ACADEMIC ACHIEVEMENT IN THE LEARNING DOMAINS AND PERFORMANCE IN LICENSURE EXAMINATION FOR ENGINEERS AMONG LPU'S MECHANICAL AND ELECTRONICS ENGINEERING GRADUATES

Dr. Jake M. Laguador*

Engr. Noimie C. Dizon

ABSTRACT

This study aimed to investigate the Board Examination Performance of BS Mechanical Engineering and BS Electronics Engineering graduates from Lyceum of the Philippines University (LPU) – Batangas City from 2006 – 2011. Descriptive type of quantitative research method was used in the study wherein total population of all board examinees was considered. Results showed that Mechanical Engineering (ME) examinees performed well in Machine design while ECE did well in Mathematics. ME examinees did not perform well in Power Plant Design/Industrial Plant Design while ECE did not do well in General Engineering and Applied Sciences. ME and ECE examinees obtained low performance in comprehensive examination with high level of study habits and academic behavior. Affective domain is significantly related to and predicts Licensure examination Performance of the respondents. Outcomes-based curriculum must be adapted to periodically monitor the academic performance and behavior as well as the result of study habits of the students. Teachers must consistently monitor the academic performance and behavior of engineering students to provide thorough guidance for those who are low achievers.

Keywords: Academic Achievement, Electronics, Engineering, Lyceum, Licensure Examination, Mechanical

* College of Engineering, Lyceum of the Philippines University – Batangas City, Philippines

Introduction

The Licensure Examination for Engineers is a tool that measures and ensures the quality of engineers who would join the workforce of various manufacturing industries in the Philippines and abroad. The Professional Regulations Commission (PRC) as the duly constituted body created for this function has been consistent in its task of screening who among the graduates from all board courses will be in granted the professional licenses based on the board exam results.

The Lyceum of the Philippines University (LPU) in Batangas City is presently offers BS Mechanical Engineering (BSME) and BS Electronics Engineering (BSECE) which require board examinations for its the graduates to be called licensed Engineers. Determining the success factors involved in the Licensure Examination for Mechanical Engineers and Electronics Engineers is the major concern of this study. This research intends to identify the best predictor of success in Licensure Examination for Engineers that among the selected variables considered in the study. These variables include the computed average of General Education, Mathematics, Engineering Sciences and Professional subjects for BSME and BSECE programs; study habits, practices and behavior; as well as the on-the-job training performance and school participation. The profile of the College of Engineering is also considered in the study in terms of ECE and ME board examination results and institutional versus national passing rate.

The first batch of BSME and BSECE graduates from 2006 up to the most recent board exam of 2011 are included as subjects of the study. There are 33 ECE and 36 ME board examinees from 2006 – 2011. The ratings of all board examinees for ECE and ME who passed and failed the examination were obtained from the PRC while the computed weighted average for all the subjects were obtained from the records of Registrar's Office or at the Engineering Department. Documentary analysis was employed as a procedure for data gathering. This research is also intended to compare the characteristics of those who passed and failed in the licensure examination in terms of their school participation, diligence in studies and behavior which are aspects of students considered important variable being investigated in the study.

The findings served as a reference guide on which area in the board programs of engineering needs to intensify to ensure that the quality of graduates would have a greater chance of passing the licensure examination for mechanical engineers and electronics engineers. Based on the salient findings of this study, the study aims to formulate an enhancement program in the curriculum and the delivery of instruction of the teachers in Mechanical Engineering and Electronics Engineering. The result of failed examinees for ECE is very significant basis for enhancing the program while doing the same purpose for the Mechanical Engineering would be of help to strengthen more the program.

Objectives of the Study

This study aimed to investigate the Board Exam Performance of BS Mechanical Engineering and BS Electronics Engineering graduates and its relationship to selected variables from 2006-2011.

Specifically, this study was guided by the following objectives:

1. To determine the Board Examination Performance rating of Mechanical and Electronics Engineering Examinees of Lyceum of the Philippines University in Batangas City from 2006 – 2011.
2. To determine the academic achievement of the Engineering examinees in terms of the following learning domains:

2.1 Cognitive domain:

2.1.1 Comprehensive Examination result;

2.1.2 Average Academic Ratings in:

2.1.2.1 Mathematics subjects;

2.1.2.2 Science Subjects; and

2.1.2.3 Language Subjects;

2.1.2.4 ME and ECE Professional subjects.

2.2 Affective Domain:

2.2.1 Study Habits and Practices; and

2.2.2 Academic Behavior.

2.3 Psychomotor domain:

2.3.1 On-the-Job Training Performance; and

2.3.2 School Participation.

3. To investigate the significant relationship between the Licensure examination Performance ratings of the respondents and the variables in the three domains of learning.

4. To determine which of the above mentioned variables predicts the board examination performance of BSME and BSECE board examinees.

5. Based on the findings of the study, to propose measures that will enhance the Mechanical Engineering and Electronics Engineering programs.

Hypothesis

This study aimed to test these hypotheses:

1. There is no significant relationship between the Licensure examination Performance ratings of the engineering examinees and the variables in the three domains of learning.
2. Grades in Mathematics and Professional Subjects best predict the board examination performance of BSME and BSECE board examinees.

Related Literature

Mechanical Engineering is the branch of engineering that encompasses the generation and application of heat and mechanical power and the design, production, and use of machines and tools [1]. The mechanical engineering curricula at the University of Minho have been comprehensively formulated in order to meet the new goals for the whole higher education system set by the Bologna protocol in the European Union such as quality assessment for university courses; framework for the exchange of students and academics; and an opportunity for changing the teaching/learning procedures and methodologies [2]. In reference [3] studied the effects of a continuous assessment process on mechanical engineering education at Kuwait

University. Efforts to educate faculty and students about the process are beginning to produce accurate and consistent measurements of student learning.

On the other hand, Electronics Engineering is one of the largest and fastest growing fields of engineering. It covers a wide range of applications which make life easier and enjoyable such as Television, Radio, computers, telecommunication etc [4].

In order for Mechanical and Electronics Engineering graduates to become licensed engineers, they must adhere to the policies set by Professional Regulation Commission for taking the Licensure Examination.

