

Innovations In Education: Batangas State University As A National Engineering University

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Abstract: Engineering education in the Philippines plays a vital role in advancing technological innovations among universities. Engineering prodigies are using their skills and intelligence to discover or create inventions that will help the advancement of engineering education. Areas of educational research especially in engineering education help the needs of the students and graduates to be globally competitive. Being competitive in education means that universities are addressing the call to be on the top of promoting educational and technological advancement. In the past few years, many educational institutions are gradually introducing their system of education as the home when it comes to engineering education and Batangas State University is one of them. The university is known as the National Engineering University recognized by Commission on Higher Education in the Philippines. Among the 1,050 participating universities around the globe, Batangas State University, The National Engineering University ranked 4th in the Philippines and 351st in the UI GreenMetric World University Ranking 2022. By continuing to recognize the contribution of Engineering education to the growth of educational system in the Philippines, the university has produced tons of Engineer graduates who are leading innovations not only in the Philippines but also in other countries. The main purpose of this paper is to present the contribution of Batangas State University to Engineering education in the country from being a Manual Training School started in capitalist occupation of the Americans to becoming a leader of educational innovations that contribute to making the Philippines a well-known home of talented engineers.

Keywords: National Engineering University, Engineering Education, Educational Advancement, Innovations,

1. Introduction

Engineering is extracted from its root word – *techne*. The ancient text defined engineering as “to produce art” or “productive skill”. While, in the modern era, engineering is defined today as the skills of making and creating. Engineering in the recent context of defining technological advancement is broader and more complex when it comes to definition. Thus, engineering is a stomach of business, government, academic, or individual efforts using the collective knowledge of mathematics and sciences to be employed in research, designs, systems of engineering, etc. [1]. In the Philippines, different universities and technological institutions offer a branch of engineering depending on what the student wants. These engineering branches are Electrical engineering, Chemical engineering, Computer engineering, Mechanical engineering, etc. The lack of appreciation in other branches of engineering here in the Philippines is because of the lack of information in engineering education and the failure to recognize the importance and value of the cost of engineering work. Thus, the meaning of engineering education is not only to emphasize the systematical methodology of its branches but to determine the empirical data and curriculum to solve the crisis. As the Philippines is a core of advancing research innovations using branches of engineering, it will also be the start of a more complex beginning to uphold and determine its definition and meaning. Several factors must be considered to defeat its complexity.

2. Innovations in Education

With the continuous advancement of technology, it has become a big key to the expansion of education in the Philippines. Many institutions continue to increase funding for technology-related courses. The same goes for students

who attend prestigious universities to hone their technological prowess. Innovation in education is indeed necessary for success. Innovation in education means that educational institutions and para - organizations encourage teachers and students to explore, research, innovate and develop new methodologies to uncover something new. Thus, Innovation in education is important for the birth of opportunities and the emergence of systems to design different and better learning experiences. In Engineering, there has been a long criticism about the effectiveness and appropriateness of branches of engineering over the past years. The criticism has related to inadequate preparation for the profession and in part to traditional methods of teaching. As a reaction to these criticisms, attempts were made at technological institutions to change the way of teaching in which part of engineering courses were taught. The problem created by the lack of innovation in education particularly in engineering education is the relatively high failure rate in board examinations. In 2009, The Professional Regulation Commission in the Philippines reported that on a total of 304,586 examinees took licensure exams in different fields, only 36.9 percent or 112,407 passed [2]. The reason for this is because the traditional method of teaching and many institutions are not open to educational innovations. Also, educational institutions have argued that the courses provided in engineering education have been too theoretical and do not provide sufficient experience in applying the subject taught. Students qualify with extensive technological knowledge, but with little or no knowledge at all of the profession into they are moving, and with little ability to apply their knowledge to the problems they will face as future engineers. Systematically, Engineering department, seem to have been slow to incorporate innovative methods of teaching in their courses [3]. Universities and Institutions

must adhere to the call that innovations in education are the primary goal for success. As Engineering education progressed, students should be provided with different ingredients of course content for the opportunity of mental and physical enrichment and the love of education methods, theories and scientific practices.

Four Dimensions of Innovation in Education

Recent studies suggest that there are four dimensions of innovation in engineering education consisting of research methodologies crafted by education professionals. The contents of the dimensions are specifically tackling the new method approach of education innovators to the guiding principles when developing new systematic approaches to teaching and practices. These are questions that answer the paradigm of engineering education. It is also the way of the reconciliation of theory and practices.

