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Production of STEM PhD Graduates: First decade of the ASTHRD and ERDT Programs

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ABSTRACT

The first decade (2007–2018) of implementation of the Advanced Science and Technology Human Resource Development Program (ASTHRDP) and the Engineering Research & Development for Technology (ERDT) Program was examined to identify possible best practices and continuing challenges encountered in the production of new Filipino PhD graduates in science, technology, engineering, and mathematics (STEM). The ASTHRDP and the ERDT Program, started in 2007 by the Department of Science and Technology (DOST) in partnership with selected Philippine higher education institutions (HEIs), aimed to produce more STEM PhD and MS graduates. The DOST identified ten (10) and eight (8) out of 1900 HEIs, to partner with, in the initial implementation of ASTHRDP and the ERDT, respectively. From 2008 the total number of PhD and MS scholarships awarded per fiscal year both increased at an average annual rate of 18% (PhD: 302 to 893; MS: 956 to 2,832, respectively). The PhD and MS scholarship packages enable an awardee to study fulltime for three and two academic years, respectively. From 2007 to 2015, 662 ASTHRDP PhD scholarships were awarded and produced 373 PhD graduates from 2007 to 2018, with a graduation efficiency rate of 56.34%. The corresponding ERDT rate was 48.13% with 268 PhD scholarships awarded and 129 PhD scholars graduated. The ASTHRDP partner institutions performed at varying individual efficiencies, with the Visayas State University at 100% (with all 16 PhD scholars graduated), University of the Philippines Diliman at 34.34% (34 out of 99), UP Los Baños at 65.59% (162 out of 247). For ERDT, UP Diliman had a graduation rate of 61.1%. The availability of more dissertation research supervisors was identified as a key factor towards improving the ASTHRD and ERDT PhD graduation rates. A number of recommendations are proposed with the aim of improving the program graduation efficiency and producing more highly trained scientists and researchers to serve the national interest.

Keywords:
Advanced human resource development, Department of Science and Technology Philippines, Advanced Science and Technology Human Resource Development Program, ASTHRDP, Engineering Research & Development for Technology, ERDT

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Abbreviations: Advanced Science and Technology Human Resource Development Program (ASTHRDP), Commission on Higher Education (CHED), Engineering Research & Development for Technology Program (ERDT), gross domestic expenditure for R&D (GERD), science, technology, engineering and mathematics (STEM), state universities and colleges (SUCs), Science Education Institute (SEI).

I. INTRODUCTION

National economies around the world are interconnected but governments are taking an increasingly aggressive approach at protecting the intellectual properties of their homegrown entrepreneurs. Countries need to train their own cadre of R&D personnel (researchers, scientists, and engineers) in order to keep their economies both globally competitive and growing at a pace that enables them to effectively counter the downward pressures of unfavorable population demographics, dwindling natural resources, and unforeseen national calamities.

The organized task of R&D personnel in science, technology, engineering and mathematics (STEM) is to advance current scientific understanding of various natural phenomena and to apply successfully this newly gained knowledge to develop more precise and reliable techniques and tools for boosting labor productivity and for enhancing the quality of life in general. The UNESCO has long argued that a sovereign state needs a minimum of 380 full-time equivalent R&D workers per million inhabitants (FTEs) and an annual gross domestic expenditure for R&D (GERD) that is equivalent to at least 1% of gross domestic product (GDP) in order to build and sustain a knowledge-based economy.

The World Bank reported that there were 78.83 ± 5.18 and 187.66 FTEs in the Philippines during the period 2003–2011 and year 2013, respectively (World Bank 2019). The Department of Science and Technology (DOST) mentioned during the 2019 Luzon Regional Scientific Meeting of the National Academy of Science and Technology (NAST) that the Philippine GERD rose from 0.137 ± 0.015 % in 2002, 2003, and 2005 to 0.57 ± 0.061 % in the period 2016- 2018 (Nazareth-Manzano, 2018). The upward trend in GERD is driven by the increasing governmental support for scientific R&D and the growing enrollment in the HEIs.