Republic Act No. 8495 regulates the practice of Mechanical Engineering in the Philippines. To become a Licensed Mechanical Engineer, the applicant shall pass a written examination with an average of seventy percent (70%) on all subjects, with no rating below fifty percent (50%) in any of the subjects on power plant and industrial plant engineering, mathematics, engineering economics, economic analysis, laws and ethics and machine design [5].

On the other hand, RA 5734 regulates the practice of the Electronics and Communications Engineering in the Philippines. In order to be admitted to the electronics and communications engineering examination, an applicant must, at time of the filing of his application therefore, establish to the satisfaction of the Board that he is at least twenty-one years of age; a citizen of the Philippines or of a foreign country qualified to take the examination under Section twenty-three of this Act; with good moral character; and a holder of the degree of Bachelor of Science in Electronics and Communications Engineering, or such equivalent engineering course from any school, institute, college, or university recognized by the Government or the State [6].

To pass the examination, a candidate must obtain an average of seventy per cent, with no rating below fifty per cent in any subject: Provided, that an applicant who fails to obtain a passing average but who obtained at least seventy per cent in each of at least one-half of the total

subjects given in the examination, may be permitted to take within two years from the date of his examination, another examination on the subjects in which he obtained a grade below seventy per cent. Should the examinee fail in the set of subject repeated in the second examination, he shall be required to take all the subjects in the next examination. To pass these licensure examinations, engineering students have to undergo five years of baccalaureate studies through educating and cultivating their knowledge, skills and values with the application of different concepts and theories of learning.

Bloom's Taxonomy underpins the classical 'Knowledge, Attitude, Skills' structure of learning method and evaluation, and aside from the even simpler Kirkpatrick learning evaluation model [7]. Bloom's Taxonomy of Learning Domains remains the most widely used system of its kind in education and also for industry and corporate training. It's easy to see why, because it is such a simple, clear and effective model, both for explanation and application of learning objectives, teaching and training methods, and measurement of learning outcomes.

Cognitive procedural learning is characterised by three phases, each involving distinct processes. Considering the implication of episodic memory in the first cognitive stage, the impairment of this memory system might be responsible for a slowing down of the cognitive procedural learning dynamics in the course of ageing [8].

Entrance test scores weigh heavily in admissions decisions, but these are not the only variable considered in admitting a student to even the most selective institution of higher learning. Most colleges and universities use the test scores as a means of assessing a candidate for admission. Other criteria included in this assessment are the high school grade point average (GPA), rank in class, record of extracurricular and service activities, letters of recommendation, applicant's essay, evidence of persistence, and interviews, which assist the college or university in determining the applicant's maturity, determination, personality, and character. [9]. Result of Entrance Examination of students is one of the variables included in the present study which is considered factor in determining the performance of the students in board examination and it is under the cognitive domain.

Curriculum plays a vital role in the realization of three domains of learning. It serves as a guide to achieve the objectives of outcomes based education. An engineering program is better able to ensure the ownership, development and integrity of and research into its own curriculum if it has a centralized university improvement system that presents unit-level quality management research to external market and accountability groups [10].

The attribute focus in engineering education now adopted by the engineering education accrediting bodies of the US, UK and Australia is based on meeting the assumed needs of professional practice. It is associated with an increasing expectation by employers of work-ready graduates rather than relying on subsequent work-based learning and experience to develop many of the essential professional practice attributes [11]. Engineering education should be relevant to the needs of the industry as it absorbs the large majority of engineering students, either directly or indirectly. The contact between industry and engineering students has therefore to be stimulated. As no legal obligation exists in Belgium, this is left entirely to the initiative of the professors and the engineers in industry [12].

On the spot Comprehensive examination is an important practice in engineering before they will allow taking the National Board Examination [13]. The result of this exam is also an important input for the College of Engineering in Lyceum of the Philippines University – Batangas whether they will allow or not a certain student to take the board examination.

Indicators of success and persistence were based on theoretical and empirical evidence and included both cognitive and non-cognitive variables. Cognitive variables included high school rank, SAT scores, and university cumulative grade point average. Non-cognitive factors included academic motivation and institutional integration. Outcome variables included grade point average, enrolment at the university, and status as an engineering major [14].

In reference [15] identified the twelve helpful academic activities and support service factors and later grouped into three major themes with subcategories: personal effort and involvement, peer interaction, and faculty contact. Personal effort and involvement refers to the specific activities and academic support services that participants perceived as positively

influencing their academic performance. Peer interaction refers to students' relationships with other students and the perceived impact of these contacts on their academic performance. The present involved the on-the-job performance of the students as well as their school participation in the extra-curricular activities of the university. These are also being considered as factors that would contribute to the objective of passing the board examination.

One report compared the overall pass rate of program students against national pass rates and attempted to identify factors that contributed to below-national performance of the program students [16].

The Civil and Geological Engineering (CAGE) department stresses the importance of licensing in professional development in all our courses starting from freshman level. All the seniors are required to sign up for a one-credit hour seminar course during their last semester and take the FE test in preparation for their professional licensure; those who pass the FE test earn an "A" grade, improving their GPA as well [17].

In reference [18] and his colleagues examined the current mechanical engineering educational programs in America and Australia to determine the degree of holistic, systems thinking of each program. Faculty from ten American Universities and ten Australian universities participated in online surveys and interviews with the resulting data analysis and interpretation suggest that holistic, systems thinking is present in both American and Australian engineering educational programs, although it is more prevalent in Australian programs. The specific examples of educational opportunities are courses, projects, extracurricular activities, research experiences that integrate complex systems study.

In reference [19] examined the development of risk awareness in the areas of professional responsibility, risk assessment, techniques for reducing risk and potential exposure to hazards and risk in the workplace among undergraduate students studying mechanical engineering at a South African university. The results were compared to those obtained from the University of Liverpool - the UK students outperformed their South African counterparts. It is recommended

that teaching interventions regarding health and safety be introduced earlier in the South African Mechanical Engineering curriculum to address this deficiency.

