

## APPROACHES AND GROWING IMPACTS OF PROBLEM-BASED LEARNING IN TEACHING AND LEARNING AT JIGME NAMGYEL ENGINEERING COLLEGE

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### ABSTRACT

*Academic enhancement through meaningful teaching and learning approaches is vital in any educational institution. Achieving the aspiration for innovative approaches and pedagogy in teaching and learning needs continuity and variation depending on its learning environment, diverse learners and other relevant factors. This study focused on the 'Strengthening Problem-Based learning in South Asian Universities (PBL South Asia)' project which is co-financed by European Union. It is qualitative research that made use of published records from institution and government reports, media, and website along with relevant literature as the based-reference resources. More so, Jigme Namgyel Engineering College (JNEC) as one of the beneficiary partners of this project has its own pace of activities that were developed and materialized. The commitment and progress of the PBL South Asia project at JNEC was recorded in this study. It shows a significant progress on materializing 'Capacity Building in Higher Education' in realizing the vision of the college to be one of the recognized institutions of applied engineering, technology and management in the region.*

*Keywords: Problem-Based Learning, pandemic, teaching and learning, curriculum, project*

### INTRODUCTION

Jigme Namgyel Engineering College (JNEC) is one of the constituent colleges under the Royal University of Bhutan (RUB). The college has been established in the early 1970s and has been playing a pivotal role in training and supplying skilled technical manpower. Since its establishment, it has had a history of being one of the premier institutions in the region. As of date, thousands of graduates have been graduated from JNEC and are holding a key position in the various organizations within and abroad. JNEC is offering applied engineering, technology and management courses at the current time and aspires to be one of the best institutions in the region (JNEC, 2021). Academic rigors at JNEC are quite significant and the college always explores innovative approaches in materializing its vision and mission

through meaningful collaboration with stakeholders, agencies and institutions within and abroad. One key realization on current time is that the thirst for interdisciplinary engagement of students and staff for which college has applied a joint project under the framework of Erasmus Plus (Capacity Building in Higher Education (CBHE)), co-funded by Erasmus+ Programme of the European Union (EU) and the project is led by Aalto University (Aalto Global Impact), Finland with partners universities and colleges from Europe, Nepal, India and Bhutan. The conception meeting in 2017 and project preparation and submission followed immediately thereon. The project worth Euro 1million maximum funding thus became reality for 10 partners universities and institutions in Europe, India, Nepal and Bhutan (Aalto, 2018) The project 'Strengthening Problem Based



learning in South Asian Universities (PBL South Asia)' was successful for EU funding is on full swing though there are a series of challenges encountered due to current pandemic. The key goals of the project are on 'Strengthen', 'Integrate' and 'Consolidate where capacity development, courses on Problem Based Learning (PBL), the inclusion of nexus on sustainable development, social responsibility and human rights and deriving best practices along with synergy between design at the local level to global context (PBL South Asia project goals) The PBL South Asia project intends to foster local innovation ecosystems by bridging learning between universities in Europe and South Asia in terms of technical exchanges, enhancing the capacity of partner higher education institutes, and strengthening the capacity of partner higher education institutes.

### Brief Introduction to Problem Based Learning

The Potential of 'Problem Based Learning (PBL)' has been quite significant since the concept which was originated from the field of medical education in the mid-1950s (Walsh, A. E., 2005). Furthermore, it is pointed out that PBL is a pedagogical approach and thus has been quite an influential curricular innovation and one of the most significant innovations in the higher education system (Tan, O. S., 2004 and Zieber, E. M., 2006). Since then, the concept of PBL has been significantly used in wider ranges of higher education and also brought one substantial incorporation in the effective student-centric learning due to active participation of students in the approaches (Ali, S. S., 2019). Meaningful engagement of students from the ideation to problem formulation and solution realization are some key structures that are seen while dealing with PBL (Amerstor, C. M., et.al., 2021 and Gulker, A., 2017). A curriculum that focuses on PBL is critical in realizing the key aspect of teaching and learning. With its popularity in medical studies, it made significant impacts in another field. The curriculum needs to be designed in such a way that the main players for the teaching and learning in a small realistic group of student has to work on tackling the problem (Uys, L. and Gwele, N., 2005).

