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A Feasibility Study on Doctor of Philosophy Majors in Science, Technology, Engineering, and Mathematics (STEM) in a State College in Bicol

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Abstract

This study aimed to determine the feasibility of offering Doctor of Philosophy major in Science, Technology, Engineering and Mathematics in a state college in Bicol region. It utilised the descriptive research design which involved 103 respondents broken as follows: 45 employees of the College, 26 Master of Arts in Teaching, and 32 graduate-employees from other institutions. A focus group discussion was also employed in the validation and additional insights on the data generated. The data were generated out of a survey questionnaire which was crafted by the researchers which was also subjected for validation. The survey questionnaire employed a 4-point Likert scale with corresponding descriptive ratings of very low to very high. The study showed that offering of the program is feasible based on the 4 parameters/indicators such as, market demand, financial viability, management viability, and operational capability. All of these indicators were found to be the strength of the College, thus, the feasibility of offering the program. Offering of the proposed program greatly supports the institutional mandate of "primarily providing advanced education, higher technological, professional and vocational instruction and training in the sciences, arts, education, entrepreneurship, engineering and other related courses". Out of the results, it was recommended also to continue the enhancement of its faculty, facilities, and a regular conduct of tracer studies.

Keywords— PhD-STEM, feasibility study, institutional mandate

I. INTRODUCTION

Graduate education, being the culminating point in the educational system, is among the better means to improve the competencies of the education professionals whose goal is to further their contributions in the improvement of learning outcomes and delivery of educational programs to its intended beneficiaries [1]. This is in line with the mandate of higher educational institutions (HEIs) which is, among others, to provide competent human resource within the Philippines and abroad [2].

Meanwhile, basic education in the Philippines, as governed by the Department of Education (DEPED), has implemented in 2011 the K-12 program. This program is geared at having a holistically developed Filipino such as being college- and livelihood-ready, and equipped with 21st century skills [3]. The K-12 program in itself was developed in lieu of the old curriculum which was viewed by both local and international community as insufficient, and by the Southeast Asian Ministers of Education Organization – Innotech (SEAMEO – Innotech) as congested as squeezing the 12-year education into a 10-year period [4]. Among the features of the curriculum is giving the students, upon completion of 10 years basic education after kindergarten, and, on taking the senior high school (SHS), the freedom to select a track according to their interests and abilities. These tracks are Academic, Technical-Vocational-Livelihood, Arts and Design, and Sports. The college ready track is the Academic, which also

has 4 strands known as Accounting Business and Management (ABM), General Academic Strand (GAS), Humanities and Social Sciences (HUMSS), and Science, Technology, Engineering and Mathematics (STEM).

The shift in the basic education system created a new focus in the delivery of educational programs, thus, requires also a shift or improvement in the competencies of the education professionals. With this inevitable challenge, and true to its core values and commitment of brilliance, competence and adaptability the College strives to look for ways to go through and come out as a victor. Nonetheless, the College is mandated, apart from research and extension services, to primarily provide advanced education, higher technological, professional and vocational instruction and training in the sciences, arts, education, entrepreneurship, engineering and other related courses. This study is geared to know whether or not offering a doctorate degree in Science, Technology, Engineering and Mathematics (PhD-STEM) in the College is feasible.

The Commission on Higher Education deems feasibility study as a requisite in a proposal for new program offering of a HEI. A feasibility study is primordial to almost every proposed project [5]. For academic programs, higher education institutions have to consider societal benefits of its program offerings [6].

Based on its institutional mandate, the College "*… is committed to primarily provide advanced education, higher technological, professional and vocational instruction and training in the sciences, arts, education, entrepreneurship, engineering and other related courses. And, undertake research and extension services and provide progressive leadership in its areas.*"[7], the College of Education proposed to offer the Doctor of Philosophy in Science, Technology, Engineering, and Mathematics Program in support of the school's vision to be a premier college for creative and innovative applied sciences and technology, and in making true to the humanism of its educational philosophy of enhancing a learner's potentials to the optimum, as aligned to its Charter.