Students believed that sustainable development is important for engineers, although they often have difficulties in making a direct link between the theory of sustainable development and engineering practice. It also illustrates an approach to teaching sustainability that could help to stimulate students' interest in this subject during their studies and to ensure their commitment to practicing sustainable engineering later as professionals [20]. One reason for identifying deficiencies in study habits is to develop ways to improve them. Students must be aware of strategies for optimal learning, and help them learn to use habits for personal success [21]. Engineering students who earned the highest grades, in contrast to their less successful counterparts, tended to score higher on study habit scales that suggested lower levels of distractibility and higher levels of inquisitiveness. This pattern was evident even when groups were defined on the basis of grade-point averages that were adjusted for the effects of attitude test performance [22].

In general, engineering students have been exposed to more technology than any students before them; however, this technical advancement has caused them to develop certain habits and general attitudes, unique to their age, which present especial challenges that educators and mentors, must address. The extent to which these habits and attitudes shape a student depend upon the way in which the student matures during the first year, and especially during the first term, at the university [23]. Research indicates that participation in extracurricular activities affects students' academic performance. More specifically, studies have been conducted assessing the effects of specific extracurricular activities on academic performance [24].

In involving students in extracurricular activities, teachers should make use of every opportunity to help them develop a sound attitude towards these activities. Involvement in extracurricular activities is positively related to academic performance, personality, and peer acceptance. Although the overall correlations of involvement in extracurricular activities with academic performance and peer acceptance have not been found to be statistically significant,

there is strong evidence showing that genuinely positively relations do exist between some of the sub-scales [25].

Method

The researchers utilized the descriptive type of quantitative research method. The BS Mechanical and Electronics board examinees from 2006-2011 were the subjects of the study. The study intended to describe the Board Examination Performance rating of Mechanical and Electronics Engineering Examinees of Lyceum of the Philippines University in Batangas City from 2006 – 2011 and the performance level and observed characteristics of those who passed and failed examinees in the three domains of learning. The study also tested the significant relationship between National Board Examination Performance rating of the examinees and the variables in the three domains of learning and determined which of the variables cited in the study best predicts the board examination performance of BSME and BSECE examinees.

Subject

The first batch of BSME and BSECE graduates from 2006 up to the most recent board exam of 2011 were the subjects of the study. There were 33 ECE and 36 ME board examinees from 2006 – 2011.

Procedure

The researchers interviewed faculty members from the general education department and the engineering department who were former teachers of the subjects under study. They were asked regarding the behavior and diligence of the students to study and some questions directly related to board examination. The Dean and the department chair of the College of Engineering were responsible for tracing the involvement of the participants in the student activities of the college during the time of their enrolment.

The ratings of all board examinees for ECE and ME who passed and failed the examination were obtained from PRC while the computed weighted average for all the subjects were obtained from the records of the Registrar's Office or at the Engineering Department. Documentary analysis was employed as a procedure for data gathering.

Data Analysis

1. Arithmetic Mean was used to describe the Board Examination Performance of Mechanical and Electronics Engineering Examinees of Lyceum of the Philippines University in Batangas City from 2006 – 2011 and their performance level in Comprehensive Examination and Average Academic Ratings in General Education subjects and Basic Engineering Science subjects as well as in ME and ECE Professional subjects.
2. Weighted mean and rank were utilized to analyze and interpret the study habits and practices as well as the behavior, On-the-Job Training Performance; and school participation of the students.
3. Pearson Product Moment Correlation and regression analysis were used to test the significant relationship between Licensure Examination Performance rating of the examinees and the variables in the three domains of learning as well as to determine which of the variable/s included in the study predict/s the board examination performance of BSME and BSECE board examinees.

The five-point likert scale was used to interpret the On-the-Job Training performance of ME and ECE examinees.

Weight	Range	Verbal Interpretation
5	4.50 – 5.00	Excellent
4	3.50 – 4.49	Very Good
3	2.50 – 3.49	Good
2	1.50 – 2.49	Fair
1	1.00 – 1.49	Poor

The four-point likert scale was used to describe the study habits and practices of ME and ECE examinees.

Weight	Range	Verbal Interpretation
4	3.50 – 4.00	Always
3	2.50 – 3.49	Sometimes
2	1.50 – 2.49	Seldom
1	1.00 – 1.49	Never

The five-point Likert scale was used to describe the school participation of ME and ECE examinees.

Weight	Range	Verbal Interpretation
5	4.50 – 5.00	Very Active
4	3.50 – 4.49	Active
3	2.50 – 3.49	Moderately Active
2	1.50 – 2.49	Passive
1	1.00 – 1.49	Very Passive

Results and Discussion

Engineering Licensure examination is a significant measure to ensure the quality of output or graduates provided by a certain higher education institutions and it is equally important in giving professional license to all passers which will provide privileges and opportunity for them to secure good company positions. Determining the academic achievements of engineering students in LPU- Batangas and some underlying factors related to three domains of learning was the main focus of the study.