### Problem Based Learning Overview at Jigme Namgyel Engineering College

JNEC, as one of the beneficiary project partners of this PBL South Asia project, has been instrumental since its inauguration. The college has been focusing on learning the better aspect of PBL and building the needful for the successful implementation of such approach in developing 21<sup>st</sup>-century education. It focuses on community development with innovation and sustainability. Also, as part of the ongoing project, a few critical and crucial activities that have been implemented are capacity development (staff and students), curriculum development, Massive Open Online Courses (MOOC) development, initiation of procurement of laboratory equipment, PBL deliveries and joint projects. More activities are yet to be completed, which will be mostly focused on capacity building and feedback.

### OBJECTIVES OF THE STUDY

The study determined the strengths and potentials of problem-based learning (PBL) and why it is still gaining wider attention in higher education. Moreover, it sought to analyze the evidence from the cases of implementing PBL in the curriculum and the strategic actions of Jigme Namgyel Engineering College.

### METHODOLOGY

The study made use of the primary data from JNEC's ongoing project plan and activities, as well as the secondary data from the published sources and literature review to explore and highlight the critical outcome of the research. Research is qualitative in nature and is backed with relevant statistics to come up with the findings and conclusions.

### RESULTS AND DISCUSSION

The concept of PBL in the case of JNEC was nothing new than to realign and work that college has been doing. The college has been doing many things in the past where the initiatives

and actions look more of a reflection of it being PBL approaches.

### 1. Project Kick-Off Meeting

The project kick-off meeting and workshop were conducted at Aalto University, Finland between 4<sup>th</sup> to 8<sup>th</sup> February 2019. This important event was attended by two officials from JNEC where the overall objectives of the PBL South Asia project, along with required deliverables and work packages, were discussed between the partners. The key activities include team building, PBL methods and design thinking, PBL for global sustainable development, project administration and management that were covered during the event. The whole objective was to introduce to the project, plan actions, and network with each other through sharing and learning.

The project has implemented are:

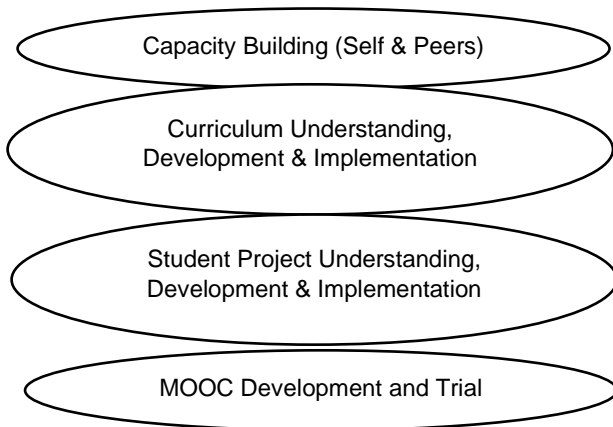


Figure 1: Insights of PBL activities as of now at JNEC

### 2. Capacity Building-Series-I

Any initiatives and deliverables can be best realized if it is into capacity development. The process of developing and enhancing the skills, instincts, abilities, processes, and resources that organizations and communities require to survive, adapt, and thrive in a rapidly changing world is known as capacity-building (UN-Academic Impact). Furthermore, the three-member team has

participated in a PBL program and student cases understanding at Kathmandu, Nepal. After the project kick-off meeting in February 2019, the learning from the event along with experiences gained from the student activities conducted at Kathmandu, Nepal the college hosted a workshop on Introduction to PBL on 8<sup>th</sup> May 2019. The coverage of the workshop is as follows.

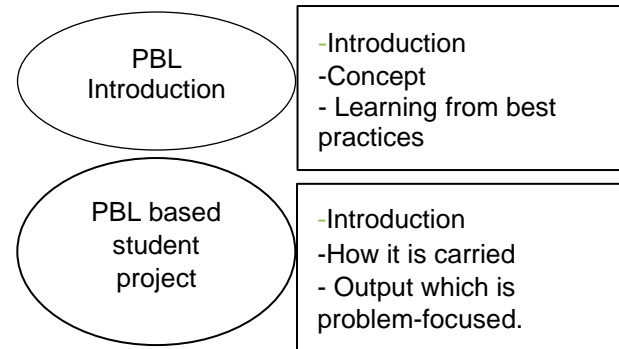


Figure 2: PBL Introduction as the start of action at JNEC

### 3. Understanding and Participating in PBL project case (Identifying and Implementing)

The college prioritized and identified all the project coordinators for student project work from JNEC to participate in the PBL case study at the Indian Institute of Technology (IIT), Bombay in August 2019. Despite the number of participants more than approved and identified from JNEC for these activities, the college decided to invest in the capacity that will make a significant contribution in realizing the goals of the project in the college.

