

## Tracer study of Bachelor of Science in Mathematics

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### ABSTRACT

This research aimed to determine the employability of its graduates as well as the strengths and weaknesses of the Bachelor of Science in Mathematics (BSM) program of a Philippine Higher Educational Institution. Adapting the Commission on Higher Education (CHED) Graduate Tracer Survey Questionnaire, the study provided data that were used as basis in the review and revision of the said program. Results of this research may be used to answer the needs of society by adjusting the curriculum to meet the needs of the 21<sup>st</sup> century learners, help prepare the students not only for the world of work and land relevant employment but also to innovate in the future. Results of the study were utilized to document the employment characteristics, transition to employment and the level of satisfaction of the fifty (50) BSM graduates in terms of the level of satisfaction of the school's services, learning environment and facilities. The findings revealed that the graduates claimed their pre-service training under the BSM program helped them acquire 21<sup>st</sup> Century skills and competencies which were not only effective and adequate but also relevant in responding to the demands of their chosen occupations. Providing soft training on applied computer software, forming partnership with software developers, offering foreign language and major courses that merge machine learning and data science were some of the recommendations suggested by the graduates to further improve the BS Mathematics program.

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## 1. INTRODUCTION

With the goal of driving social innovation and relevant 21<sup>st</sup> century education, a Philippine Higher Educational Institution (PHEI) in Region IV is committed to develop competent graduates who can readily respond to social issues and perennial challenges by providing 21<sup>st</sup> century academic programs anchored on technologies and future-oriented philosophies.

One of the programs offered by this PHEI is the Bachelor of Science in Mathematics (BSM) which was first given Temporary Permit No. 190, series of 2003 to operate by the Commission on Higher Education (CHED) for the SY 2003-2004. There were no enrollees during its first year of operation but on its second year, three students enrolled in the program under a scholarship grant from the school. Since 2004, the BS Math program has been regularly promoted by the school through offering scholarship grants to mathematically gifted high school graduates from various feeder schools in the region. In spite of the extensive promotion of the BSM program, the number of students who enroll and finish it still remained relatively small compared to the other programs being offered in the college. On the average, only about two to three students enrolled and successfully finished the program except for batch 2009, batch 2014 and batch 2015 with 27, 20 and 10 graduates, respectively.

The curriculum of BSM has undergone two revisions after its first three years of operation. One took effect starting SY 2006-2007 and the other one was implemented starting SY 2012-2013. Some of the notable changes that took effect in the SY 2006-2007 curriculum are those particularly relating to the major courses in mathematics while the ones incorporated in the second revision were in compliance to CMO No. 59 series 1996 (New General Education Curriculum) [1], CMO No. 19 series 2007 (Policies and Standards for BS Mathematics and BS Applied Mathematics) [2], and CMO No. 23 series 2010 (Inclusion of Foreign Languages as Electives in the Curricula of HEI programs) [3]. Since its first year of operation, no tracer study has been done yet that would look into the employability of the BSM graduates of this PHEI which is the main rationale for conducting this research.

Tracer surveys are studies that gather feedback from graduates of an educational institution to monitor their achievements and progress in their career and give policy bodies' vital information on key issues [4].

The general objective of tracer surveys is to evaluate medium to long-term impact of education programmes. More concrete objectives include improving the education and training content and study conditions, improving the transition of graduates from education to the labour market, and to better matching the supply of skills with the demand for them [5].

During the last 15 years a new type of tracer study emerged: more individual institutions of education are conducting tracer studies, sometimes in close cooperation with other institutions of education (network approach). Feedback for curriculum development and other aspects of improving study conditions and provisions is often the most important aspect of such institutional tracer studies. Information about job search, employment conditions and work are taken as signals of the labour market chances of graduates from different study programmes. Of special interest is the horizontal link between education and work [6].

Several researches conducted in the past claimed that results of tracer surveys cannot be considered conclusive as it is presumed that only predominantly successful or fulfilled persons partake in these surveys. However, the study conducted by Heidemann [7] proved that tracer surveys actually present vital information about the admission into the workplace and labor market including the reflective assessment of study programs.