The 2018 national budget was 2.18 times bigger than that in 2006, with the corresponding allocations for the DOST and the state universities and colleges (SUCs) increasing 6.035 and 3.43 times, respectively. The sustained budget increases were a result of a growing Philippine economy. From 2006 to 2016, the annual National Expenditure Programs that were prepared and submitted by Malacañang to Congress for approval were equivalent to 19.3 ± 1.32 % of the GDP in the previous fiscal year. The Philippine population grew from 77.992 million in 2000 to 104.918 million in 2017, at an average annual rate of 2% despite having a life expectancy of 68.6 years, which is lower than the world average, 70.8 years, in the period 2005–2010 (Saloma, 2018).

Sensibly, the Philippine government continues to invest in advanced human resource development to train and produce more Filipino scientists and researchers. During the 2019 NAST Visayas Regional Scientific Meeting, the DOST through the Science Education Institute (SEI) presented its plan to offer 1,927 PhD, 4,264 MS, and 31,360 BS scholarship grants in the year 2020, which are 51.7%, 17.4%, and 33.3% larger than the corresponding numbers in 2018 (Biyo 2020). From 2008 to 2018, the number of PhD, MS, and BS scholars who were supported by the DOST increased at an average yearly rate of 32.1%, 28%, and 12.9%, respectively, to 302 PhD, 956 MS, and 10,294 BS. The graduate scholarships were administered by the SEI primarily through the Advanced Science and Technology Human Resource Development Program (ASTHRDP) and the Engineering Research & Development for Technology Program (ERDT).

The ASTHRDP and the ERDT were established by the DOST in 2007 in partnership with a number of HEIs that were selected due to their pre-existing STEM PhD degree programs. The following schools were initially invited to participate as ASTHRDP

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consortium partners: Ateneo de Manila University (ADMU), Central Luzon State University (CLSU), De La Salle University (DLSU), Mindanao State University-Iligan Institute of Technology (MSU-IIT), University of the Philippines (UP) Diliman, UP Los Baños, UP Manila, UP Visayas, University of Santo Tomas (UST), and Visayas State University (VSU). The University of San Carlos (USC) in Cebu joined sometime later. On the other hand, eight were chosen as ERDT partner-institutions: ADMU, CLSU, DLSU, MSU-IIT, Mapúa University (MU), UP Diliman, UP Los Baños, and the USC. The number has not changed up to the present time. Five of the ten original ASTHRDP and four of the eight ERDT partner-institutions institutions are located in the National Capital Region.

In this paper, we examined the performance of the ASTHRDP and the ERDT in terms of PhD and MS graduate production relative to the number of PhD and MS scholarships awarded more than a decade after the two programs were first implemented. Our aim is to formulate evidence-based recommendations that will address existing structural weaknesses that hamper the graduation efficiencies of the two publicly funded programs. If adapted and implemented successfully, these recommendations will help accomplish a more prudent use of precious national resources and a more efficient utilization of our country's young scientific talent.

II. BACKGROUND

A. The STEM Human Resource Feeder Structure

The Philippines, with a population estimated at 107.29 million in 2019 (Statista n.d.) is the 13th most populous country in the world. It harbors a large number of talented high school students who could be recruited to pursue STEM undergraduate degrees and then encouraged and groomed to continue to graduate school and eventually earn a PhD degree in a highly specialized STEM field of study. About 1.253 million students were enrolled per high school level in AY 2016–2017 (PSA 2017).

A particularly rich reservoir of young scientific talent is the Philippine Science High School System (PSHS) which is operated by the DOST. The PSHS has an established national presence through its seventeen campuses which are strategically located across the archipelago. Total PSHS enrollment during AY 2017–2018 was close to 7900, a figure that translates to a high school graduation rate of around 1,300 per year. Aside from the PSHS, the domestic high school system also includes another set of fifty-three (53) science high schools in addition to several private high schools with excellent training programs in STEM, all of them being managed and regulated by the Department of Education.

In AY 2018–2019, the Commission on Higher Education (CHED) accredited a total of 1,963 HEIs including 111 nationally funded state universities and colleges, and 131 other public institutions that are financed by local government units [CHED 2019). Eighty-eight percent of HEIs are privately-owned. The number of approved HEIs increased by 3% (57) relative to that in AY 2017-2018. A total of 362 HEIs were accredited with the highest status of Level IV in terms of the quality of the faculty, services and facilities representing a year-to-year increase of 9%.