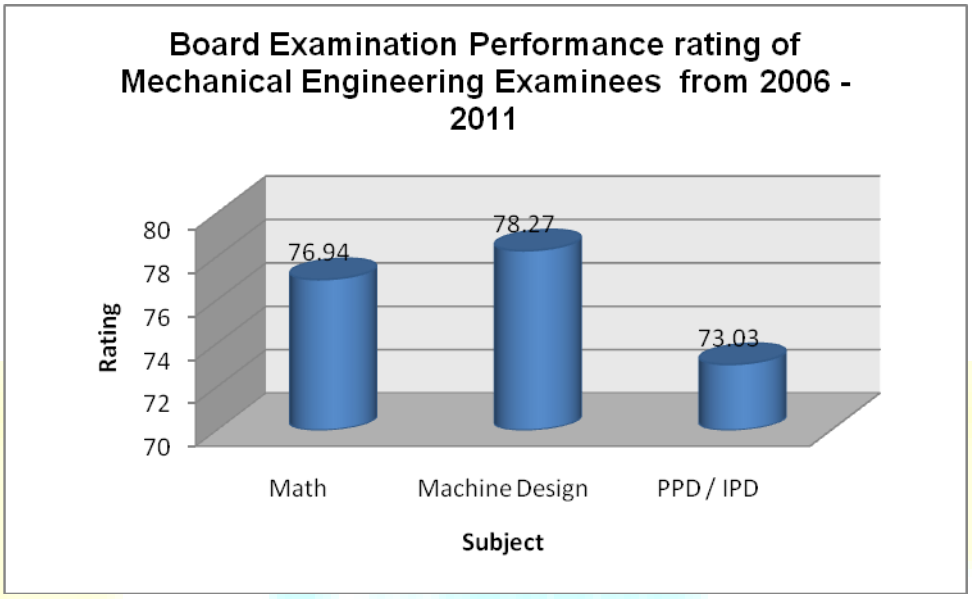

Figure 1. Board Examination Performance of Mechanical Engineering Examinees

Mechanical Engineering examinees obtained highest average score in Machine design (78.27%) subject followed by Math subjects (76.94) while Power Plant Design (PPD)/ Industrial Plant Design (IPD) obtained the lowest rating of 73.03 percent. This indicates that Faculty members handling PPD/IPD subject must exert more effort to strengthen the delivery of instruction and ensure the cognitive ability of the students in the subject must be developed.

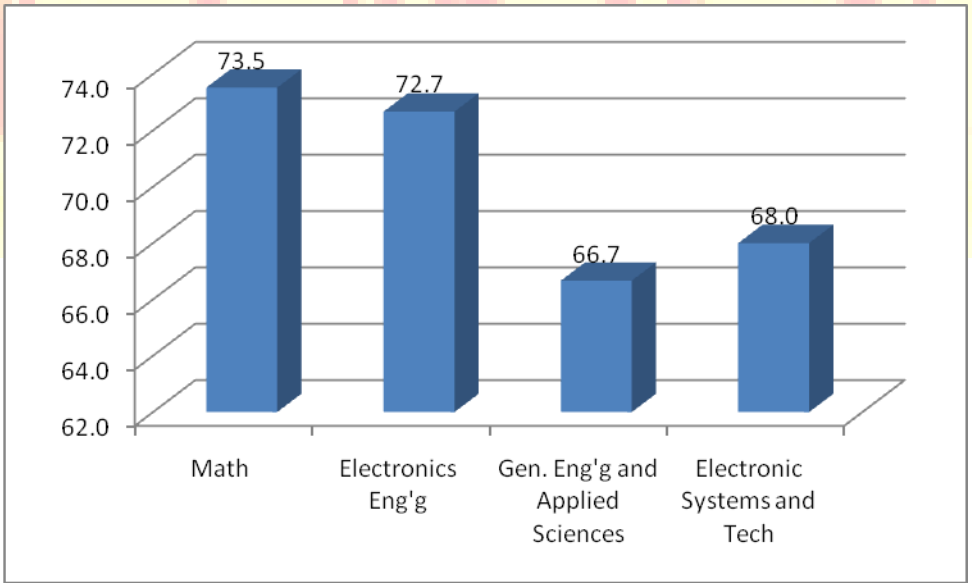

Figure 2. Board Examination Performance Rating of Electronic Engineering Examinees

Electronics Engineering examinees obtained highest average score in Mathematics (73.5%) subject followed by Electronics Engineering subjects (72.7%) while Electronic Systems and Technology (68.0%) and General Engineering and Applied Sciences (66.7%) obtained the lowest ratings. These findings are indicative of the need for the faculty members handling the subjects like Natural and Physical Sciences, Thermodynamics, Mechanics, Strength of Materials to keep on improving the content of the subject being delivered to the students, the teaching strategy that would lead to better retention and provide comprehensive evaluation through exercises and board type examination.

Likewise, Electronics Engineering must also be provided better learning facilities and reading materials on latest trends in information technology related to electronics and communication technology. Students must also be encouraged to spend more time on reading latest electronics magazines and research journals to keep abreast of the new innovation and trends in related fields. Technological innovation has the fastest way of improving its features, functions, and processes to provide better dimension of living and responding to the company requirements as part of research and development objectives.

Technology and information one year or two years ago would not be the same today. Discovering advancement in technology is a never ending process. That's why, the knowledge provided by the Higher Education Institutions to the ECE students during college days in Electronics Systems and Technologies would not be sufficient to survive the board examinations.

Table 1 presents the academic achievement of the Mechanical Engineering Examinees in terms of comprehensive examination result under cognitive domain.

Table 1

Academic Achievement of the Mechanical Engineering Examinees in Terms of Comprehensive Examination Result under Cognitive Domain

Subject	Rating	Verbal Interpretation	Rank
Math	70.27	Failed	4
Machine Design	76.26	Poor	2
Industrial Plant Design	76.28	Poor	1
Power Plant Design	74.86	Poor	3
Average	74.42	Failed	

Legend: 74 and below – Failed; 75 – 79 – Poor; 80 – 85 – Fair; 86 – 90 – Good; 91 – 95 – Very Good; 96 – 100 – Excellent

The data in Table 1 show that the Mechanical Engineering students obtained highest rating in Industrial Power Plant (76.28%) followed by Machine Design (76.26%) and PPD (74.86%) while Mathematics subject (70.27%) has the least obtained rating. The questions for comprehensive examination in Industrial Power Plant and Power Plant Design must be reviewed to ensure its level of difficulty and topics included were satisfactorily met the knowledge and areas needed in the actual board examination. Because based on the result on Figure 1 shows that in PPD/IPD, the examinees obtained lowest score among the three areas of the national board examination though they obtained high score on this part of the comprehensive examination.

Table 2 presents the academic achievement of the Electronics Engineering Examinees in terms of comprehensive examination result under cognitive domain.