Considering this perspective, the College of Education, Arts and Sciences of this PHEI initiated the conduct of tracer studies on the graduates of the programs they offer, including the BSM program which is the main focus of this research. Results of the tracer studies formed part of curriculum reviews which became the basis of revision and improvement of the different programs under the college.

This study seeks to document the employment characteristics, transition to employment and the level of satisfaction of the BS Mathematics graduates from SY 2006-2007 to SY 2015-2016 in terms of the PHEI's services, learning environment and facilities.

According to Schomburg [8], higher education institutions utilize data gathered from graduates through tracer studies to assess higher education's relevance, to get useful information for the improvement of the university, contribute to its accreditation process and inform its stakeholders. He identified significant conjectural challenges or the study programs' underlying significance as the indicators needed (period of job exploration, salary, status of employment, rank, job independence and satisfaction, etc.), methods of assessing the labor market indicators; identifying pertinent aspects that elucidate the graduates' success aside from higher education (workforce, local flexibility, personal impetus, etc.); the extent to which Higher Education (HE) causes professional success, and the components of HE that have an impact (study conditions and provisions and the like).

Competent human workforce is one of the main necessary limitations to support superior economic growth in South Asia. Findings from the study conducted by Asian Development Bank [9] show that in order to move up the value chain, it is necessary for countries from South Asia to capitalize in human resources whose knowledge and expertise greatly contribute to the countries' competitiveness.

According to Mubuuke et. al. [4], results of tracer surveys can facilitate information collection that definitely influences training and policy. In this study, most of the graduate radiographers were contented with their work, but gave recommendations, such as increasing their compensation and revising curriculum to address the current exigencies in the work environment. Part of this study's recommendations are for training institutions to involve their graduates in improving learning, and for management sectors to utilize the evidence given by the alumni in articulating suitable programs that definitely impact healthcare delivery.

The tracer study of PNU Graduates conducted by Gines [10] proved to be significant primarily in recognizing the strengths of the current curriculum in terms of its sufficiency, excellence and the pre-service training's relevance to the competencies needed in the local and international market as well as in addressing its weaknesses. Regular conduct of institutionalized tracer studies considering both alumni and employers as respondents, offering enticing inducements to male graduating high school students to consider teaching as a career and conducting practicum for one semester are among the recommendations given.

Results of the tracer survey conducted by UNESCO-IHE Institute for Water Education [11] which aimed to investigate alumni career development and relevance of their academic programs revealed that the graduates gave the impression that they truly benefit from the program having received acknowledgement for their superior expertise, being given raise in income, acquiring augmented personal and professional linkages and enhanced capabilities.

Findings of the tracer study by Fronda & Villanueva [12] on HRM graduates' employability showed they were certain that the training obtained from the program not only enabled them to land jobs related to their course both locally and globally but also gave them opportunities to advance their expertise by shifting occupations in various hospitality industry companies. The graduates also believed that although the HRM program is intact it still requires enrichment particularly on expanding on-the-job trainees' access to a variety of hospitality industry companies that would offer more prospects for skills development.

According to Cheng Tan & French-Arnold [13] who made an overview of UNESCO's case studies on the employability of graduates in Asia, technology and knowledge are now being favored by international economy. Being considered as vital to nationwide policies for safeguarding shares in the global market, a suitable higher educational institution (HEI) system should help prepare the graduates to become skilled and proficient in their chosen field. This is a shared task not only among HEIs but also with basic education and post-secondary education system to ensure that graduates are sufficiently equipped and trained to meet the challenges.

In the Teacher Education Graduate Tracer Study conducted by Aquino et.al. [14], most of the respondents were Bachelor of Secondary Education (BSED) graduates who believed that teaching is a profession that is both compensating and perplexing. Results revealed that at the time the study was conducted a relatively large portion of the respondents are public school teachers who easily land a job since they are LET passers and remain in their profession for economic reasons. Part of the suggestions were for the results of the study to be used by the College of Teacher Education (CTE) to strengthen their linkages with various schools in the proximate locality and the surrounding towns as well to increase the possibilities of finding employment for their graduates. The CTE must continually ensure faculty competence and enhancement and effective use of teaching strategies. This must be seriously considered in providing a balanced and relevant training for the students so that they will become more competent in the workplace.