Since 1988, by virtue of DECS Order No. 39 S. 1988, the college has produced exemplary teachers with different majors, including Mathematics and Physics. With continuous education as among its purpose, the initiative of offering Doctor of Philosophy in Science, Technology, Engineering and Mathematics (PhD-STEM) will provide extensive knowledge and research opportunities to the teacher graduates. The general objective of the program (PhD-STEM) is to further enhance the professionals in the applications of educational theories, principles and pedagogies as they pursue various educational career opportunities, and face challenges, be it locally or otherwise. It will expose the graduate students more complex research and organizational cases that may develop further their skills aside from their methodical and pedagogical expertise. In the program, the graduate students will be provided with more than enough theoretical and practical cases highly competent educational practitioners. The program, having an outcomes-based design, will be a hybrid of theory and practical-based researches and dissertation.

The proposal is aligned to the general objective of the College which is to make instruction, research, extension and production as important components its inclusive array of program offerings.

II. OBJECTIVES OF THE STUDY

The study is thrusted to know whether or not offering Doctor of Philosophy in Science, Technology, Engineering and Mathematics in the State College is feasible. Specifically, it aims to 1) Determine the viability of offering Doctor of Philosophy in Science, Technology, Engineering, and Mathematics program in terms of (a) Market demand, (b) Financial viability, (c) Management viability, and (d) Operational capability; and 2) Determine whether to offer the program or not, based on the results of the above objectives.

III. MATERIALS AND METHODS

To determine the capabilities, i.e., strength and weaknesses, of the College to offer Doctor of Philosophy in STEM, the study adopted the descriptive research design [8]. Survey questionnaire was designed to obtain data aligned with the objectives of the study and Focus Group Discussion (FGD) was employed to validate and get additional inputs relative to the study.

The instrument used in data gathering was in the form of a survey questionnaire. And, as with most survey forms, it was comprised of two sections, that is, the participants' profile and the other section contains questions to determine the viability of Doctor of Philosophy Program in terms of market demand, financial viability, management adaptability, and operational capability of the College. The questionnaire was presented for scrutiny to experts, and was subjected to validation. Oral agreement by the participants and corresponding permits from their immediate superiors were secured by the researchers prior to conducting the survey. Participants for the survey were 45 employees of the College, all of the 26 graduates of Master of Arts in Teaching of the College (A/Y 2018-2019), and 32 graduate-employees from other agencies. Graduates of education and engineering were considered most in the groups of participants.

A focus group discussed the viabilities of the program offering out of the data collected and sharing experiential knowledge. The College's academic programs, faculty profile, and tracer studies, as well as the College's mission and goals formed part of the review of related documents. Weighted mean and percentage were used as statistical assessment of the viability of the proposed program.

IV. RESULTS AND DISCUSSION

The participants were composed of 80% female and 20% male. With ages ranging from 24 to 50 years old, 32% of which are below 30 years old, most of them are married. There are 61 teachers (59.2%), 19 engineers (18.5%), while 23 (22.3%) of them represent different disciplines, all of them has their corresponding licenses and eligibilities. In terms of affiliations and employment ranks, 88 (85.4%) are on government service while 15 (14.6%) in private. They are mostly on rank and file (82.5%), 14.6% are in mid-level rank while the remaining 2.9% (3 of them) are on top management level.

As to the desire to pursue Doctor of Philosophy, 89.8% intends to pursue a PhD. Table 1 shows the perception of the participants on the PhD-STEM offering of the college.

Most of the participants showed interest to pursue a PhD in STEM and even thought of recommending the program to their colleagues. They also perceived that professionals from other disciplines will be interested to enroll in the post-graduate program once offered.

Table 1: *Participants' perception on PhD-STEM*

	Weighted Mean	Descriptive Rating
Will be interested to enroll in the program.	3.59	Very much interested
Will be happy to recommend the program to colleagues.	3.76	Very much interested
Other professionals will be interested in the program	3.59	Very much interested

Legend:
3.26 – 4.0: very much interested
2.51 – 3.25: interested
1.76 – 2.50: somewhat interested
1.0 – 1.75: not interested

This interest can be taken from the premise that post-graduate diploma is still among the best type of continuous education. A PhD diploma is awarded full credit units for the compliance period [9].

Market Demand

For market demand, data in Table 2 presents an average mean of 3.30 for the perceived demand for PhDs in the next 5 years, which is interpreted as very high. Perhaps the

participants viewed that a PhD degree is a sure passport to employment, the average perception of 3.18, which has a descriptive rating of 'high'. However, for the rest of the parameters, obtained descriptive ratings of 'very high'. Of the 26 alumni-respondents of the College who graduated from Master of Arts in Teaching, 10 of whom are employed by the College, showed 'very high' interest of pursuing PhD-STEM.