Key PBL themes identified for the activities include the following.

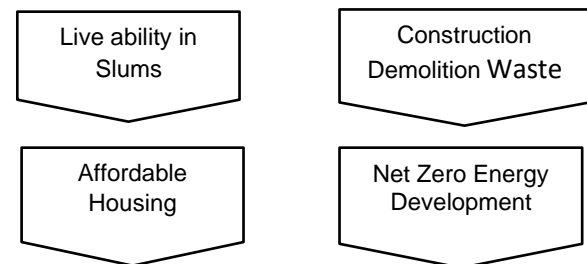


Figure 3: Four themes identified for the PBL case study

Around 80 participants from 10 partners of the project took part in this activity and presented their study’s findings along with their mitigation plan of actions. The whole exercise of this event to learning by doing in the student case has direct impacts to the society in fulfilling environmental, economic and social challenges that are faced by communities.

#### 4. Capacity Building and Curriculum Development Workshop

A team comprising President, Deans (Academic Affairs, Research and Linkages) took part in this curriculum development workshop at the Indian Institute of Science (IISc), Bangalore, India from 14-18<sup>th</sup> October 2019. This workshop introduced the participants to design thinking strategies and their implementation on curriculum framing (CPDM, IISc, 2020). From the best practices that are followed in incorporating PBL in academic courses as shared by partners from Europe and learning from IIT, Mumbai and IISc, Bangalore, the college has worked out and framed the following modules (subjects) that can incorporate PBL approaches in case of JNEC. Intensive review and presentation of the same were facilitated so that critical feedback for incorporating the best of the best approaches can be included.

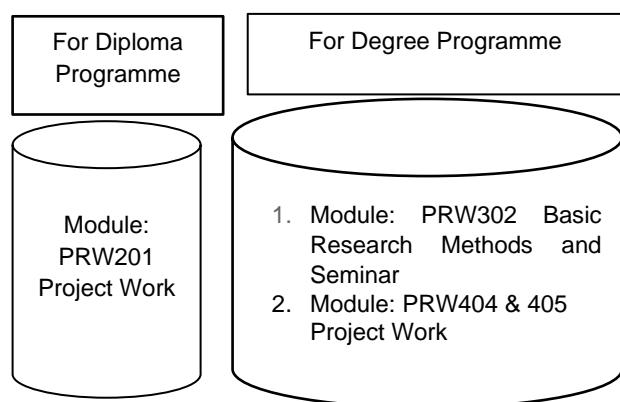


Figure 4: Four modules identified and developed for PBL methodology

The major project work module of the Diploma programme is offered in the final year while the basic research modules are offered in the third year and the major project work module offered in the final year of B.E. Power Engineering, B.E. Mechanical Engineering and B.E. Surveying and Geoinformatics programme has been identified and accordingly the PBL methodology has been incorporated.

On the other hand, in the 2<sup>nd</sup> successive year where JNEC incorporated the PBL modules in the college, the students found it interesting as well as challenging. They shared they are very much content while learning by doing and also with interaction to the beneficiaries from inceptions of the activities.

#### 5. Capacity Building-Series-II

With the successful incorporations of the above two core activities and the experiences and learnings that were derived, the second series of capacity-building activities were held at JNEC on 4th November 2020. The workshop with the theme ‘Experience Sharing and Way Forward for PBL Activities in JNEC’ was focused on sharing the knowledge and skills developed through the PBL case study undertaken at IIT Mumbai (JNEC, 2020). The beneficiaries of the two-week PBL case study in IIT, Mumbai, shared the benefits of their engagement in such case studies and have started taking the PBL activities of the college through their experiences and mentorship supports. It was highly appreciated by the participants to learn and take the applied problem, engage in formulation, design and ultimately solve the issues where possible.