The Tracer Study of RTU Graduates conducted by Ramirez et. al. [15] involved mostly graduates from SY 2006 to SY 2011 who are single females, commonly in the field of business and commercial technology particularly financial management. Results of the study revealed that RTU creates sought-after graduates who are employed along their fields of specialization and prefer local employment rather than overseas, with incidences of unemployment very low and self-employment almost imperceptible. A miniscule number of graduates engage in further studies primarily to satisfy their personal ambition and to assure their career development. There is still a need to strengthen the communication skills, critical thinking, human relations, problem-solving and information technology that could make curricular offerings more significant to current jobs.

In order to establish the significance of its curricular programs in meeting manpower needs and the imminent full implementation of the K-12 program, Cañizares [16] endeavored to trace the Science and Mathematics Education (SME) graduates of the University of San Carlos. Results showed that the graduates' reflective evaluation of the curriculum indicated that sequencing of the subjects is its best aspect and that their perceived levels of professional efficacy showed that majority of the top rated character traits essential in their work has something to do with collaboration.

The results and recommendations presented by the reviewed literatures point to the important role that tracer studies play in curriculum development and enhancement of programs being offered by higher educational institutions.

This study is anchored on the UNESCO General Education Quality Analysis/Diagnosis Framework (GEQAF) which describes four key elements that are collaborating to provide for excellent education and valuable learning experiences. The key elements include (1) the development goals "that guide the key outcomes of an education system, (2) the system's desired outcomes, (3) the core processes and (4) core resources that produce these outcomes as well as support mechanisms that enable the production of the outcomes." Thus, educational programs are instituted to meet the human resource needs to achieve the country's vision and development goals.

Desired outcomes should clearly describe the expertise and lifelong learning abilities of graduates/human resources needed by the country and determine the kind of educational processes that should be put in place to achieve these goals. These educational processes include learning as the central process, and teaching and assessment as facilitators of this learning process.

Regular evaluation of the quality and relevance of our educational programs is required to ensure they are aligned with regional and world development goals. Quality assurance (QA) is a guarantee to

various stakeholders, students and employers that undergraduate and post-graduate programs are relevant and responsive to the developmental, social, intellectual and economic needs of contemporary societies. A QA system will also safeguard ongoing review of how curricula are being implemented, identify current weaknesses and strengths and plan for improvement [17]. Quality teaching and student learning should be the focus of every educational institution. In order for student learning to be enhanced, quality teaching initiatives should not only focus on the teacher but should encompass the whole institution and the learning environment [18].

This tracer study aimed to document the employment characteristics, transition to employment and the level of satisfaction of the PHEI's BS Mathematics graduates from SY 2006-2007 to SY 2015-2016 in terms of the level of satisfaction of the school's services, learning environment and facilities.

The core resources (curriculum, teachers, learners and learning environment) which are among the four key elements described in the UNESCO General Education Quality Analysis/Diagnosis Framework (GEQAF) are integral factors considered in the research framework for this study. The Figure 1 is the research framework used in the study.

