

## Assessment of Microbiology Education in the Philippines

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**In 2014, only 8.7% or 202 out of 2313 Higher Education Institutions (HEIs) in the Philippines were reported to offer a BS Biology degree. An analysis of the microbiology programs of 37 HEIs-respondents in 2016 using questionnaire, augmented by data from websites, and personal interviews revealed that only eight HEIs offer a BS Biology program with a major in microbiology. Only one HEI offers BS Microbiology in the whole country. Together with five others, it produces graduates that are automatically qualified to take the certification examination conducted by the Philippine Academy for Microbiology (PAM). In one HEI, its graduates were deemed unqualified to take the PAM examination as they lack Microbial Ecology, a required course. Two other HEIs can produce graduates that can qualify to take the PAM examination by designing a program that will allow students to take all the required courses from a list of microbiology offerings. Some courses are even offered only as electives. One HEI offers all the necessary courses as electives even as a microbiology major program is non-existent. Only the Basic Microbiology course is common to the BS Biology programs of the 37 HEIs that provided sufficient data for analysis. There are graduate programs in Biology in ten HEIs but only the University of Santo Tomas (UST), University of the Philippines Diliman (UPD) and University of the Philippines Los Baños (UPLB) have MS Microbiology programs. Five HEIs have a doctoral program but only UPLB offers a PhD degree in Microbiology, while UPD has a PhD in Biology program with specialization in Microbiology. Except for 9 of 160 faculty members teaching microbiology in 25 HEIs that provided their faculty profile, all have PhD or MS degrees. The establishment of microbiology education consortia in various regions in the country is considered as the most feasible strategy to increase the number of BS Biology graduates who can qualify to become certified microbiologists.**

Key Words: certification, curriculum, education, examination, microbiology

Abbreviations: ADMU–Ateneo de Manila University, BS– Bachelor of Science, CLSU–Central Luzon State University, CvSU–Cavite State University, HEIs–Higher Education Institutions, MC–Miriam College, MS – Master of Science, MSU-IIT–Mindanao State University-Iligan Institute of Technology, NCR–National Capital Region, PAM–Philippine Academy of Microbiology, PhD–Doctor of Philosophy, PSM–Philippine Society for Microbiology, Inc., UPD–University of the Philippines Diliman, UPLB–University of the Philippines Los Baños, UPM–University of the Philippines Manila, UST–University of Santo Tomas, USM–University of Southern Mindanao, WVSU–West Visayas State University

### INTRODUCTION

Microbiology is a fundamental and broad discipline in biology that touches on human's daily existence and is indispensable in many industries. A Microbiology section is a vital component of every company with responsibilities in production, processing and monitoring (Raymundo 2015). The microbial safety of final products, which is of utmost

importance to the survival of the company, defines its role.

For microbiologists to function effectively and efficiently in various settings, appropriate training is a must. A Microbiology education program that is properly conceived, well-designed, and relevant to current needs is paramount in the making of good microbiologists. As the world evolves, the practice in the field of Microbiology continues to change,

demanding more stringent requirements, which, in particular, are usually a characteristic of the manufacturing industries. To meet these ever-changing demands, additional skills must be learned while strengthening critical analytical capability in various areas of Microbiology. Further, there is a need to expand research in Microbiology. The increasing demand for microbiologists in the country has necessitated a parallel exigency in the offering of Microbiology courses in the Biology programs of different institutions and in more professional microbiologists in the teaching force.