Table 2

Academic Achievement of the Electronics Engineering Examinees in Terms of Comprehensive Examination Result under Cognitive Domain

Subject	Rating	Verbal Interpretation	Rank
Mathematics	68.71	Failed	4

Electronics	76.11	Poor	1
GEAS	70	Failed	3
Communication	75.55	Poor	2
Average	72.59	Failed	

Legend: 74 and below – Failed; 75 – 79 – Poor; 80 – 85 – Fair; 86 – 90 – Good; 91 – 95 – Very Good; 96 – 100 – Excellent

The data reveal that the Electronics Engineering students obtained highest rating in Electronics subject (76.11%) followed by Communication (75.55%) and GEAS (70%) while Mathematics subject (68.71%) has the least rating. In average, the examinees obtained better score in Electronics because this is the subject where they spent sufficient time in terms of years of study compare to General Engineering and Applied Sciences (GEAS) as well as Mathematics Subjects where the focus of study were too broad and several topics were included which sometimes given not enough concentration.

Both Electronics and Mechanical Engineering examinees obtained lowest ratings in Mathematics. This implies that there is a need to strengthen the delivery of instruction and widen the coverage of the topics being discussed based on the coverage of the comprehensive examination. Some lessons especially the last part of the syllabus has never been discussed anymore due to lack of classroom contact periods. Students must be given enough exercises at home to practice solving the problems included in the examination especially on the application part of the lessons. Enough attention must also be considered in evaluating the competencies of the students in terms of proper way of analyzing the given and process of identifying correct formula to be used. Results of the comprehensive examination must be analyzed to determine the subjects needed more time for review sessions.

Table 3 presents the academic achievement of the Mechanical Engineering Examinees in terms of average academic ratings under cognitive domain.

Table 3

Academic Achievement of the Mechanical Engineering Examinees in Terms of Average Academic Ratings under Cognitive Domain

Subject	ME			ECE		
	Rating	VI	Rank	Rating	VI	Rank
Mathematics	2.41	Fair	3	1.97	Good	3
Sciences	2.29	Fair	2	1.89	Good	2
Language	2.12	Fair	1	1.81	Good	1
Professional	2.73	Poor	4	2.25	Fair	4
Average	2.39	Fair		1.98	Good	

Legend: 1.00 – 1.25 – Excellent; 1.26 – 1.50 – Very Good; 1.51 – 1.99 – Good; 2.00 – 2.49 – Fair; 2.50 – 3.00 - Poor

Mechanical engineering examinees obtained highest rating in language courses (2.12) followed by sciences (2.29) and Mathematics (2.41) all verbally interpreted as Fair while the professional courses obtained the least (2.73) rating verbally interpreted as poor. It is understood that general and professional subjects in any field of specialization have different approaches to learning. The level of complexity of the topics being discussed in a certain subject explains why students find it difficult to comprehend and appreciate the learning process as well as the subject itself.

Language courses including the mastery of English and Filipino communication skills could be much easier to grasp by the students compared to engineering applications and its allied sciences have the comparatively high scores in these subjects.

Same rankings of the areas of study were obtained by the Electronics Engineering Examinees. But ECE examinees had higher rating in all areas compared to ME. ECE examinees had good performance results in Math, sciences and languages while ME examinees have obtained fair performance. ECE examinees also have higher performance in professional subjects (2.25) compared to their ME counterparts.

Table 4 presents the academic achievement of the Engineering Examinees in terms of study habits under affective domain. Based on the observations of teachers, engineering examinees always listened attentively to the classroom discussion (3.90) and they always take down notes in class (3.90). They always ask the help of teachers or classmates to understand the lesson (3.88); always showed interest and motivation towards major subjects (3.83) and raised questions during discussion (3.81).

Table 4
Academic Achievement of the Respondents in Terms of Study Habits under Affective Domain

Study Habits	ME		ECE		Total		
	WM	VI	WM	VI	WM	VI	Rank
Made a definite time to study regularly in the library.	3.34	S	3.52	A	3.43	S	10
Submitted his assignments and projects on-time.	3.35	S	3.52	A	3.44	S	9
Substantially answered the questions of teachers.	3.70	A	3.68	A	3.69	A	7
Went to school early or on time.	3.57	A	3.61	A	3.59	A	8
Listened attentively to the classroom discussions.	3.87	A	3.92	A	3.90	A	1.5
Asked the help of teachers or classmates to understand the lesson.	3.85	A	3.90	A	3.88	A	3
Raised questions during discussion.	3.84	A	3.77	A	3.81	A	5
Took notes in class.	3.92	A	3.88	A	3.90	A	1.5
Showed interest and motivation	3.89	A	3.77	A	3.83	A	4

towards major subjects.							
. Prioritized working with projects than going out with friends.	3.71	A	3.72	A	3.72	A	6
Composite Mean	**3.70**	**A**	**3.73**	**A**	**3.72**	**A**	

These students paid closer attention in classroom discussion and jotted down notes for review. They put greater emphasis on the lessons presented and delivered by teachers during class periods because that is the right time for them to ask questions to clear some points of the lessons from which they were uncertain. Interest of the students in certain topic would also be determined through their motivation to know more about the subject by raising more issues, problems and other related cases for clarification.

The ECE examinees always prioritized working with projects than going out with friends (3.72); substantially answered the questions of teachers (3.59) and went to school early or on time (3.59). Teachers also observed from these students the initiative and perseverance to exert much effort in bringing out first their projects and other school requirements than any other unrelated academic activities. These examinees had been observed with intellectual capacity to provide substantial response from the inquiries of the teachers and they were also efficient in terms of classroom attendance. They sometimes submitted their assignments and projects on-time (3.44) and have a definite time to study regularly in the library (3.43). They had been rated low by their teachers because of late submission of their projects not because these students were not doing their responsibility but due to the complexity of their requirements. Studying regularly in the library is not visibly observed because of some domestic considerations.

The composite mean score of 3.72 had no much difference in the mean scores obtained by ME (3.70) and ECE (3.73) with "Always" verbal interpretation. This implies that these examinees have good and observable study habits and classroom practices which possibly contributed to their performance in national board examination. Developing positive attitude towards studies could provide better image of success either in employment or board performance.

Table 5 presents the academic achievement of the Engineering Examinees in terms of academic behavior under affective domain.