Table 1: Dimension 1: What is the extent of the newness?

Type A: Fundamental redesign	Adopting drastically different designs for learning.
Type B: Incremental improvement	Making adjustments or tweaks at the margins, without fundamentally changing the design of school.

Fundamental redesign discussed that in the innovation in education, teachers need to have the ability to redesign the fundamental courses for successful learning of students. It is done by using different materials not just by following the course content. Adopting drastically implies the 'must situation' to redesign and reconstruct bits of information in the design of old teaching methods.

Incremental improvement is implying and denotes an increase in making adjustments in the way of teaching without changing the legalistic design of the school. It suggests that adjustments created by innovation will lessen the failures of students to learn the course content.

Table 2: Dimension 2: Has the new ever been done before?

Type A: Invention	Creating new design from scratch. Innovation as invention means "new everywhere."
Type B: Replication	The process of spreading inventions, which were once uniquely and different.

Invention in innovation is vital for educational system's rebirth. The creation of new designs for educational transformation contributes to the implications of educational designs and methods for better learning. Experts from various educational institutions must discuss implementing new inventions to support and supply ideas for technological advancement. Thus, institutional organizations must focus on apply their knowledge to the problems they will face as future engineers. Systematically, Engineering department, seem to have been slow to incorporate innovative methods of teaching giving additional budgets for the creations of new scientific inventions.

Replication suggests that the new educational inventions can be shared with different educational institutions to help the growth of their studies and contribute to the advancement of

technology. This can be done by allocation budgets to produce these new inventions to introduce them to the people.

Table 3: Dimension 3: Is the school itself new?

Type A: Creation	Means implementing a new design in a new school or program.
Type B: Adoption	Converting or refining design characteristics in an existing school or program.

Creation is about creating new experiential learning in educational institutions. It addresses the problem of learning experience when it comes to assessing course content. In this dimension, educational institutions are focused primarily on the implementation of teaching methodologies.

Adopting by adopting different styles of teaching methodologies, educational institutions are freely engaged in conducting various teaching methods of complex courses, especially in engineering education. Therefore, educational institutions should devote time to researching new ways of teaching courses that are relevant to technology, mathematics and science.

Table 4: Dimension 4: Who initiates the new?

Type A: People at the working level	Create designs based on the individual needs of the students those design will serve.
Type B: People in outside support roles	Recruit people to implement those new designs or pass them on to people already working in schools.

People at the working level it is important to identify the people who will serve as the principal designer or implementer of the new teaching methodologies. These people are from educational institutions or stakeholders who will initiate the programs and designs for the better learning experience. It is possible also to create experts from different institutions to create educational programs to tackle the problems of different sets of learners.

People in outside support roles these people are not the principal implementer of learning programs but they are the support team for the implementation. They are also from education institutions that focus on increasing the quality of teaching in different sectors of education. They are also an important part of innovation in education because they are the main persons in programs related to improving the quality of education not only in sectors but also as a whole.

The four dimensions of innovation in education begin with the questions that are needed to implement what should be programmed in every part of the educational institution to fill the needs of the students. It should also not be rushed and the studies should be appropriate so that the results are better. These are just starting keys that can be used by any educational institution that aspires to further extend the quality of education and even the teaching of teachers especially in the modern era of education.