In 1994, out of 69 Higher Education Institutions (HEIs)-respondents in a survey, only four offered a formal education in Microbiology (Raymundo and Talatayod 1994). It was quite a concern that the increase in the number of microbiologists in the country has not kept pace with the rise in manufacturing companies, specifically in the food and pharmaceutical industries

Intimately entwined with the aforementioned concern is the Philippine Academy of Microbiology (PAM) of the Philippine Society for Microbiology, Inc. (PSM). PAM has been conducting annual certification examinations for microbiologists starting in 2003, and based on its registry, there are only 250 registered microbiologists as of 2017, and 75 specialist microbiologists as of 2016 ([www.pam.psm.org.ph](http://www.pam.psm.org.ph)) in the country. Considering the approximately 4500 registered food manufacturing and pharmaceutical companies currently in existence ([www.fda.org.ph](http://www.fda.org.ph)), and assuming a requirement of just one microbiologist in every company, the need for more specialists becomes an understatement. This scenario definitely will worsen when Philippine products have to compete rather more fiercely in the markets of the Association of Southeast Asian Nations (ASEAN) region when free trade takes place across borders. Export market requirements for food safety and traceability are increasingly becoming more rigorous. Consequently, the role of microbiologists cannot be overemphasized.

This study is an attempt to provide a general picture of the current state of Microbiology education in the Philippines and an assessment based on the number of universities offering microbiology programs, their curricula and faculty vis-a-vis the need of microbiologists in the country from a cross-section of HEIs. The ultimate aim is to propose a

strategy that would lead to a possible resolution of the problem of Microbiology education in the country.

## MATERIALS AND METHODS

A survey instrument on Microbiology Education was developed and sent to the various PSM Regional Chapter Presidents. Thereafter, reproduced copies were distributed to the different HEIs in the regions. Data obtained were collated and analyzed. The results were then presented in the session on Microbiology Education during the 45<sup>th</sup> Annual Convention and Scientific Meeting of the PSM held on July 23, 2016 at the Vigan Convention Center, Vigan City by representatives of the PSM Regional Chapters from Northern Luzon, Bicol, Visayas, and Mindanao. In addition, Dr. Windell Rivera of the University of the Philippines Diliman (UPD) presented the status of Microbiology Education in the National Capital Region (NCR). The information for Calabarzon (Region 4A) was collated by Prof. Edmerson Geronimo of the University of the Philippines Los Baños (UPLB) and added to the data gathered earlier. Data directly gathered from Central Luzon State University (CLSU) were also included in this analysis. Other important secondary data came from websites, proceedings, and personal interviews.

Only 37 of the surveyed HEIs provided data on curriculum content sufficient for analysis, while 25 furnished information on faculty profile. However, it was ascertained that all the major HEIs offering BS Biology program were included.

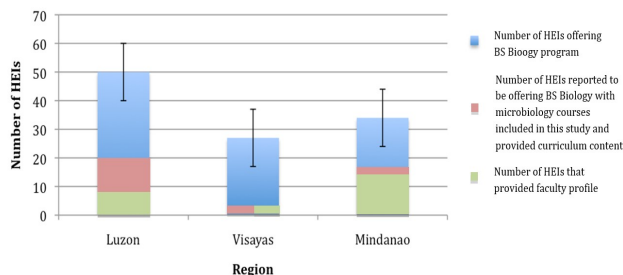
## RESULTS AND DISCUSSION

About a decade ago, 9.8% or 167 out of 1700 of HEIs in the Philippines were offering BS Biology programs (Raymundo and Talatayod, 2009). This percentage declined to 8.7, or 202 out of 2313, in 2014 as the additional number of new HEIs did not offer BS Biology degrees (CHED, 2014). In the present study, 121 HEIs were reported to be offering BS Biology (Fig 1). The total aggregate for Luzon, is understandably the highest at 50, followed by Mindanao at 34 and the Visayas Region at 27. Out of these HEIs, data from a total of 37 were analyzed for curriculum content and 25 for faculty profile.