The overall mean of 3.30 translates that the proposed PhD-STEM's market viability as very high; thus, considered as strength of the college. Competition among professionals and the rise in enrollment in STEM strand [10] means more demand for Master's and Doctorate degree holders in education with specialization in Science, Technology, Engineering and Mathematics. The focus group discussed on this issue and unanimously agreed that there is rise in interest in the science and technology which can be attributed to the new curriculum (K-12) gaining confidence and interest from the learners and the society itself. The FGD also agreed further that educators produced by the College should pursue further studies so that they can keep themselves abreast with the ongoing development in the industry and in the educational system.

Table 2: *Perceived market viability of Doctor of Philosophy in STEM Program*

Market Viability	Internal	External	Average	
	Mean	Mean	Mean	DR
1. The demand for Doctor of Philosophy in STEM 5 years forward.	3.22	3.38	3.30	VH
2. The employment opportunities for Doctor of Philosophy in STEM graduates locally and elsewhere.	3.08	3.28	3.18	H
3. Career advancement opportunities for PhD STEM graduates.	3.56	3.28	3.42	VH
4. Graduates of Master of Arts in Teaching interested to pursue PhD STEM at the College.	3.50	3.13	3.31	VH
TOTAL	3.34	3.27	3.30	VH

Legend:
DR – descriptive rating
Strength: high – very high
Weakness: low – very low
3.26 – 4.00: very high (VH)
2.51 – 3.25: high (H)
1.76 – 2.50: low (L)
1.00 – 1.75: very low (VL)

The current verticalization framework in continuous professional development observed by educational institutions is tantamount to rise in the demand of postgraduate programs like Masters and Doctors of Education with specific specializations [11].

The foregoing expresses that, since it is relevant, availability and accessibility of graduate programs must be presented.

Financial Viability

Table 3 presents the financial viability assessment of the proposed Doctorate program.

The College, being a state college, has the capability to offer affordable programs. As perceived by the internal respondents, all of them rated the College 'very high' in terms of affordability of the graduate programs. Meanwhile, on some slightly varied perceptions, the employer support, albeit the government or private entities, was viewed only to be high, especially by the external respondents. However, overall mean still perceives the financial viability of the program to be 'very high' at 3.42 weighted mean. This result can still consider the institution to be strong in terms of financial viability.

Table 3: *Perceived financial viability of Doctor of Philosophy in STEM Program*

Financial Viability	Internal	External	Average	
	Mean	Mean	Mean	DR
1. Affordability of the graduate courses in the College	4.00	3.26	3.63	VH
2. College programs towards faculty/staff capability enhancement.	3.36	3.06	3.21	H
TOTAL	3.68	3.16	3.42	VH

Legend:
DR – descriptive rating
Strength: high – very high
Weakness: low – very low
3.26 – 4.00: very high (VH)
2.51 – 3.25: high (H)

1.76 – 2.50: low (L)
1.00 – 1.75: very low (VL)

On another note, the new program offering can also be viewed as an avenue of the College to further engage in an income generating project [12]. The additional income can help augment the resources of the institution [13].

Management Viability

Table 4 shows the respondents' perception on the College's management viability.

The overall mean of 3.38 whose descriptive rating of 'strongly agree' can be viewed as the management viability is a strength of the College. While 4 of the 5 parameters considered was rated 'strongly agree' the parameter of faculty qualification was rated 'agree' only with an average mean of 3.25, which is borderline between 'agree' and 'strongly agree' which also the divide between the external and internal respondents, respectively.

The consideration of management of the institution as strength was supported by the FGD findings. Pointing to the facts that the department proposing the program, is currently headed by doctorate degree in education and supported by area chairpersons with vertically aligned specializations and individually possessing post graduate degrees. As a whole, the institutions continuous effort to develop its faculty and staff supports this strength. Faculty development programs is generally viewed as a positive change generator in terms of learning and teaching outcomes, enhanced abilities in terms of management and leadership, social skills for collaborations, and professional growth [14].