The author of this concept suggests that in practice, innovation occurs at various places along these four dimensions. No innovation is fully, uniquely an invention vs. replicating what has been tried elsewhere. No innovation can be neatly described as fundamental change vs. more incremental. No innovation is fully attributable to people working in school vs. those outside [4]. Ted Keldorie, the author of *The Split Screen Strategy* simply states that Innovation, gradually spreading, is the most successful system changed. Structured as open systems, they are self-improving; new designs and new models and new methods appear; the organizations in these systems gradually adopt these changes on their initiative, in their interest and from their resources [5]. This means that innovation is not a one-time plan, it is adapted by careful planning to fill the deficiencies of the educational system. As mentioned above, the dimensions of education innovation need to collaborate using structured course content. It is not feasible that the new methods will become more dominant than the other areas. This is what is needed to make the education system more effective, especially in the Philippines where the teaching system and methodology are not good. Elizabeth Hunter identified the '3 Kinds of Education Innovation' that will support the gradual spreading of a strategic plan for educational reformation [6]. These three are structure, content and process. The structure is defined by the ways of classrooms and schools are organized. This part reflects how a part of educational institution moves based on the policy of its branches. It is important to identify this part before carrying out an innovation because it starts from the smallest branch to the largest. Once identified the structure and how the schools are organized, this is where the content creation will take place. Content is the second part of innovation. It is a way to introduce new subjects or revise old subjects in new ways. Introducing new courses and subjects is vital in educational innovation because it will attract students and stakeholders for institutional partnerships. In the Philippines, the addition of new courses depends on the budget along with the professional instructors who are experts on those subjects that will add and deliberate by educational institutions. Once the initiation and laying of structure and content have been successful, this is where the process comes into play. It will start with the structure, which will be adapted with the right content course and proper management of the process. Processes are those that have to do with human interaction. It fits the definition of innovation according to Yale Information Technology System that it can be defined as the process of implementing new ideas to create value for an organization. This may mean creating a new service, system, or process, or enhancing existing ones. Innovation can also take the form of discontinuing an efficient or out-of-date service, system, or process. They correspond to Republic Act No.9155 known as the Governance of Basic Education Act of 2001, this policy aims to strengthen School-Based Management (SBM) by further developing the governance of education to schools, expanding community participation and involvement, and making the delivery of education services to the learners more responsive, efficient and effective through an enhanced school planning and improvement that lays down specific interventions through the initiated project in schools [7].

To support the call for innovations in education in the Philippines, different educational organizations developed a

plan on how to support the government in the call for educational reform.

3. Current Programs/Projects for Innovations in Education

There are four current projects for Innovations in Education here in the Philippines. It is mainly consisting of different sets of educational reform and reconstruction especially in rural areas. These projects were developed through the collaboration of various educational organizations in the Philippines. Its purpose is to spread the educational reform in different parts of the Philippines that will help to change the old systems that are no longer applicable to modern educational designs today. The names of these projects are Project IMPACT (Instructional Management by Parents, Community and Teachers), NCBTS (National Competency-Based Teacher Standards), ICeXCELS (Instructional and Curricular Excellence in School Leadership and Management), OTOP (Observe the Observer Program).

3.1 Project Impact (Instructional Management by Parents, Community and Teachers)

The Impact (Instructional Management by Parents, Community and Teachers) Learning System was developed in 70's with funding from the International Development Research Center (IDRC). The system heavily relies on self-learning modules based on the curriculum changed over time, these learning materials likewise were revised. The materials were also enhanced with other multimedia components such as audio and video supplements and self-learning modules on computer education. Thus, the learning system was renamed e-IMPACT because of technology based enhancements. The system was piloted in (6) schools all over the country, one in Luzon area, three in Bicol Region, One in Central Visayas, and one in region 9, Mindanao [8].

3.2 NCBTS (National Competency-Based Teacher Standards)

National Competency-Based on Teacher Standards (NCBTS) is being used to test the level of competitiveness of a teacher. NCBTS defines "effective teaching as being able to help all types of students learn the different learning goals in the curriculum, provides a single framework that shall define effective teaching in all aspects of a teacher's professional life and in all phases of teacher development, it is based on the core values of Filipino teachers and on effective teaching and learning with seven (7) domains namely (1) Social Regard for Learning (2) Learning Environment (3) Diversity of Learners (4) Curriculum (5) Planning, Assessing, Reporting (6) Community Linkages (7) Personal Growth and Professionalism. This framework presents the NCBTS serves as a guide to professional educator teacher teaching ability and skills. It has been seven domains that can help all physical educator teachers to continue to improve their teaching to help them to become effective teacher [9]. These domains help professional teachers to attain effective teaching that will assess all types of students and learn the different learning goals in the curriculum. These domains will also help in the advancement of innovation in education in any aspect. So, they may be used in all university colleges in the Philippines to achieve educational reform.