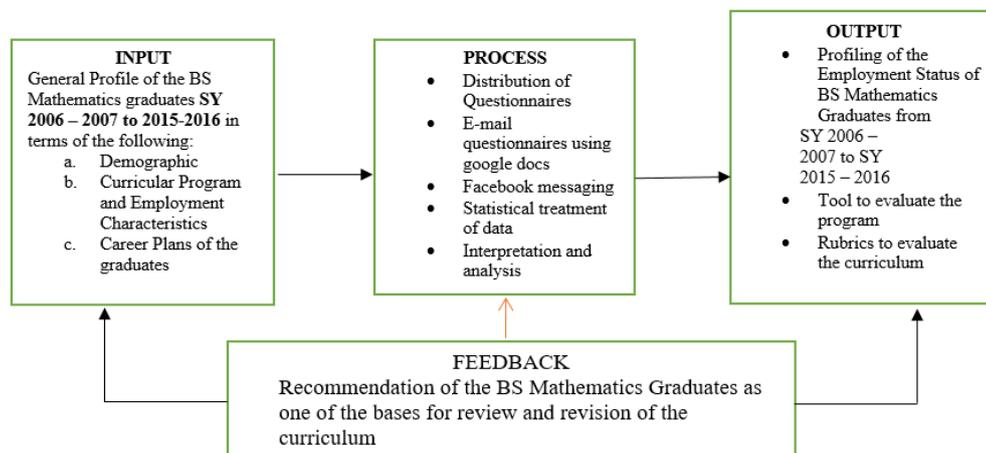


Figure 1. Research paradigm of the study

## 2. RESEARCH METHOD

This descriptive study involved BS Mathematics graduates who completed their formal education and training in a Philippine Higher Educational Institution between study year (SY) 2006-2007 and SY 2015-2016. The contact details of the graduates were sought and obtained from multiple sources, including records from the registrar's office, social media channels such as Facebook and Twitter and from former students. The cross-sectional survey research method was employed adapting the modified version of the CHED Graduate Tracer Survey Questionnaire prepared using Google Docs. Total enumeration was employed since there were only 83 graduates to be considered who were contacted via email addresses, facebook or twitter and were sent the tracer survey questionnaire which they answered online. However, only 50 graduates were able to complete the survey.

The research utilized descriptive statistics like mean and percentages. Likewise, closed-ended responses using Likert Scale and open-ended responses were adopted. Recommendations from the focus group discussion (FGD) conducted with some of the graduates were also content-analyzed to determine underlying themes and the trending of responses and discover some contributing factors that may lead to the improvement of the BS Mathematics program.

The FGD was scheduled on a weekend to ensure that all six volunteers (BS Mathematics graduates of batch 2009, 2011, 2012, 2014 and 2015) would be able to attend it. With the permission of the participants, the researcher audio-recorded the whole session and also served as the transcriptionist. The FGD was facilitated by the moderator, a full-time female faculty member from the College of Education, Arts and Sciences of the PHEI and an expert in the field of mathematics. Following the guide questions formulated by the researcher, the moderator explained to the participants that their partaking in the FGD is voluntary and will not cause them any harm and they can withdraw from participating anytime during the process. Moreover, they were ensured that their responses will be kept confidential and will be used entirely for research purposes only. The researcher carefully transcribed and coded the responses of the participants to draw out the emerging themes to ensure proper analysis and interpretation of the qualitative data.

### 3. RESULTS AND DISCUSSION

In order to identify and understand the employment characteristics, transition to employment and the level of satisfaction of the PHEI's BS Mathematics graduates from SY 2006-2007 to SY 2015-2016 in terms of the school's services, learning environment and facilities, pertinent data were tabulated and subjected to appropriate statistical treatment. The profile of the BSM graduates considered in this study is presented on Table 1.

Table 1. Profile of BS math graduates from SY 2006-2007 to SY 2015-2016

Profile		Frequency	Percentage
Age	20-25	42	84.0
	26-31	8	16.0
Sex	Male	15	30.0
	Female	35	70.0
Marital Status	Single	47	94.0
	Married	3	6.0
Year Graduated	2008	1	2.0
	2009	7	14.0
	2010	1	2.0
	2011	7	14.0
	2012	2	4.0
	2013	3	6.0
	2014	15	30.0
	2015	9	18.0
Employment Characteristics	Employed	47	94.0
	Not employed	3	6.0
	TOTAL	50	100

As seen in Table 1, majority of the respondents are female comprising 84%, aged 20–25 years who are single, mostly graduates of batch 2014 corresponding to 30% of the total respondents. Nearly all of them (94%) are currently employed either in the field of teaching or in other industries such as research, accounting, banking particularly developing soft wares and processing loans/credits and business intelligence doing analytics. Most of them were able to gain employment within two months after graduating from college.

#### 3.1. What are the respondents rating of their program in terms of:

##### 3.1.1. Quality of teaching

One of the critical functions of a teacher along with imparting wisdom and developing the skills of their students is to ascertain how effectively they have achieved the knowledge, expertise and ideals intrinsic in the lessons. This necessitates teachers to compose a repertory of efficient approaches for them to successfully measure, assess and evaluate student learning [19].

Looking at Table 3, it could be gleaned that 76% of the respondents consider the faculty members' quality of teaching to be very effective as supported by specific descriptors as seen in Table 2, as "having mastery of the subject matter taught" with a mean of 3.64, "were helpful and approachable" and "made good use of examples and illustrations to explain difficult points" with a mean of 3.58.