**HEIs with BS Biology with specialization in Microbiology.** Nine Philippine HEIs offer degree programs with major in or specialization in Microbiology (Table 1). This includes UST which presently is the only HEI with a BS Microbiology program in the whole country. In the National Capital Region (NCR), HEIs that have a BS Biology/Life Science with major in Microbiology program are Miriam College (MC) and Ateneo De Manila University (ADMU) with 12 to 14 Microbiology courses each. At UPD, the BS Biology program has no major in Microbiology but it offers nine Microbiology courses as electives. On the other hand, UPM requires only one Microbiology course for its BS Biology students but BS, MS, and Doctor of Public Health students must take 3 to 11 courses in Microbiology. The other HEIs offering a microbiology track under their BS Biology programs are Cavite State University (CvSU) - Don Severino De Las Alas Campus and UPLB in the Calabarzon region, Central Luzon State University (CLSU) in Nueva Ecija, West Visayas State University (WVSU) in Iloilo City, Mindanao State University-Iligan Institute of Technology (MSU-IIT) in Iligan City, and University of Southern Mindanao (USM) in Kabacan, North Cotabato (Table 1). UPLB offers 19 Microbiology courses which currently is the most extensive offering, while the rest of the HEIs have only 8 to 10 courses.

The need to increase the number of HEIs that can produce trained microbiologists is quite apparent. These microbiologists must have the qualifications to take the certification examination administered by the PAM of the PSM. To qualify, an applicant must have taken 24 units of Microbiology courses among which should be Basic Microbiology, Microbial Ecology, Virology, Microbial Physiology and either Medical or Food Microbiology. This certification is a need that becomes more important with the looming implementation of the ASEAN free trade agreement where guidelines for analysis of products have become more stringent.

**Number of Microbiology Courses Offered.** All of the surveyed schools in Bicol, two from Calabarzon, two from Mindanao, and one from Northern Luzon, only have Basic Microbiology in their BS Biology/BS Education (Major in Biology) programs (Table 1). In these institutions, Basic Microbiology also serves as a service course for other BS degree programs. This



**Fig. 1.** Number of HEIs reported to be offering BS Biology with microbiology courses and number studied for curriculum content and faculty profile

**Table 1.** Number of microbiology courses offered by HEIs in some regions of the Philippines, excluding seminars and research/ thesis.

Institution	Degree Course	Number of Microbiology Courses
<b>National Capital Region</b>		
University of Santo Tomas	BS Microbiology	12 (BS)
	MS Microbiology	8 (MS)
Ateneo de Manila University	BS Life Science specializing in Microbiology	14 (BS)
	MS Biology	No specialization in Microbiology in the graduate Biology programs
	PhD Biology	
University of the Philippines Diliman	BS Biology	12 (BS)
	MS Microbiology	18 ( the same offerings for the MS and PhD programs, but with different requirements)
	PhD Biology	
University of the Philippines Manila	BS Biology	1
Miriam College	BS Biology (Microbiology track)	12
<b>Northern Luzon</b>		
University of the Philippines Baguio	BS Biology	1
<b>Central Luzon</b>		
Central Luzon State University	BS Biology (Microbiology)	7
	MS Biology	3
	M Biology	1
	MS Biology Education	2
	PhD Biology	3

Table 1. Continued . . .

Institution	Degree Course	Number of Microbiology Courses
<b>Calabarzon</b>		
Adventist University	BS Biology	1
Southern Luzon State University	BS Biology	2
Batangas State University	BS Biology	1
De La Salle Lipa	BS Biology	3
Cavite State University - Don Severino De las Alas Campus	BS Biology (Microbiology) MS Biology	10 1
University of the Philippines Los Baños	BS Biology (Microbiology) MS Microbiology PhD in Microbiology	19 22 21
<b>Bicol</b>		
Ateneo de Naga University	BS Biology	1
Bicol University	BS Biology	1
University of Nueva Caceres	BS Biology	1
Divine Word College	BS Biology	1
Central Bicol State University of Agriculture	BS Biology	1
<b>Visayas</b>		
University of the Philippines Visayas	BS Biology	5
West Visayas State University	BS Biology (Microbiology)	8
<b>Mindanao</b>		
Mindanao State University – Iligan Institute of Technology	BS Biology (Microbiology track) MS Biology PhD Biology	13 3 11
Mindanao State University - Marawi	BS Biology	3
Mindanao State University – General Santos	BS Biology	4
Xavier University – Ateneo de Cagayan	BS Biology	3
Central Mindanao University	BS Biology	1

Table 1. Continued . . .