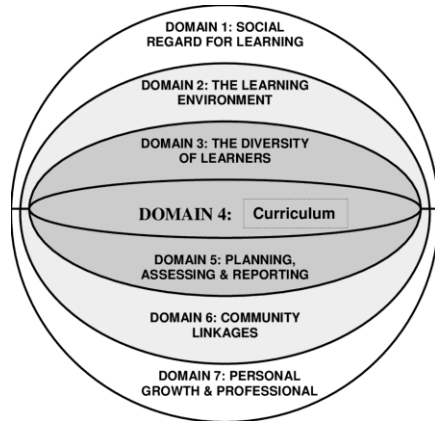


Figure 1: 7 Domains of National Competency Based-Teacher Standard

Domain #1. Social Regard for Learning – it is focused on the idea that teachers serve as positive and powerful models and values in teaching different effort to learn students.

Domain #2. Learning Environment – This domain focuses on the importance of providing a social, psychological and physical environment.

Domain #3. Diversity of Learners – Teachers emphasize the learning process, to different types of learners, by identifying and respecting individual differences and using knowledge about student differences to design different sets of studies for students to achieve the purpose of the study.

Domain #4. Curriculum – This domain refers to all the elements of the teaching-learning process working in convergence to help students achieve high-curricular goals.

Domain #5. Planning Assessing and Reporting – This domain is focused on using the instructional learning planning analysis data, creating instructional material and ensuring that the teaching method is appropriate to the students.

Domain #6. Community Linkages – Focuses on ideal school activities related to schools and local community connections between schools and community resources.

Domain #7. Personal Growth and Professional Development- It is a perfect value for teachers to have high personal regard, this domain refers to professional development toward teacher improvement and sets out time for personal and professional development through participation in seminars for study workshops, regular reading of study materials and focused on educational research to continuous improvement as teachers.

3.3 ICeXCELS (Instructional and Curricular Excellence in School Leadership and Seminar)

In line with its commitment to continuous improvement, SEAMEO INNOTECH has embarked on a case study of one of its flagship projects, the Instructional and Curricular Excellence in School Leadership for Southeast Asia, or ICeXCELS. ICeXCELS is a flexible learning program developed and implemented by the Center since 2006. The case study aims to document the success and impact of

ICeXCELS among its learners from the Philippines and Thailand. The data gathering began late in August 2011 with the conduct of interviews with two successful course completers from Thailand. The second part of the data gathering is scheduled to take place in October 2011 and includes school heads from northern, central and southern regions of the Philippines [10].

3.4 OTOP (Observe the Observer Program)

Teacher observation is one of model of professional learning that “is key to supporting a new vision for professional development,” explained Stephanie Hirsh, executive director of Learning Forward. The new vision, according to Hirsh, involves teacher teams that meet daily to study standards, plan joint lessons, examine student work, and solve common problems. Team members then apply that learning in the classroom, watching each other teach and providing regular feedback. [11].

4. Batangas State University as National Engineering University

Batangas State University is one of the best-known educational institutions in the Philippines when it comes to engineering education and educational innovations. The leadership in educational innovation is proven through its achievements in the field of Science, Engineering, Research Development. From its being a Manual Training School in 2003 until it becomes a National Engineering University in 2022 nationwide, Batangas State University continues to impart better educational systems and methodologies to change people’s lives and contribute to the country’s economy. In 2001, Through Republic Act 9045, Pablo Borbon Memorial Institute of Technology was elevated to Batangas State University including its branches in Barangay Alangilan, Batangas City, in the Municipalities of Balayan, Bauan, Lobo, San Pascual, Rosario, Taysan, Padre Garcia, Lemery, Calaca, Taal, Tanauan, San Juan and Lipa City. The Commission for Higher Education also recognizes the university as The National Center of Excellence in Electronics Engineering; and The National Center of Development in Electrical Engineering and Mechanical Engineering. Also, the university is the only state university in the country with engineering programs accredited by the US-based Accreditation Board for Engineering and Technology (ABET). In 2006, The University established linkages with colleges in China, Malaysia, South Korea, Thailand and Vietnam. BSU’s educational programs continued to help the expansion of education innovations in the Philippines. The university also featured with highest number of ASEAN Engineer faculty among higher education institutions in the country. In 2015, the university modernized the infrastructure to create a 21st century learning environment. Along with renovating and modernizing infrastructure, Research and development centers emerged which included Verde Island Passage Center for Oceanographic Research and Aquatic Life (VIP CORALS); Science, Technology, Engineering and Environmental Research (STEER) Hub; Electronic Systems Technopreneurship and Innovation (CTI); Digital Transformation Center; Electronic Systems Research Center (ESRC); GIS Applications Development Center; Digital Transformation Center; Adaptive Capacity-building on Technology Innovation for Occupational Hazards and Natural Disasters Center; Social Innovation Research Center

and the Technology Support Office; Knowledge, Innovation and Science Technology (KIST) park as a Special Economic Zone. Due to the activeness of Batangas State University to keep up with the innovation in education, it gradually became known and kept up with the institutions when it comes to the quality of education until in 2020, it was declared as the **National Engineering University** by the virtue of Republic Act 11694.