Table 2. BS mathematics graduates' rating on the faculty members' quality of teaching

The faculty:	Mean	Interpretation
gave clear explanations	3.40	Very Effective
made good use of examples and illustrations to explain difficult points	3.58	Very Effective
gave assignments that helped in the learning process	3.44	Very Effective
stimulated you intellectually	3.48	Very Effective
commented on your work in ways that help you learn	3.52	Very Effective
were helpful and approachable	3.58	Very Effective
had mastery of the subject matter taught	3.64	Very Effective
made use of class time effectively	3.52	Very Effective
Overall Mean	3.52	Very Effective

Table 3. Frequency count of BS mathematics graduates' rating on the faculty members' quality of teaching

	frequency	percent
Effective	12	24.0
Very Effective	38	76.0
Total	50	100.0

These are further supported by the responses of the participants in the focus group discussion as one of them stated that the way their professors offer detailed explanation was superior compared to other teachers in her Master's degree program. Another participant commented that there was a good student-to-professor relationship which gave them hands-on but not spoon-fed training. Still, one participant claimed that the faculty gave their full support to students' activities and the strong math foundation they built with the students was an advantage in his Master's degree as he felt equipped to take on the challenges.

This viewpoint is supported by Aquino, et.al. [14] Which accentuated the importance of enhancing faculty competence and their use of effective teaching strategies in order to provide the students with relevant and effective training.

### 3.1.2. Student activities

For higher education to play its role in promoting ideals and values associated with a world culture of peace, it needs to become an agent of change, to respond to social needs and to promote the principles of solidarity and equity. One of the important ways to meet the challenges is to become more student-centred in all aspects of its activities, to encourage the development of a citizenry fully able to take its place on the community, national, regional and international stages. The following assumptions, derived from the WDHE, begin to make a strong case for the development and implementation of a highly effective student affairs and services programme in higher education around the world [20].

This was likewise verified by the participants in the focus group discussion as one of them stated that being an officer of the BS Math society, her leadership skills were honed and proved to be very useful in the work place. Another participant mentioned that being a former president of the BS Math society gave him an edge in applying for a teaching job in the PHEI as shown in Table 4.

Table 4. BS mathematics graduates' rating on their participation in student activities

The students:	Mean	Interpretation
Participated in intramurals/sports fest/varsity team	2.54	Often
Held a leadership position in a students' club, campus organization residence hall, or fraternity/sorority	2.74	Often
Been an active member of any non-academic club	2.46	Rarely
Been an active member of any academic club	2.9	Often
Participated in a leadership-training program	2.96	Often
Affiliated with religious clubs/participated in religious activities	2.36	Rarely
Participated in activities that helped me explore my career option	2.6	Often
Overall Mean	2.65	Often

These views are underpinned by Aquino, et.al. [14] Stated that student support should be further improved and must be seriously considered in providing balanced and relevant training for the students so they will become more competent in the workplace.

Based on Table 5, it could be inferred that majority of the respondents were either rarely involved (32%) or often involved (40%) in the co-curricular and extra-curricular activities conducted by the school relative to their program. Their highest involvement was described as having participated in a leadership-training program and being an active member of any academic club.

Table 5. Frequency Count on BS Mathematics Graduates' Rating on their participation in student activities

	Student Activities	
	Frequency	percent
Never	4	8.0
Rarely	16	32.0
Often	20	40.0
Very Often	10	20.0
Total	50	100.0

The study of Cheng Tan & French-Arnold [13] also stressed this point emphasizing that students themselves have to take personal responsibility to optimize the opportunities they have in institutes of higher learning and ensure that they leave their institutes as highly sought after graduates.

### 3.1.3. Student support services

The mission for student affairs and services must complement the institutional mission, its educational purposes, the locale in which it is operating, and its student characteristics. Programmes must be established and resources allocated for the purposes of meeting student affairs/services primary goals: enhancement of student learning/development [21].

In Maharishi University of Management [22], student government regularly schedules open forum meetings where students can give feedback and suggestions on any aspect of the academic program, in addition to all other areas of the student experience. Issues are sent to the appropriate faculty committees for action.