Table 5

Academic Achievement of the Engineering Examinees in Terms of Academic Behavior under Affective Domain

Academic Behavior	ME		ECE		Total		
	Value	VI	Value	VI	WM	VI	Rank
Worked for a team with full cooperation	3.35	S	3.78	A	3.57	A	7
Has a high sense of responsibility.	3.38	S	3.63	A	3.51	A	10
Took examinations honestly without signs of cheating	3.67	A	3.67	A	3.67	A	5
Stayed calm and focus during the times of distress and pressure	3.84	A	3.89	A	3.87	A	2
Acted as leader rather than merely a member in a group	3.47	S	3.64	A	3.56	A	8
Demonstrated high level of self-confidence	3.43	S	3.66	A	3.55	A	9
Maintained high level of interest towards studies	3.72	A	3.72	A	3.72	A	4
Actively participated in classroom discussion	3.48	S	3.72	A	3.60	A	6
Is a well-disciplined student	3.77	A	3.87	A	3.82	A	3
. Patiently and attentively followed class instructions	3.91	A	3.92	A	3.92	A	1
Composite Mean	3.60	A	3.75	A	3.68	A	

Engineering students particularly who took the board examination had been observed to be patient and attentive in following class instructions (3.92); stayed calm and focus during the times of distress and pressure (3.87) and were well-disciplined students (3.82). It is worth noting that students adhere to the classroom policies and are aware of the directions given for certain tasks. They know how to manage difficult classroom activities and control pressures.

The engineering examinees maintained high level of interest towards studies (3.72) and took examinations honestly without signs of cheating (3.67). Engineering students who pursued Mechanical and Electronics Engineering programs were already screened through qualifying examination at the end of their second year. Majority of these students who passed the qualifying exam have demonstrated high respect towards the program and have developed good study habits which stem from their high goal of being licensed.

Teachers also believed that these students were taking examinations with all honesty. Although there were few cases of cheating reported but it could not be considered very serious problem in the College of Engineering at LPU due to the small number of students enrolled in professional subjects for both ECE and ME. Students had no chance to look at the answers of their seatmates because of their seats are arranged far apart.

While the Mechanical engineering examinees were observed to actively participate in classroom discussion sometimes; they also worked for a team with full cooperation; acted as leader rather than merely a member in a group, their Electronics counterparts were observed to be doing these behavior always. Teachers rated ECE students higher than ME in this regard. Based on observation and experience, majority of ECE students were more expressive than ME in terms of raising their inquiries, letting others know their thoughts and making themselves ahead of others in terms of management and leadership skills.

Demonstrating high level of self-confidence (3.55) and possessing high sense of responsibility (3.51) were the least rated academic behavior of the students as observed by their respective teachers. Confidence could be demonstrated most visibly through public speaking and in handling difficult situations. Engineers are not born and made to become well known speakers

but there are some who are very fortunate to be blessed with such confidence and guts to become one. Engineering programs must create an atmosphere and culture of faith and self-assurance that they could have the capability to express their creativity and original ideas in wider community.

Sense of responsibility is the least observed behavior among engineering students but it could be more visible if they would be given activities that could test their leadership skills to develop more their teamwork and unity. Part of the LPU core values seek to inculcate these attributes to make them unique Lyceans.

The composite mean score of 3.68 implies that engineering board examinees have high level of academic behavior. The behavior of the students demonstrated during college years is a reflection of what they would become and how they could manage and control the result of their actions.

Table 6 presents the academic achievement of the Engineering Examinees in terms of On-the-Job Training Performance under psychomotor domain.

Table 6

Academic Achievement of the Engineering Examinees in Terms of On-the-Job Training Performance under Psychomotor Domain

On the Job Training Performance	ME		ECE	
	Value	VI	Value	VI
Personal Characteristics	4.16	Very Good	4.42	Very Good
Attitudes Towards the Job	4.34	Very Good	4.57	Excellent
Job Performance	4.38	Very Good	4.53	Excellent
Adherence to Company Policies	4.42	Very Good	4.59	Excellent
Competencies	3.97	Very Good	4.38	Very Good
Composite Mean	**4.25**	Very Good	**4.49**	Very Good

Learning by doing is one of the most important aspects of psychomotor domain. On-the-Job Training performance of the examinees was used to describe the psychomotor ability of the subjects under study. The results show that ECE students performed better than ME in terms of the OJT performance appraisal report rated by their immediate superiors. ME trainees have very good performance in terms of adherence to company policies while the ECE trainees obtained excellent rating. ME trainees have very good rating in terms of job performance and attitude towards the job while ECE trainees obtained excellent remarks. The least rating of both groups was described as very good.

Although ECE trainees obtained higher ratings than the ME trainees in terms of OJT performance, it doesn't show any significant relevance to their performance in national board exam because majority of the passers were ME examinees. OJT performance is not a predictor of ECE and ME board performance based on the result of Table 9. This implies that getting higher performance in OJT is not an assurance that they can pass the licensure examination.

Table 7 presents the academic achievement of the Engineering Examinees in terms of school participation under psychomotor domain.

Table 7

Academic Achievement of the Engineering Examinees in Terms of School Participation under Psychomotor Domain

School Participation	ME		ECE	
	Value	VI	Value	VI
Academic Activities	1.65	Passive	2.63	Moderately Active
Cultural Activities	1.18	Very Passive	1.70	Passive
Sports Activities	2.24	Passive	2.85	Moderately Active

Composite Mean	**1.69**	Passive	**2.39**	Passive

School participation is another factor of psychomotor domain in the study which investigates the level of the ME and ECE examinees involvement in academic, cultural and sports activities of the college, university and even outside the campus events.

Based on the result, ECE students obtained higher level of school participation than ME in all aspects as manifested by the composite mean scores of 2.39 and 1.69, respectively. Although both computed composite means have verbal interpretation of Passive, the difference of 0.7 is considerable big enough to believe that ECE students have higher involvement in school activities than ME.

Both group obtained lowest rating in Cultural activities probably due to the nature of engineering program which is not inclined to traditional and social arts. ECE examinees were moderately active in sports and academic events but majority of ME students could be considered not socially active as indicated in Table 5 which illustrates the least academic behavior of ME in terms of leadership, self-confidence and active classroom participation. These results also manifest the general behavior of the students. Based on the interviews conducted, ME students in LPU were more focused on meeting all their course requirements and joining co-curricular or extra-curricular activities was not their priority.

