill-set that served as the crowning achievement of their undergraduate study. The program produced only a handful of graduates—typically fewer than ten per academic year—and their employment opportunities were limited. In contrast, forty-three students passed their thesis examinations in the second semester of AY 2017-2018. Their arduous thesis work has prepared them well to meet with the different employment demands of a knowledge-based global economy.

Moreover, the BS Physics and Applied Physics graduates who have produced promising research results are also more likely to proceed to graduate studies and continue their noble quest to understand more accurately how Nature works. Securing a steady stream of highly skilled and motivated new students is one critical element to a successful graduate program that produces many PhD graduates in a timely manner. The other is the availability of committed and competent dissertation supervisors and mentors.

CAESAR SALOMA
Editor-In-Chief