Institution	Degree Course	Number of Microbiology Courses
Ateneo de Davao	BS Biology MS Biology	4 1
Ateneo de Zamboanga University	BS Biology	6
University of the Philippines Mindanao	BS Biology	2
Western Mindanao State University	BS Biology	3
Misamis University	BS Biology	5
Southern Christian College	BS Education Biology AB Biology	2
Fr. Saturnino Urios University	BS Biology	4
Notre Dame of Marbel University	BS Biology	3
Caraga State University	BS Biology	4
University of Southern Mindanao	BS Biology (Microbiology)	10
University of Southeastern Philippines	BS Biology	1
Iligan Medical Center College	BS Biology	3

situation somehow gives the impression that Microbiology is not, as yet, an important component in their BS Biology programs as there are no Microbiology courses other than the basic course. UPD has no undergraduate microbiology program but offers 12 microbiology courses as electives (Table 1).

UPM also offers BS Biology which requires only one Microbiology course. On the other hand, its BS Public Health program includes three Microbiology courses in its curriculum but lacks the PAM examination-required Microbial Physiology, Microbial Ecology, and Virology courses. These are required courses in the MS Public Health and Doctor of Public Health major in Medical Microbiology programs, making graduates of these programs eligible to take the PAM certification examination.

**Graduate Programs in Biology.** Graduate programs in Biology are offered in 10 HEIs in the country but only UST, UPD and UPLB have MS Microbiology

programs (Table 1). CLSU offers MS and PhD graduate programs with accompanying microbiology subjects. Its MS Biology, Master in Biology, and MS Biology Education degree programs have three, one, and two Microbiology subjects, respectively, while the PhD Biology program offers three courses. MSU-IIT offers an MS Biology program with three Advanced Microbiology courses. CvSU – Don Severino De Las Alas Campus and the Ateneo De Davao University in Mindanao offer MS Biology with Advanced Microbiology as the only graduate Microbiology course.

Five of the HEIs have doctoral degree programs. Two UP constituent universities have Microbiology specialization, with UPLB offering a PhD in Microbiology and UPD a PhD Biology with specialization in Microbiology. Of three other HEIs that offer a PhD in Biology, ADMU does not have Microbiology specialization and has no Microbiology courses in its program, while CLSU offers three specialty courses in Microbiology. UST has no PhD program in Microbiology. In the case of MSU-IIT, the PhD in Biology – Microbiology track offers 11 advanced Microbiology courses but there have been no takers and no faculty member has been added to handle these courses.

**Profile of Faculty Teaching Microbiology.** Forty percent of the HEIs have 4 to 6 faculty members teaching Microbiology courses, while 20% have 1 to 3 faculty members doing same responsibilities (Table 2). These represent the majority of HEIs offering BS Biology programs.

Twenty-eight percent of the HEIs included in this study have 7 to 9 faculty members teaching microbiology courses. Another 12%, including UST, UPM, UPLB and MSU-IIT, have 10 to 12 faculty members handling Microbiology. Many of them, however, are not Microbiology graduates or have not taken an equivalent number of Microbiology subjects.

Nine of the total number of faculty members handling Microbiology courses are BS graduates with no specified field or BS Medical Technology degree holders. The USM employs three, Southern Christian College has two while UPLB, MSU-Marawi, Misamis University, and Western Mindanao State University have one each. In most cases, they handle the laboratory part of the course.