The availability of student support services of the PHEI is evidently seen in Table 6 as the respondents agreed that the administrative staff, librarians and guidance counsellors were all helpful. This is more evidently shown in Table 7 which shows that majority of the respondents perceived that the student support services offered by the school are readily available. The efficient extension of assistance given by these personnel makes the curricular offerings more relevant to the students.

This is similar to the findings of Cañizares [16] in his tracer study on the Science and Mathematics Education (SME) graduates of the University of San Carlos. The graduates' perceived levels of professional efficacy showed that majority of the top rated character traits essential in their work has something to do with collaboration. The study revealed the institutional capability of the Science and Mathematics Education Department (SMED) and the relevance of its curricular programs.

Table 6. BS mathematics graduates' rating on the student support services

Student Support Services	Mean	Interpretation
Administrative staff (Cashier, Registrar, Security, etc.)	1.80	Helpful
Librarians	1.76	Helpful
Guidance Counsellors	1.74	Helpful
Chaplain/Pastor/Religious Minister or Elder	1.58	Helpful
Laboratory Technicians/Extensionists	1.46	Available
Research Personnel	1.40	Available
Overall Mean	1.62	Helpful

Table 7. Frequency count on BS mathematics graduates' rating on the student support services

	Student Support Services	
	Frequency	Percent
Available	32	64.0
Helpful	18	36.0
Total	50	100.0

## 3.2. What are the respondents perceived factors that help and hinder them from getting a job?

### 3.2.1. Most Important Factors in getting a good job

Smart business owners make hiring top talent a priority. Since a company's productivity and profitability depend on the quality of its workers, managers consider a mix of factors, including credentials, work experience, personality and skills when reviewing candidates for employment [23]. Table 8 shows BSM mathematics graduates' rating on the most important factors in getting a good job.

Table 8. BS mathematics graduates' rating on the most important factors in getting a good job

Factors	Frequency	Percent
None	3	6.0
University Ranking	3	6.0
Work Experience	13	26.0
Personal Connection	2	4.0
Occupational Skills/Practical Exercise	24	48.0
Language Skills	2	4.0
IT Skills	1	2.0
Referral	1	2.0
Qualification	1	2.0
Total	50	100.0

Looking at Table 8, it could be ascertained that most of the respondents perceived that having work experience and developing occupational skills/practical exercise are the most important factors to consider in getting a job.

During the focus group discussion, one of the participants mentioned that she was able to apply in the operations the technical knowledge gained from the program (i.e. looking for the cause of short/deficiency in the account). Another participant added that the training he gained from the program developed his logical thinking and allowed him to shift from one field of work to another (from merchandising to engineering).

These views are further supported by the findings of Ramirez, et.al. [15] Which recommended the expansion of tie-ups with private enterprises that can provide employment opportunities to the university graduates.

### 3.2.2. Main Barriers in getting a good job

Universities have typically been charged with failing to instill in graduates the appropriate skills and dispositions that enable them to add value to the labour market. The problem has been largely attributable to universities focusing too rigidly on academically orientated provision and pedagogy, and not enough on applied learning and functional skills [24].

The Table 9 describes that most of the respondents perceived having little or no work experience and learning outdated/irrelevant skills as the main barriers in getting a good job. This was further supported by the responses of the participants during the focus group discussion as one mentioned that the BS Mathematics program was heavy in theories but lacks in innovation (applied software). The program was too theoretical in approach and there was no OJT/applied skills or exposure to what the industry needs.

Table 9. BS mathematics graduates' rating on the main barriers in getting a good job

Factors	Frequency	Percent
None	3	6.0
Poor University Ranking	1	2.0
No/Little Work Experience	15	30.0
No personal Connections	3	6.0
Outdated/Irrelevant Skill Learned	24	48.0
No information on Job Opening	3	6.0
Lack of Technical Knowledge and Skills	1	2.0
Total	50	100.0

Another participant added that the lack of knowledge in SAS and absence of courses on applied software and other major fields hindered her from being employed in her first job application. This was seconded by another participant who shared that in his first job, he was expected to be knowledgeable already in the SPSS and SAS software which he did not have yet as no training was provided for them in the program. As a result, he did not enjoy working then since he was under pressure most of the time. Two of the participants added that during their stay in the school, on the job training was not offered yet so exposure to industry was lacking and there was limited opportunity for students to be trained on Statistics or accounting.