Close to half (47%) of undergraduates (3.212M) were enrolled in public HEIs where access to tertiary education is free as provided for by Republic Act 10931 that was signed into law by Philippine President R. Duterte in August 2017. Between AY 2003–2004 and AY 2015–2016 (13-year period), undergraduate enrollment grew by 69% to 4.105 million with those in public HEIs rising at a rate of 10% per annum [7-8] (CHED 2019; Saloma 2016). STEM accounted for 13.7% of the total undergraduate enrollment of 2.982 million in AY 2017–2018.

In AY 2018-2019, 50% of graduate students (0.751 million) were studying in public HEIs. Graduate school education is not covered by the subsidy provisions of RA 10931. In AY 2017 2018, STEM enrollment accounted for 13.8% of the total with 1.54% of students pursuing graduate degrees in the sciences and mathematics. In comparison,

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there were 0.3882 million graduate students in AY 2003–2004 with 36.5% of them studying in public HEIs. By AY 2014-2015, the graduate population increased to 0.647 million, with 46.2% of them in public institutions. Enrolment in CHED priority disciplines was 0.231 million, representing 59.44% of total enrolment in 2003. It became 0.371 million or 57.2%, of total enrolment in 2014. The graduate enrolment in CHED priority disciplines in 2014 was: sciences (1.9% of total enrolment); maritime, medicine and health, engineering and technology (17.7%), agriculture-related and veterinary medicine, teacher education, information technology-related, and mathematics (0.77%), and architecture and planning.

A palpable correlation was observed between graduate and undergraduate enrolment and Philippine GDP growth [8]. The GDP grew steadily at an average rate of 8.9 ± 2.54% per annum from 2005 to 2015, which enabled more Filipinos to pursue graduate studies at a growth rate that was faster than that for undergraduate enrolment. Graduate enrolment in all fields increased by 67.12%, with enrollment in STEM growing at a slower pace of 38.53% from AY 2003–04 to AY 2014–15. Because the corresponding number of PhD faculty increased by only 3.3%, a majority of these graduate students encountered considerable difficulty in getting a PhD degree due to the lack of qualified dissertation research supervisors.

Less than 1% of accredited HEIs have the means to offer STEM PhD programs due to the lack of qualified PhD faculty members to teach graduate courses and to supervise the doctoral dissertation research of PhD students. This scarcity of competent and committed PhD supervisors has been hampering the production of more doctoral graduates not just in STEM but in other academic fields as well. In AY 2003–2004, only 9.24% of all HEI faculty members were holders of requisite doctoral degrees. Fifteen years later in AY 2018–2019, the number increased to 16.58% reflecting a measly average growth rate of 0.49% per annum. The non-availability of PhD supervisors coupled with the complexity and high cost of starting and operating a research laboratory, are preventing more HEIs—especially in other regions of the country—from offering tenable STEM PhD programs.

B. The ASTHRDP and ERDT Scholarships

The DOST first conceived of the ERDT Program and the ASTHRP in 2007 for the purpose of increasing the number of STEM PhD and MS graduates by coordinating and making full use of available resources including PhD faculty members in the different HEIs, and by providing financial support for student scholarships and research grants. The DOST-SEI started by evaluating the capabilities of all Level IV HEIs and found that only nine were offering a tenable STEM PhD degree program for qualification to participate in either program.

The ASTHRDP is managed by a Steering Council that is composed of representatives from the DOST and the partner-academic institutions. Council representation is usually through the deans of the colleges offering the degree programs where the ASTHRDP scholars are enrolled in. For example, UP Diliman is represented by the incumbent Dean of the College of Science while UP Los Baños is served by the Dean of Graduate School. The DOST is represented in the Council by the SEI Director. A similar arrangement was also adopted for the ERDT Program with the Dean of the College of Engineering representing UP Diliman.

The Steering Council is the highest policymaking body of the ASTHRDP. It screens and recommends the names of the successful student applicants in each academic year for possible financial support by the DOST. Prior admission to a bona fide degree program in a partner institution is an application pre-requisite. The ASTHRDP and the ERDT have identified 105 and 26 priority scientific disciplines for possible scholarship support (Biyo, 2019).