**Table 2.** Frequency of HEIs in the Philippines with specified number of faculty members teaching Microbiology.

Number of Faculty Members	Number of HEIs	Percent of Total
1-3	5	20
4-6	10	40
7-9	7	28
10-12	3	12
Total	25	100

Most of the HEIs offering a BS Biology program have more or less an equal number of staff members with MS and PhD with the exception of MSU-IIT, UPD and UPM (Table 3). MSU-IIT has only one staff member with PhD and 10 with MS. On the other hand, UPD has only 9 faculty members teaching Microbiology but all of them have PhDs. UPM has 7 PhDs and two additional MS staff members. CLSU has 5 PhDs and 4 MS staff members, while CvSU – Don Severino De Las Alas campus has 2 PhD and 3 MS staff members.

The three HEIs that have 7 or more faculty members with PhDs teaching Microbiology courses are all in the UP System with UPD and UPLB having 9 each and UPM with 7. Both Notre Dame of Marbel University and Caraga State University have 4 MS and 1 PhD faculty members, while MSU-Marawi has 4 PhDs and 1 BS faculty members handling microbiology courses.

The lack of PhD Microbiology graduates could be addressed by offering more scholarship grants to younger staff. An additional responsibility of a senior faculty aside from providing leadership in instruction, research and extension, is to encourage younger staff to pursue graduate studies in microbiology and to take the PAM certification examination. This should serve as buffer in case some faculty members leave for greener pastures, or if a senior staff retires. The Professor Emeritus programs where retired faculty can continue to teach and advise can partially solve the need for highly-specialized Microbiology faculty.

There are degree programs, other than BS Biology, offering Microbiology courses in each of the regions included in this study. Most notable is the BS Public Health program of UPM. With a few more required units in microbiology, graduates of these degree programs can qualify for the PAM certification examination. Further, several schools in the Visayas are already capable of offering BS Microbiology programs on account of the availability

**Table 3.** Faculty profile of HEIs offering Microbiology courses in their BS Biology Programs.

HEIs	BSBio	MS, MSMT DVM	PhD, Dr.rer nat, MD	Total
<b>NCR</b>				
University of Santo Tomas	0	7	5	12
Ateneo de Manila University	0	3	3	6
University of the Philippines Diliman	0	0	9	9
University of the Philippines Manila (Public Health)	0	2	7	9
Miriam College	0	3	2	5
<b>Central Luzon</b>				
Central Luzon State University	0	4	5	9
<b>Calabarzon</b>				
University of the Philippines Los Baños	1	9	8	18
Cavite State University - Don Severino De las Alas Campus	0	3	2	5
De La Salle Lipa	0	2	0	0
<b>Visayas</b>				
West Visayas State University	0	2	6	8
University of the Philippines Visayas	0	5	4	9
<b>Mindanao</b>				
Mindanao State University – Iligan Institute of Technology	0	10	1	11
Mindanao State University - Marawi	1	0	4	5
Mindanao State University – General Santos	0	2	1	3
Xavier University – Ateneo de Cagayan	0	2	2	4
Central Mindanao University	0	3	2	5
Ateneo de Davao	0	1	0	1
University of the Philippines Mindanao	0	5	4	9
Western Mindanao State University	1	2	1	4
Misamis University	1 <sup>1</sup>	1	2	4
Southern Christian College	2	0	0	2
Notre Dame of Marbel University	0	4	1	5
Caraga State University	0	4	1	5
University of Southern Mindanao	3	2	3	8
University of Southeastern Philippines	0	1	1	2
Total	9	77	74	160

of good Microbiology laboratories and qualified professors but have yet to organize such programs.

Several factors contribute to a successful implementation of a well-designed and relevant Microbiology program that meet the need for trained microbiologists in the food and pharmaceutical industries. Two are of critical importance: the availability of sufficient laboratory facilities, supplies and equipment, and the presence of qualified mentors/faculty members with graduate degrees in Microbiology or related fields.