Table 8 reveals the relationship between the Licensure Examination Performance ratings of the Engineering examinees and the Three domains of learning.

Table 8

Relationship between the Licensure Examination Performance ratings of the Engineering Examinees and the Three Domains of Learning

Domains	r-value	p-value	Decision	Interpretation
Cognitive Domain	0.271	0.068	Fail to Reject	Not Significant

Comprehensive Examination	-0.253	0.051	Fail to Reject	Not Significant
Average Academic Ratings	0.160	0.222	Fail to Reject	Not Significant
Affective Domain	0.439**	0.000	Rejected	Highly Significant
Study Habits	0.291*	0.049	Rejected	Significant
Academic Behavior	0.360**	0.005	Rejected	Highly Significant
Psychomotor Domain	0.193	0.228	Fail to Reject	Not Significant
OJT	0.095	0.468	Fail to Reject	Not Significant
School Participation	0.174	0.185	Fail to Reject	Not Significant

*Legend: **Significant at p-value < 0.01 *Significant at p-value < 0.05*

Based from the table, the computed r-value of affective domain (0.439), and academic behavior (0.360) reveal moderate positive correlation where the resulted p-values were less than 0.01 level of significance. Study habits which a coefficient of correlation of 0.291 has less than 0.05 level of significance, thus the null hypothesis of no significant relationship between the Licensure examination Performance ratings of the respondents and the variables in the three domains of learning in terms of affective domain specifically in academic behavior and study habits is rejected. This means that there is a significant relationship between the tested variables.

Academic behavior of the examinees marked significant relationship with their Licensure Exam Performance as well as their study habits. The way students behave and manage their academic activities during college showed greater importance in Licensure exam. This implies that students with higher ratings in terms of their study habits and academic behavior have greater chance of passing the board exam.

All variables tested were important factors to consider in determining future performance of the students but in the case of ME and ECE students at LPU – Batangas, only academic behavior has significant relationship with Licensure examination performance. ECE students have higher academic ratings than ME, but majority of the ECE examinees failed in Licensure Exam. Another factor that could explain this result is due to the different complexity levels of board examination between ME and ECE. It is already known fact that ME has always higher national passing percentage than ECE. There is approximately 28.3% national passing rate for ECE from 2007 – 2010 while ME performance has approximately 54.3% from 2006 – 2010.

This implies that no matter how high academic ratings are and how active the ECE students are in LPU-Batangas, these are not assurance to pass the ECE licensure examination.

Table 9 reveals the predictor of the Board Examination Performance of BSME and BSECE Examinees at the Lyceum of the Philippines in Batangas City.

Table 9

Predictor of the Board Examination Performance of BSME and BSECE Examinees

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					Sig. F Change	R Square Change	F Change	df1	df2
1	.360(a)	.130	.115	7.81525	.130	8.649	1	58	.005

a Predictors: (Constant), Affective

b Dependent Variable: board performance

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	528.279	1	528.279	8.649	.005(a)
	Residual	3542.534	58	61.078		
	Total	4070.812	59			

a Predictors: (Constant), Affective

b Dependent Variable: board performance

y = b + ax

where: y = board exam performance

b = value of beta coefficient

a = constant

x = value of affective domain

y = 18.822 + 14.793x

Board performance = 14.793 (affective domain) + 18.822

As seen from the result above, the table provides the r and r^2 value, the r value is 0.360 which represents the simple correlation and therefore indicates moderate degree of correlation. The computed r^2 indicates how much of the dependent variable, board performance can be explained by the independent variable, affective domain. In this case, 13.0% of the variance in board performance is explained by affective domain.

ANOVA table indicates that the regression model predicts the outcome variable significantly well. This is because the statistical significance of the regression model is 0.005 which is less that the level of significance of 0.05. Overall, the model which is the affective domain is significantly good enough in predicting the outcome variable, board performance.

Affective domain predicts the Licensure Examination performance of ECE and ME with only 13 percent guarantee based on the statistical analysis. This is the only learning domain that could be considered with patterns of results nearly the same with their examination performance while other domains do not establish nearly similar outputs.

Therefore, students must exert much effort in developing good study habits. This is a strong foundation of all good practices to learn more and be proficient not only in academics but also in acquiring easily the necessary skills in their chosen fields of specialization. Fostering right attitude is always an important part of every individual's success. Nurturing good behavior is also establishing good performance.

Proposed Program

The proposed enhancement in BSME and BSECE programs focused in the development of syllabi according to the requirement of Outcomes-based curriculum which provide detailed evaluation performance of the students. Monitoring of students' academic performance and study habits must also be done periodically to ensure that the low performing students would be given enough attention and proper guidance so that LPU could achieve higher customer satisfaction rating.

Remedial and review classes were also needed to strengthen the capability of the students to face the challenges of engineering in a more natural way through designing an environment and culture which are geared towards excellence.

Conclusion

Mechanical Engineering examinees performed well in Machine design while ECE did well in Mathematics. ME examinees did not perform well in Power Plant Design/Industrial Plant Design while ECE did not do well in General Engineering and Applied Sciences. Mechanical Engineering examinees obtained low comprehensive examination performance and fair academic ratings with high level of study habits and academic behavior. ME examinees did well in their OJT performance with low school participation. While ECE examinees obtained low comprehensive examination and good academic ratings with high level of study habits and academic behavior. ECE examinees did well in their OJT performance with passive to moderately active school participation.

Affective domain is significantly related to Licensure examination Performance of the respondents. Affective domain predicts the Licensure Examination performance of ECE and ME. Outcomes-based curriculum must be adapted to periodically monitor the academic performance and behavior as well as the result of study habits of the students.

Recommendation

General Education instructors teaching Physical and Natural Sciences as well as in all Engineering mathematics must strengthen the delivery of their instruction and they must provide proper evaluation of knowledge, skills and values according to Outcomes-based curriculum. Professional and General Education Teachers must consistently monitor the academic performance and behavior of engineering students to provide thorough guidance for those who are low achievers. They must provide positive environment and culture of excellence in handling classroom management through enhancing the values of students towards achieving greater expectation of success in all their projects and academic undertakings. They must develop the study habits of their students through providing projects and assignments with clear objectives that need to utilize their leadership capability and confidence to express their original ideas.