The study of Ramirez, et.al. [15] is similar this viewpoint and stresses the need to review and upgrade the curricular offerings of their university to ensure the provision of more skill/competency development programs especially for skills on communication, critical thinking, Information technology, human relations, and problem-solving.

Similarly, the report of Cheng Tan & French-Arnold [13] highlighted the importance of graduate employability and concerted effort to ensure that graduates are adequately prepared and trained to meet challenges.

### 3.3. What are the respondents rating on the impact of their program on their skills and competencies?

Raising expectations about the development of professional competencies among students and employing pedagogical approaches and educational practices that promote student independence, self-directed learning, self-reliance, and interactions with the community, even on a relatively small scale, can have a significant impact on the development of twenty-first century competencies [25].

It can be inferred from Table 10 that majority of the respondents believed that the training they gained from the program had very high impact on their critical thinking, ability to solve complex problems, ability to work with others, and confidence to learn independently. Likewise, it had a high impact on their written and spoken communication skills, knowledge of the field and development of work-related knowledge and skills.

Table 10. BS mathematics graduates' rating on the program's impact

Impact of the program on the graduates'		Frequency	Percent
Critical Thinking	Not Applicable	8	16.0
	High	16	32.0
	Very High	26	52.0
Ability to solve complex problems	Not Applicable	8	16.0
	High	16	32.0
	Very High	26	52.0
Ability to work with others	Not Applicable	8	16.0
	Low	6	12.0
	High	15	30.0
	Very High	21	42.0
Confidence to learn independently	Not Applicable	8	16.0
	Low	2	4.0
	High	16	32.0
	Very High	24	48.0
Written Communication Skills	Not Applicable	8	16.0
	Low	9	18.0
	High	19	38.0
	Very High	14	28.0
Spoken Communication Skills	Not Applicable	8	16.0
	Low	11	22.0
	High	20	40.0
	Very High	11	22.0
Knowledge of the field	Not Applicable	8	16.0
	Low	3	6.0
	High	23	46.0
	Very High	16	32.0
Development of work-related knowledge and skills	Not Applicable	9	18.0
	Low	6	12.0
	High	20	40.0
	Very High	15	30.0
Total		50	100.0

During the focus group discussion, one of the participants mentioned that through the training she had from the program, she learned to be patient (does not stop until she gets what she needs to accomplish) and polite. Another participant shared that since she made a shift in career after graduation, her training in the program developed her structured, analytical and critical thinking. It also enabled her to communicate effectively, be resourceful and persevere in all her undertakings.

On the other hand, one participant commented that the abstraction of math became advantageous in his profession as his mastery of content enabled him to explain the why's of pure math courses he is teaching. This was seconded by another participant as she remarked that the background in basic math as well as the step-by-step procedure that was part of her training in the program has helped her to reach out to her students and imbibe the institution's values in her teaching.

The graduates' standpoint on the impact of the program bear similarities with the study of Mubuke, et.al. [4] Which suggested that training institutions should engage their graduates in enhancing learning by utilizing the information they give in formulating appropriate policies that positively influence their programs. Similarly, Gines [10] supports this perspective in that he recognized the need to intensify the curriculum's adequacy, quality and relevance of pre-service training in relation to the competencies demanded in the market both locally and internationally.

### 3.4. What are the respondents' over-all rating on their college experience under the PHEI's BS Mathematics program?

The Table 12 shows that majority of the respondents comprising 54% viewed their over-all college experience under the BS Mathematics program to be very helpful as it developed a positive influence on their intellectual growth and interest in ideas as well as on their growth, attitudes, and values as depicted in Table 11. Similar observations were shared by the participants during the focus group discussion as one mentioned that the curriculum was very flexible that she was able to apply in her work most of the theories learned in her undergraduate courses.

Another participant shared that the training he got from the program was flexible and gave him solid foundations of mathematics which he was able to apply in his line of work. Still another mentioned that the flexibility of the program allowed her to teach Statistics even if she has little background through self-study and solid basic math foundation. Similarly, one participant said the program was flexible as it provided balance in all fields/courses and the students are well-equipped to land any job since they were trained in the program.