**Proposed Microbiology Consortium.** An immediate feasible strategy to produce more microbiologists that can qualify to take the PAM certification examination is the creation of Regional Consortia in Microbiology Education. This is a logical move given that only nine HEIs are offering degree programs with major in Microbiology (Table 4). This strategy will entail inter-university collaboration allowing students of an institution that as yet does not have the capability to offer a degree with major in Microbiology to take 24 units of Microbiology that includes 6 units of thesis. A common curriculum,

which includes the courses required for PAM certification examination as previously mentioned and syllabus, can be agreed upon for inter-university implementation. A similar attempt 16 years ago did not prosper due to poor implementation (PAM report, unpublished). The CHED proposed program for a Microbiology track needs to be followed by non-autonomous HEIs. Any microbiology program, however, must be suited to the needs of the industry sector and meet the ASEAN integration challenge. In a recent forum on the Assessment of the Microbiological Needs of the Food and Pharmaceutical Industry (Raymundo, 2015), it was declared that aside from theories, principles and mastery of microbiology techniques, social skills related to ethics, value formation and improving interpersonal relationship at the workplace must be instilled in the training of microbiologists. Participants from the industry during that forum emphasized that microbiologists to be able to meet the challenges of the ASEAN integration must assume multifunctional roles in both the laboratory and in the production area. There is a need to explore what is beyond the basic domain of Microbiology.

**Table 4.** HEIs offering BS Microbiology and BS Biology, Major in Microbiology.

Region	HEIs	Remarks As to Eligibility of Their Graduates to Take the PAM Certification Examination
Central Luzon	Central Luzon State University	Lacks Microbial Ecology
	University of Sto. Tomas	Eligible
NCR	Ateneo de Manila University	Eligible if students take the 5 courses required by PAM
	Miriam College	Eligible if students take the 5 courses required by PAM
CALABARZON	Cavite State University Don Severino De las Alas Campus	Eligible
	University of the Philippines Los Baños	Eligible
Visayas	Western Visayas State University	Eligible
	Mindanao State University - Iligan	Eligible
Mindanao	University of Southern Mindanao	Eligible

The acquisition of knowledge on packaging, product formulation, sensory sciences and international standards certainly has positive influence on the training of microbiologists. Indeed, this presents an immense challenge to Microbiology education program designers.

In a consortium scheme, the professors/mentors will come from a pool of microbiologists with at least an MS in Biology with major in Microbiology or MS Microbiology and/or have had teaching experience in Microbiology for several years. Common faculty professional fees and standard fees, in terms of tuition or following the schedule of fees of the host institution, can be observed. Students can cross-enroll in any one of the member institutions, and can take the Microbiology courses offered in any one of the different campuses of the accredited institutions. This approach will ensure the increase in the number of graduates qualified to take the certification examination of PAM. The organization of consortia can be considered as a special program of the various member institutions and can be administered by a Governing Board. A memorandum of agreement will have to be signed by member institutions. The consortium will have to be approved by CHED.

**CONCLUSION AND RECOMMENDATIONS**

Although many HEIs in the Philippines have a BS Biology program, only nine offer microbiology as a field of specialization. Out of these 9 HEIs, only six produce graduates that are automatically qualified to take the PAM certification examination for registered microbiologists. To enable other universities to produce graduates ready to take the examination, their BS Biology major Microbiology programs must be restructured. In some HEIs, like in ADMU and MC, the students together with the advisers have to plan a major program taking into consideration the five core courses needed to qualify for the PAM

examination. This limitation in the number of HEIs offering microbiology education can partly be surmounted by encouraging microbiologists in the academe to pursue graduate studies to improve on their expertise and enable them to offer additional microbiology courses in their home institutions.

The prospect of increasing the number of BS graduates that can qualify for the PAM certification examination is bright. The organization of Microbiology Education Consortia among neighboring institutions that will implement common Microbiology curricula and policies, and share manpower resources with expertise in the various specialized fields of Microbiology would be an auspicious beginning of an undertaking that can solve the dearth of microbiologists in the country. This road to success must be paved by support from the Commission on Higher Education (CHED) and the Department of Science and Technology- Science Education Institute (DOST-SEI) in terms of an umbrella policy and provision of scholarship grants.

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