Table 1 lists the number of DOST scholarships that were awarded yearly from 2008 to 2018. Also shown are the projected number of scholarships to be awarded in 2019 and 2020. The number of available PhD and MS scholarships have increased steadily at average yearly rates of 41.38% and 26.62% respectively, from 2008 to 2020 (DOST SEI

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2019). The number of undergraduate scholarships increased at a slower pace of 15.77% per annum.

In the fiscal year 2018, the PhD scholarship package consisted of full tuition support, a tax-free stipend (PhP 33,000/mo), book allowance (PhP 10,000/year), transportation allowance (actual), dissertation grant (PhP 100,000), research grant (PhP 253,000), and research dissemination grant (PhP 150,000). The benefits are deemed sufficient to enable a PhD scholar to study full-time for three years without the need for an additional source of income. In addition, the PhD supervisor who is able to successfully graduate a scholar-advisee within a prescribed period of time is also awarded an incentive mentoring fee of PhP 72,000.

III. PROGRAM PERFORMANCE

Table 2 presents the number of ASTHRDP scholarships awarded yearly from 2008 to 2015 (7-year period) together with the number of PhD scholars who graduated in the different partner-institutions from 2007 to 2018 (11-year period) (DOST-SEI 2019). The periods of reckoning are chosen to take into account that the PhD degree curriculum is designed for completion in three years.

Table 1. Number of DOST undergraduate, MS and PhD scholarships awarded from 2008 to 2020 via the ASTHRDP and ERDT Program.

DEGREE	AWARDED										TARGET		
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BS	10,284	11,246	10,142	9,099	9,565	10,031	12,117	15,858	17,491	19,058	23,531	26,831	31,360
MS	956	1,715	2,137	2,079	1,459	1,744	1,912	2,282	2,407	2,832	3,632	4,206	4,264
PhD	302	392	489	513	416	425	466	625	720	893	1,270	1,985	1,927
TOTAL	11,542	13,353	12,768	11,691	11,440	12,200	14,495	18,765	20,618	22,783	28,433	33,022	37,551

Table 2. Number of ASTHRDP scholarships awarded (2008-2015) and corresponding number of PhD graduates produced (2007-2018) by the ASTHRDP partner-institutions.

ASTHRDP Partner Institution	PhD Scholars 2007-15	Allocation (%)	PhD Graduates 2007-18	Graduation Rate (%)
Visayas State Univ	16	2.42	16	100.00
Central Luzon State Univ	38	5.74	31	81.58
UP Los Baños	247	37.31	162	65.59
Univ of Santo Tomas	49	7.40	31	63.27
MSU Iligan Institute of Tech	72	10.88	44	61.11
ASTHRD Program	**662**	**100.00**	**373**	**56.34**
UP Manila	25	3.78	12	48.00
Univ of San Carlos	16	2.42	7	43.75
De La Salle Univ	44	6.65	18	40.91
Ateneo de Manila Univ	24	3.63	9	37.50
Others	19	2.87	7	36.84
UPD College of Science	99	14.95	34	34.34
UP Visayas	13	1.96	2	15.38

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Within the 7-year period of reckoning (2007–2015) a total of 662 PhD scholarships were awarded with 37% and 15% of the scholars pursuing their doctoral studies in UP Los Baños and UP Diliman College of Science, respectively. Within the corresponding 11-year period (2007-2018), a total of 373 PhD scholars were graduated representing a graduation efficiency rate of 56.34% for the ASTHRDP. The VSU graduated all its assigned scholars while UP Visayas recorded the lowest efficiency rate of 15.38%. Five partner institutions performed above par: VSU (100%), CLSU (81.58%), UP Los Baños (65.59%), UST (63.27%), and MSU-IIT (61.11%). Together they graduated 67% (284 out of 422) of their assigned PhD scholars.

The following partner-institutions underperformed: UP Manila (completion rate: 48%), USC (43.75%), DLSU (40.91%), ADMU (37.50%), UP Diliman (34.34%) and UP Visayas (15.38%). Together they graduated only 37% (89 out of 240) of the scholars entrusted to them for technical training. There is a wide 30 percentage-point gap between those that performed above and those that performed below the average ASTHRDP performance.