Set of questionnaire for qualifying examination of incoming third year BSME and BSECE students must be reviewed and revised to ascertain the students' capability to carry-out tasks and responsibilities of being enrolled in a board program. College of Engineering must establish comprehensive review programs before the semester ends during 4^{th} and 5^{th} Year levels to ensure familiarity and understanding of different theories and principles of their major fields. Comprehensive examination set of questionnaire must be kept updated and revised every year to ensure its reliability. Results of the comprehensive examination must be analyzed to identify which subject areas the examinees need to improve more. Future researchers might consider another set of variables to predict the Licensure examination performance of BSECE and BSME examinees.

References

[1] Mechanical Engineering, available online: http://www.thefreedictionary.com/mechanical+engineering, date accessed: May 1, 2013.

[2] Teixeira , J. C. Fernandes, Ferreira, J., Da. Silva, Flores, P., (2007), "Development of mechanical engineering curricula at the University of Minho", European Journal of Engineering Education, 32 (5).

[3] Christoforou, A. P., Yigit, A. S., (2008), "Improving teaching and learning in engineering education through a continuous assessment process", European Journal of Engineering Education 33(1).

[4] Electronics Engineering, url: http://career.webindia123.com/career/options/engineering/electronics/intro.htm, date retrieved: June 19, 2011.

[5] REPUBLIC ACT NO. 8495, AN ACT REGULATING THE PRACTICE OF MECHANICAL ENGINEERING IN THE PHILIPPINES

[6] Republic Act No. 5734 - THE ELECTRONICS AND COMMUNICATIONS ENGINEERING ACT OF THE PHILIPPINES

[7] Bloom B. S. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain.* New York: David McKay Co Inc.

[8] Beaunieux, Helene; Hubert, Valerie; Pitel, Anne Lise; Desgranges, Beatrice; and Eustache, Francis. (2009), Episodic memory deficits slow down the dynamics of cognitive procedural learning in normal ageing Memory, Volume 17, Issue 2, Pages 197 - 207

[9] College Admissions Tests - The ACT, The SAT, Test Scores and Their Relationship to Admissions Selectivity - Students, Colleges, Entrance, Verbal, Ability, and Mathematics url: http://education.stateuniversity.com/pages/1843/College-Admissions-Tests.html# ixzz1PltQg6iX, date retrieved: June 19, 2011.

[10] Bender, Kim K., Siller, T. J., (2006), "How an Engineering College Uses a University's Quality Enhancement System to Generate and Manage Evidence for Multiple Accreditation and Accountability Bodies", Quality in Higher Education, Volume 12,

[11] Ferguson, Clive (2006), "Defining the Australian mechanical engineer", European Journal of Engineering Education, Volume 31, Issue 4.

[12] Gobin, R. (1987), "The Role of Industry in the Education of Mechanical Engineers", European Journal of Engineering Education, Volume 12, Issue 3.

[13] Pelfrey, William V., Hague, James L. (2000), Examining the comprehensive examination: Meeting educational program objectives, Journal of Criminal Justice Education, Volume 11, Issue 1, Pages 167 – 177.

[14] French, Brian F., Immekus, J.C., Immekus, W.C. (2005), "An Examination of Indicators of Engineering Students' Success and Persistence", Journal of Engineering Education, retrieved from http://www.jee.org/2005/october/8.pdf on June 11, 2011

[15] Amenkhienan, Charlotte A. (2004), "Engineering students' perceptions of academic activities and support services: factors that influence their academic performance". College Student Journal. FindArticles.com. 19 Jun, 2011. Url: http://findarticles.com/p/articles/mi_m0FCR/is_4_38/ai_n8589838/

[16] Mazurek, D.F., "Consideration of FE Exam for Program Assessment, *Journal of Professional Issues in Engineering Education and Practice*, 121 (4), 1995, pp. 247–249.

[17] NIRMALAKHANDAN, N., D. DANIEL, K. WHITE (2004), "Use of Subject-specific FE Exam Results in Outcomes Assessment". Journal of Engineering Education. FindArticles.com. 18 Jun, 2011. http://findarticles.com/p/articles/mi_qa3886/is_200401/ai_n9378649/

[18] Kellam, N. N., Maher, M. A., Peters, W. H. (2008), "The faculty perspective on holistic and systems thinking in American and Australian mechanical engineering programmes", European Journal of Engineering Education, 33 (1).

[19] Langdon, G. S., Balchin, K., Mufamadi, P., (2010), "Evaluating risk awareness in undergraduate students studying mechanical engineering", European Journal of Engineering Education, 35(5).

[20] Azapagic, Adisa; Perdan, Slobodan; Shallcross, David, (2005), "How much do engineering students know about sustainable development? The findings of an international survey and possible implications for the engineering curriculum", European Journal of Engineering Education, 3(1).

[21] *Richards, Larry G., Richards, Herbert C. and Sheridan, Dana C. (1999),* Predicting Success in a First Year Engineering Course: The Role of Study Habits", IEEE November 10 - 13, 1999 San Juan, Puerto Rico, 29th ASEE/IEEE Frontiers in Education Conference 11a7-5.

[22] Blumner, H.N. and Richards, H.C. Study Habits and Academic Achievement of Engineering Students, *Journal of Engineering Education*, Vol.86, No.2, April, 1997, 125-132.

[23] Evans, N.J., Forney, D.S. and Guido-DiBrito, F.,(1998) *Student Development in College: Theory, Research, and Practice*,(Jossey-Bass).

[24] Fujita, Kimiko (2006). "The Effects of Extracurricular Activities on the AcademicPerformance of Junior High Students", Undergraduate Research Journal for the Human Sciences, Vol 5.

[25] FUNG, Yee-wang and WONG Ngai-ying (1991), "Involvement in Extracurricular Activities as Related to Academic Performance, Personality, and Peer Acceptance", *CUHK Education Journal Vol. 19 No.2 pp. 155-160, The Chinese University of Hong Kong Faculty of Education.*