Table 4: *Perception on management viability of Doctor of Philosophy in STEM program*

Management Viability	Internal	External	Average	
	Mean	Mean	Mean	DR
1. Adequate number of qualified faculty members	3.41	3.09	3.25	A
2. Support management from the College Administration	3.53	3.45	3.49	SA
3. Extensive experience of running graduate programs	3.53	3.21	3.37	SA
4. International exposure of faculty in research and publications	3.47	3.48	3.48	SA
5. Possibility of inviting visiting experts	3.47	3.30	3.39	SA
TOTAL	3.48	3.31	3.40	SA

Legend:
DR – descriptive rating
Strength: agree – strongly agree
Weakness: disagree – strongly disagree
3.26 – 4.00: strongly agree (SA)
2.51 – 3.25: agree (A)
1.76 – 2.50: disagree (DA)
1.00 – 1.75: strongly disagree (SDA)

Operational Capability

Table 5 presents the factors considered in the operational capability of the proposed program offering were "Accessibility of the graduate school", "Availability of adequate physical facilities", "Availability of state-of-the-art laboratories", and "Access to adequate relevant resources in the library".

The operational capability of the College was viewed by the respondents as 'very high' with an overall mean of 3.42. This also means that the operational capability is considered strength of the College.

Table 5: *Perception on operational capability of offering Doctor of Philosophy in STEM*

Operational Capability	Internal	External	Average	
	Mean	Mean	Mean	DR
1. Accessibility of the graduate school.	3.87	3.33	3.60	VH
2. Availability of adequate physical facilities in the College	3.59	3.15	3.37	VH
3. Availability of state-of-the-art laboratories	3.47	3.22	3.35	VH
4. Access to adequate relevant resources in the library	3.53	3.12	3.33	VH
TOTAL	3.62	3.21	3.42	VH

Legend:
DR – descriptive rating
Strength: high – very high
Weakness: low – very low
3.26 – 4.00: very high (VH)
2.51 – 3.25: high (H)
1.76 – 2.50: low (L)
1.00 – 1.75: very low (VL)

The FGD also identified some strengths of the college like an up-to-date library system (with both online and physical accessibility plus subscription to online databases and journals), laboratory facilities, such as chemistry and physics laboratories, food technology laboratory and manufacturing fabrication laboratory. There were also noted some weaknesses, such as outdated facilities, which were seldom used, though, unused and inappropriate laboratory supplies and equipment..

Summary of assessment on viability of proposed Doctor of Philosophy in STEM is presented in Table 6.

The above findings showed that the 4 parameters considered, which are, market demand, financial, management, and operational capability viabilities yielded '*very high*' rating which are also considered strength of the College. The FGD noted some weaknesses, specifically in the operational capability, such as the aging and inappropriate laboratory supplies and equipment. However, further enhancement of the identified strength might obliterate the noted weaknesses of the College.

Table 6: *Assessment on Viability of Doctor of Philosophy in STEM*

Indicators	Mean	DR	Remarks
1. Market demand Viability	3.30	Very high	strength
2. Financial viability	3.42	Very high	strength
3. Management Viability	3.40	Very high	strength
4. Operational Capability	3.42	Very high	strength

Legend:
DR – descriptive rating
Strength: high – very high
Weakness: low – very low
3.26 – 4.00: very high (VH)
2.51 – 3.25: high (H)
1.76 – 2.50: low (L)
1.00 – 1.75: very low (VL)

With the above results, the proposed Doctor of Philosophy in STEM of the College can be considered compliant with the requirement stipulated by the Commission of Higher Education [11].

V. CONCLUSION AND RECOMMENDATION

The results above showed enough bases to conclude that the proposed Doctor of Philosophy major in Science, Technology, Engineering, and Mathematics is appropriate and compliant with the requirements stipulated by the Commission on Higher Education, thus, feasible to be offered by the College.

Inclusion of the program among the existing offerings of the College will further strengthen its adherence to its mandate to "*primarily*

provide advanced education, higher technological, professional and vocational instruction and training in the sciences, arts, education, entrepreneurship, engineering and other related courses" [7].

Based on the above results, the researchers recommend a) to include Doctor of Philosophy in Science, Technology, Engineering and Mathematics in the program offerings of the College, b) continuous enhancements of facilities of the College in terms of instruction, research and extension giving priority on laboratory and physical facilities to address the weaknesses noted by the FGD, c) continuous faculty development and hiring of additional faculty for CAS, and d) regular conduct of tracer study among the graduates.

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