Table 3 also tabulates the number of ERDT scholarships awarded from 2008 to 2015 together with the number of PhD scholars graduated by the different partner-institutions from 2007 to 2018 (DOST-SEI 2019) . Within the 7-year period of reckoning a total of 268 PhD scholarships were awarded with 40.30% and 10.45% of the scholars pursuing their doctoral studies in UP Diliman College of Engineering and DLSU, respectively. Within the corresponding 11-year period, a total of 129 PhD scholars were graduated representing a graduation efficiency rate of 48.13% for the ERDT.

Three partner institutions performed above par: DLSU (completion rate: 64.29%), UP Diliman (61.11%), and ADMU (50%). Together they graduated 61% (91 out of 150) of their assigned PhD scholars. On the other hand, the following partner-institutions performed below par: CLSU (48%), MSU-IIT (46.67%), UP Los Baños (42.86%), MU (12.82%), and the USC (11.11%). Together as a cohort they graduated 32% (38 out of 118) of their assigned PhD scholars. A twenty-nine percent gap exists between those that performed above and below par.

IV. Discussions

Offering a course where only about half of its enrollees can be expected to pass at the end of

Table 3. Number of ERDT scholarships awarded (2008–2015) and the corresponding number of PhD graduates produced (2007–2018) by the ERDT partner-institutions.

ERDT Partner Institution	PhD Scholars 2008-15	Allocation (%)	PhD Graduates 2008-18	Graduation Rate (%)
De La Salle Univ	28	10.45	18	64.29
UPD College of Engineering	108	40.30	66	61.11
Ateneo de Manila Univ	14	5.22	7	50.00
ERDT Program	**268**	**100.00**	**129**	**48.13**
Central Luzon State Univ	25	9.33	12	48.00
MSU Iligan Institute of Tech	30	11.19	14	46.67
UP Los Baños	14	5.22	6	42.86
Mapúa Univ	39	14.55	5	12.82
Univ of San Carlos	9	3.36	1	11.11
Others	1	0.37	0	0.00

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the term is always a cause of deep concern for a department in an academic institution whether public or private. It is a manifestation of an underlying systemic inefficiency that has less to do with the individual students themselves and more with institutional planning and implementation as well as with the degree of diligence of those in-charge to effect timely corrective feedback-action.

The performance of the ASTHRDP and ERDT Program may be viewed in a similar manner given that their PhD graduation efficiency rates for the period 2008-2015, were only 56.34% (373 graduates out of 662 awardees) and 48.13% (129 out of 268), respectively. For the remaining 428 scholars who were unsuccessful, the long hours spent in graduate studies could be considered as a poor personal investment as they might have to refund some amounts of money as stipulated in the terms of their contracts. The public funds that were allocated and spent to support them were not money well-spent for the Filipino taxpayers. The costly inefficiency is bound to continue if valuable lessons are not learned and genuine improvements are not introduced into the tedious academic process of training STEM PhD students.

Let us take a closer look at the graduate performance of UP Diliman—the largest campus in the UP System in terms of student population and number of PhD faculty members. Figure 1 plots the yearly number of PhD graduates produced by the UP Diliman College of Engineering (CoE) and the College of Science (CS) from AY 1990–1991 to AY 2018–2019.

Within the 29-year period (1990 –2019), the College of Science produced an average of 12.24 ± 3.75 PhD graduates per year while UP Diliman as a whole produced a yearly average of 64.45 ± 15.75. In comparison, UP Los Baños and UP Manila produced an average of 53.80 ± 9.32 and 1.73 ± 1.62 doctoral graduates per year, respectively, over a 15-year period. Furthermore, the 835 doctoral graduates of UP Diliman from AY 2003–2004 to AY 2014–2015 took an average of 7.88 ± 1.57 years to satisfy their academic requirements that were designed for completion in three years for students with the requisite master's degree (Saloma, 2016).