#### 6. Student Case-Series- I and II

With the incorporation of PBL in the curriculum, the avenue for JNEC students to work jointly with students from Aalto University has been materialized. The college already accomplished two student case projects jointly in 2019 and 2020, respectively. The initiation of a joint student case for 2021 is ongoing and will be finalized anytime soon. The two cases that were executed are:

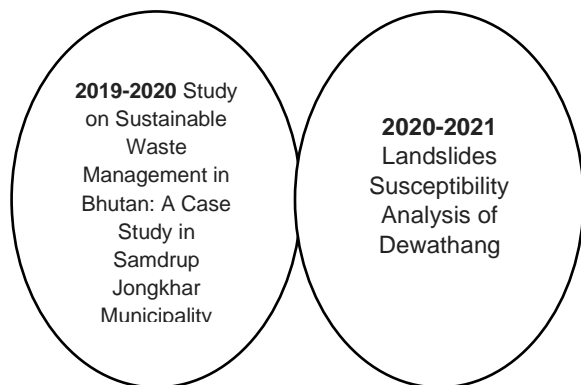


Figure 5: Two Joint PBL case projects executed between JNEC and Aalto University students

The feedback collected from the participants from this two-student case project incorporating PBL is encouraging. One of the student cases of 2020-2021 has to be conducted mostly on online mode and it has faced numerous challenges pertaining to COVID-19 restrictions. Still, the outcome has been significant and the same student case was recently selected for Climate Series IV ‘Youth Matters: Voices and Actions in Climate Change’ and presented during ‘Youth International Day 2021’ (JNEC, 2021). The teams also came up with a ‘Handbook on Landslides’ which can be significant in raising the awareness to the stakeholders.

With the impacts as well as experiences, knowledge and skills gained from such student cases for understanding and finding solutions for local issues, the college, as well as Aalto University, is in the process of finalizing the student case between the two institutions for 2021-2022. The talk is also underway in continuing these activities even after the end of this ongoing PBL South Asia project too.

### 7. Project Based Learning Realization Infrastructure Supports

As PBL cases involve field visits and data collection along with their critical analysis, infrastructure support is crucial for carrying out such activities. JNEC has already placed an order for procurement of these critical appliances that will facilitate the entire process with smooth actions. The investment in audio-visuals

appliances was thus prioritized to be procured from the project fund and other essentials will be kept on procuring at later phases.

### 8. PBL Massive Open Online Courses (MOOC)

One of the critical activities that have to be carried out is the development and testing of MOOC on PBL. The activities were supposed to happen in 2020 at TU Delft, Netherland with the support and guidance of European Partners. This process has been impacted by the current pandemic though the process was never stopped even so. The partners jointly developed the MOOC on PBL and the pilot testing of the same is underway so that the feedback from this test would be crucial in reframing the entire MOOC. From JNEC the PBL project coordinator and the project member secretary were involved in the development of MOOC contents. For pilot testing of MOOC, a group of 15 faculties who are project coordinators of different programmes and others who have a prior engagement with PBL project activities is undertaking this MOOC along with other participants from partner institutions.

The above is most of the critical activities of the PBL South Asia project undertaken and ongoing as of now. The project which was expected to be completed in 2021 got extended because of the pandemic. This extension would certainly give the project partners more hope in conducting some of the critical activities which need to be conducted in face-to-face manners for better realization.

### CONCLUSIONS

PBL South Asia project is advantageous to JNEC where local issues are rising amidst pandemic impacts. The PBL cases direct student learning through engagement and realize the appropriate solutions that can be incorporated. Also, such PBL activities foster good networking between the faculties (mentor), students and stakeholders (most of the beneficiaries) whereby all collectively contribute to understanding the issues, framing the study measures and coming up with best of the best solutions for a meaningful contribution in mitigation.



Correspondingly, the student-centric teaching and learning methodology are highly recognized in higher education where PBL approaches become one of the typical pedagogical approaches. The understanding and realizing the solution are much practical if there are holistic commitment and contributions from the mentor, students and stakeholders. Certainly, when such measures in teaching and learning are implemented, the satisfaction level of students, their trust and confidence in solving applied problems will be enhanced.

## RECOMMENDATIONS

Innovative approaches in academic teaching and learning are vital, so there should be continuity in its implementation. Though the PBL case is one approach for student-centric activities in realizing meaningful knowledge and skills development, other equally important approaches are suggested to be explored. The integration of PBL approaches with other pedagogical approaches can be explored in the higher education system case by case.

## ACKNOWLEDGEMENT

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