5. Research Centers of Batangas State University

5.1 Knowledge, Innovation and Science Technology (KIST) Park

Designated as a Special Economic Zone on May 22, 2020 by President Rodrigo Duterte through Proclamation No.947, Adjacent to the university's Pablo Borbon Main Campus II in Batangas State University – Alangilan Campus. The park will provide easy access to research facilities and high value intellectual capital. Develop by BatStateU through local funds and Private-Public Partnerships, The KIST Park will offer startup incubation, patent services, and technical support on product development [12]. It provides a dynamic platform for the training of young and innovative future engineers, scientists, and technologists. The value proposition of KIST Park includes:

- Startup Incubation
- Technical Support on Product Development
- Market Linkages & Financial Support
- Technology Transfer
- Enhanced ICT infrastructure
- Capacity Building Programs
- Spaces for locators
- Knowledge Process Outsourcing
- R&D Support Services

5.2 Science, Technology, Engineering, and Environment Research (STEER) Hub

Driven to develop competitive advantage through improved research capability and strong research culture, the university has constructed a 120 million pesos worth of research infrastructure, The Science, Technology, Engineering and Environment Research Hub (STEER HUB). The Hub will house research centers and laboratories in specialized fields in engineering, science, technology, and environment with focus on Artificial Intelligence and Data Analytics. These research centers and laboratories aim to develop high-level research in the different fields of science, engineering, technology and environment which has impact to the society. Situated in the technology campus in Alangilan, Batangas City, the hub will be equipped with laboratories for different fields, lecture rooms for small and large class, conference room, a FabLab and an open space at the fifth floor that can be used during hosting of symposium or workshop. Indeed, the University values research as a potent catalyst for alleviating poverty and achieving economic stability and to become an instrument for sustainable national development that is driven by technology and innovation for global competitiveness [13].

5.3 Social Innovation Research Center (SIRC)

The Social Information Research Center aims to undertake studies that will respond to critical and growing need for

planning and policy making. The researched is envisioned to turn knowledge into social innovations to improve human lives and environment conditions. The centers also seek to promote academic community and civil societies/government agencies partnership that will address challenges on key social and environmental issues. SIRC serves as database for relevant information on business, education, health, environment, industry, emerging technologies and others, that will serve as information for intermediary between the university and its stakeholders [14].

5.4 Innovation and Technology Support Office (ITSO)

The Innovation and Technology Support Office, also known as ITSO, are universities and institutions accomplices of the Intellectual Property Office of the Philippines (IPOPPL), that have been equipped with in-house patent libraries. During 2010, the IPOPPL launched a project to establish Innovation and Technology Support Offices (ITSO) or "Patent Libraries" with universities and higher education institutions. And in 2014, Batangas State University became one of its Host institutions. ITSO aims to strengthen the university's capacity to access patent information for use in research, education, idea generation and general business development. At the same time, ITSO envisioned to be the patent service providers not just in the university but also in local communities, conducting not only patent searches but also patent drafting, prosecution representation, advisory, training and over-all IP management. Furthermore, ITSO seeks to foster creation of intellectual property (IP) in the academe and research sectors, particularly in copyrights, industrial designs, inventions and utility models [15].

Educational organizations in the Philippines including State Universities and Colleges are gradually embracing the modern way of teaching in the modern era. Education innovation programs in the Philippines are continuously promoted through communication with various government agencies and stakeholders to achieve the dream of better-quality education in the Philippines. Batangas State University is one of those that thoroughly promote innovation in education in the Philippines by building Research Centers and partnering with various educational organizations to further expand the reach of these projects. Currently, Batangas State University has 15 Centers for Research and Innovations, 2,000 + students annually trained in Technopreneurship and 10 Startups annually incubated by the center for Technopreneurship and Innovation.

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