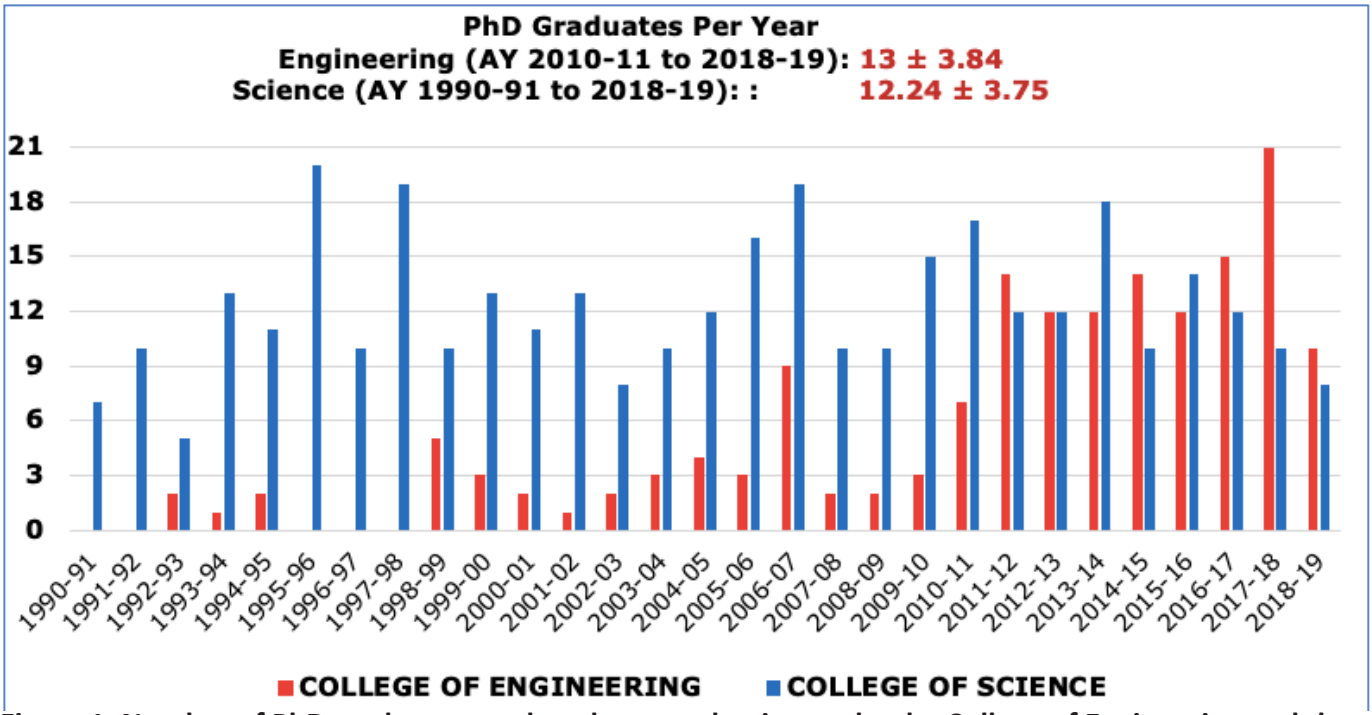

Figure 1. Number of PhD graduates produced per academic year by the College of Engineering and the College of Science of UP Diliman from AY 1990–1991 to AY 2018–2019.

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Figure 1 further shows that the inception of the ERDT Program has enabled the CoE to improve its PhD production to a yearly average of 13 ± 3.84 between AY 2010–2011 and AY 2018–2019, which is slightly higher than the 29-year CS average (12.24 ± 3.75) even though the former has fewer PhD faculty members than the latter.

In July 2018, a total of 78 and 168 full-time PhD faculty members were employed by the CoE and the CS, respectively. In February 2020, UP Diliman employed a total of 607 PhD faculty members, representing 47% of its total regular faculty members (245 professors, 277 associate professors, and 760 assistant professors). Four years earlier in December 2015, the CS faculty accounted for 30.9% of the UP Diliman total of 498 PhD faculty members. From December 2015 to July 2018 the size of the CS PhD faculty increased by 9% with the CS percentage relative to the UP Diliman total, decreasing slightly to 28%.

The figures reveal that the hiring of more PhD faculty members has not translated to the graduation of more PhD students in UP Diliman. Figure 1 indicates that the increase in the number of CS PhD faculty has not enhanced the PhD graduate production. In fact, CS PhD production has been on a downward trend from AY 2013–2014 to AY 2018–2019. The 29-year CS PhD production record is fluctuating with peaks and troughs happening throughout time indicating the absence of a long-term tendency to grow. The inception of the ASTHRDP has not made any perceptible impact on CS PhD production going into the second decade of the 21st century.