Table 11. Mathematics graduates' rating on their over-all experience under the program

College Experience	Mean	Interpretation
Connect what you have learned in the classroom with real life situations	3.12	Helpful
Translate what you have learned inside the classroom into action	3.2	Helpful
Develop a positive influence on your intellectual growth and interest in ideas	3.46	Very Helpful
Develop a positive influence on your growth, attitudes, and values	3.4	Very Helpful
Overall Mean	3.30	Very Helpful

Table 12. Frequency count on mathematics graduates' rating on their over-all experience under the program

	College Experience	
	frequency	percent
Not Helpful	1	2.0
Helpful	22	44.0
Very Helpful	27	54.0
Total	50	100.0

These are somehow aligned with Schomburg's [8] identified key factors which are relevant to explain the success of the graduates besides higher education such as labor market, regional mobility, and individual motivation.

### 3.5. What do respondents recommend for the enhancement/improvement of the degree program?

Comparing the responses in the survey questionnaire as well as those given during the focus group discussion, there is coherence and consistency in their recommendations. Among these are to enhance the BS Math curriculum and offer Master's degree in Mathematics. They also suggested to include internship/on-the-job training for all BS Math students and to offer foreign language (i.e. Chinese, European) in the curriculum to enhance the communication skills of the students. There should be track options if the graduates would want to go into teaching. Likewise, they also need to improve the basic foundations of students like teaching fractions, decimals and simple application of mathematics in real life. The students should be encouraged to engage in continuous learning to develop innovative thinking.

The school should provide soft training on applied computer software and could also consider forming partnership with software developers. This is similar to the recommendations given in the findings of the BOTA Tracer Survey [20] which suggested that to further enhance graduate employment, employers and employer organization should form linkages with institutions that are intended to recruit graduates upon completion of their studies. They further proposed that institutions conduct career fairs where they could sensitize the employers of the skills offered by their graduates.

In the current study, it was also advised to offer major courses that merge machine learning and data science. The school needs to check and be up-to-date with the new technologies as mundane tasks are now being done by robots.

The graduates also recommended that the school should provide more training for the students to have creative minds and be critical thinkers and problem-solvers. Soft skills (i.e. leadership and organizational skills) should also be developed among the students for them to be pro-active and collaborative in the work place.

These recommendations are similar to the views presented by Cheng Tan & French-Arnold [13] on the employability of graduates in Asia that the global economy favors knowledge and technology which implied that appropriate higher educational system is critical for preparing a competent workforce.

Results of both quantitative and qualitative data analyses showed that the quality of education and training provided by the BS Mathematics program is exemplary as reflected by the high employability of the graduates. The faculty members are very effective in teaching the major courses having mastery of the subject matter and being helpful and approachable, a viewpoint that is supported by Aquino, et.al. [14] Which accentuated the importance of enhancing faculty competence and their use of effective teaching strategies in order to provide the students with relevant and effective training.

The co-curricular and extra-curricular activities as well as the support services provided for the students were instrumental to honing their leadership and intrapersonal skills that proved to be very useful in their workplace. These views are underpinned by Aquino, et.al. [14] and Cheng Tan & French-Arnold [13] stating that student support should be further improved and must be seriously considered in providing balanced and relevant training for the students so they will become more competent in the workplace.

The graduates perceived that having work experience and developing occupational skills/practical exercise are the most important factors in getting a job while the lack of learning experience and learning outdated/irrelevant skills are the main barriers in landing employment. Majority of the graduates believed

that the training they acquired had very high impact on their critical thinking, intrapersonal and communication skills, and knowledge of the field. Overall, they perceive their college experience to be very helpful as it developed a positive influence on their intellectual and attitudinal growth.

#### 4. CONCLUSION

Education should be viewed as a service to the society. The PHEI is at the forefront of innovating and providing relevant and quality education that addresses the needs of the society. Results of this tracer study provides research-based profiling of the Employment Status of the PHEI's BS Mathematics Graduates from SY 2006-2007 to SY 2015-2016 as well as a matrix/crosstab and tools to evaluate the program. It also provided results that will serve as inputs for curriculum enhancement of the BS Mathematics program with the aim of bridging the gap and minimizing the mismatch between the quality of the PHEI's graduates and the demands of the labor market.

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