The STEM PhD degree is a research degree that is granted to a student who has been able to contribute new scientific knowledge that improves the accuracy of our understanding of a physical phenomenon. The crucial duty of the dissertation supervisor is to direct and guide the dissertation research of their student-advisees thereby allowing them to satisfy in due time all the duly approved academic and research requirements of the PhD program. The requirement for an original, novel, and scientifically significant research contribution is a singular feature that distinguishes STEM PhD training from those of other professions. Imposing prior acceptance of the dissertation research results in a peer-reviewed journal is a sensible criterion for allowing a PhD candidate to proceed with the dissertation examination.

The Philippines produces a yearly average of 1532.55 new lawyers (period: 2000–2019; yearly passing rate: 24.58%), 1924 new certified public accountants (2000– 2019; 30%) and 2,875 new medical doctors (2000–2016; 81%). There is no available official figure but the information presented here allows us to estimate that not more than a hundred new STEM PhD graduates are produced yearly in this country.

V. RECOMMENDATIONS

The DOST provides the financial requirements to operate the programs but it is not the one that grants the PhD degree to the ASTHRDP and the ERDT scholars. That authority is vested upon the HEI partner-institutions of ASTHRDP and the ERDT. Based on available information, we recommend a number of actions that can be undertaken to enhance the PhD completion rates of the two advanced human resource development initiatives and the STEM PhD programs offered by concerned HEIs in the country.

Firstly, the Steering Councils must adopt a more pro-active role in improving the PhD production efficiency of their assigned programs. The Councils need to examine more closely the different practices and learn why the PhD graduation efficiencies of partner institutions vary widely. The Visayas State University was able to graduate all of its PhD scholars while all constituent units of the UP System except for UP Los Baños, performed below the ASTHRDP average of 56.34%—UP Manila (48%), UP Diliman (34.34%), and UP Visayas (15.38%). On the other hand, UP Los Baños which hosted the highest number of the concerned ASTHRDP scholars, performed creditably with a PhD graduation rate of 65.59%.

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Note that most of the PhD degree programs offered by the ASTHRDP partner institutions are not redundant or duplicates of each other. Thus, simply suspending partnership with underperforming degree programs would only remove any possibility for long-term growth and development of a critical expertise such as fisheries which is a flagship program of UP Visayas. Discontinuance of partnership would be a solution that is worse than the problem itself.

Secondly, successful mentoring of a PhD student must be made into a critical requirement to cross-rank promotion especially to full professorship and more importantly, to the grant of tenure to STEM PhD faculty members. In UP Diliman College of Science, only the National Institute of Physics is currently imposing successful PhD mentoring as a prerequisite for tenure endorsement. Other colleges of science only require the successful mentoring of MS students. Unless the aforementioned requirement is adopted, the hiring of more STEM PhD faculty members would not necessarily lead to more PhD graduates as shown by the data herein.

It is reasonable to expect for a PhD faculty member to graduate at least one PhD student in every three years. For UP Diliman College of Science with its 168 PhD faculty members this expectation will result in the production of about 50 PhD graduates annually on average which is roughly four times the prevailing CS output of 12.24 per year. For the UP Diliman College of Engineering with its 78 PhD faculty members, the recommended policy change will increase its current output of 13 to 25 PhD graduates per year. For the said policy to be fair and reasonable, the concerned HEIs must develop and provide a nurturing and enabling environment for PhD faculty members to succeed as mentors of PhD students. The Steering Councils can start by taking a regular inventory of all PhD faculty members participating in the ASTHRDP and the ERDT Program.

The successful mentoring of STEM PhD students should be given a lot of weight in faculty promotions, and grant of awards and recognition.

Finally, the STEM PhD degree programs must be made freely accessible to qualified BS graduates so that those who do not qualify for ASTHRDP and ERDT scholarships for one reason or another, can still proceed to enroll without incurring too much personal financial burden or a drastic change in their daily work routine.

It is emphasized that if things remain as they are in the way that HEIs train PhD students, the relatively low graduation rates will persist and the offering of more ASTHRDP and ERDT scholarships will just result in more unsuccessful scholars and in an ill-advised utilization of ever-limited government resources.

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