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Aalto University, Finland

Jigme Namgyel Engineering College, Bhutan

Delft University of Technology, Netherlands

Sagarmatha Engineering College, Nepal

Kathmandu University, Nepal

Asian Institute of Technology and Management, Nepal

Kaunas University of Technology, Lithuania

Nepal Engineering College, Nepal

Indian Institute of Science, Bangalore, India

Indian Institute of Technology, Mumbai, India

The **Erasmus+** project, '*Strengthening Problem-based Learning in South Asian Universities*' (PBL SA) **aims to build capacity of the South Asian partner institutes by collaboratively developing best practices in PBL for undergraduate education.**

IISc Bangalore, India

India’s Top University and Research Institution in NIRF 2022 ranking

World’s Top University in Citation per faculty metric of QS ranking 2022

Vision

To be among the **world’s foremost academic institutions** through the pursuit of **excellence in research and promotion of innovation** by offering **world-class education** to train **future leaders in science and technology** and by applying science and technology breakthroughs for **India’s wealth creation and social welfare**.

Mission

-Fundamental and applied research in Science and Technology.
-High-impact research & Generation of new knowledge.
-Faculty expertise in the success of national science and technology initiatives

CPDM
(Centre for Product Design and Manufacturing)

M.Des Established 1997

CPDM Established 1998

CPDM Vision

Pursue excellence
in education, research and practice in the areas of
Design and Manufacturing
so as to support development of
systemically-complex, technologically-intensive and socially-impactful solutions
that are
functional, aesthetic, usable, and sustainable

CPDM Mission

Develop competent **professionals** who can design products and manufacturing systems that are **functional, aesthetic, usable, and sustainable**

Nurture **leaders** who can strengthen existing **practice** and develop new practice in the areas of design and manufacturing

Innovate products and manufacturing systems that can significantly impact the society

Develop **knowledge**, including **methods and tools**, to inform and empower practice and education of design and manufacturing.

During these 25 Years…

Design Schools in India

QS WORLD UNIVERSITY RANKINGS

2017- onwards

~60
PhD/ M.Sc Research

~400
M. Des (Product Design)

75+
Awards and recognitions
For students & faculty

~56 Patents

7
M.Tech (Smart Manuf.)

Worldwide **9th**

Asia **1st**

Design Practice and Management

Stanford University — Study on citations

2021

… Research students in academia around the world

Dr. Santosh Jagtap
Blekinge U, Sweden

Dr. Pradar Onkar
IIT Hyderabad

Dr. Suman Devadula
MIT WPU

Dr. Prabir Sarkar
IIT Ropar

Dr. Salim Ahmed
VIT Vellore

Dr. Shakuntala Acharya
IIT Guwahati

Dr. Gokula AV
Napier U UK

Dr. Bisheshwar Haorongbam
NID Jorhat

Dr. R Munisamy
IIITDM Kancheepuram

Dr. Abinash Swain
IIT Roorkee

Pankaj Upadhyay
IIT Guwahati

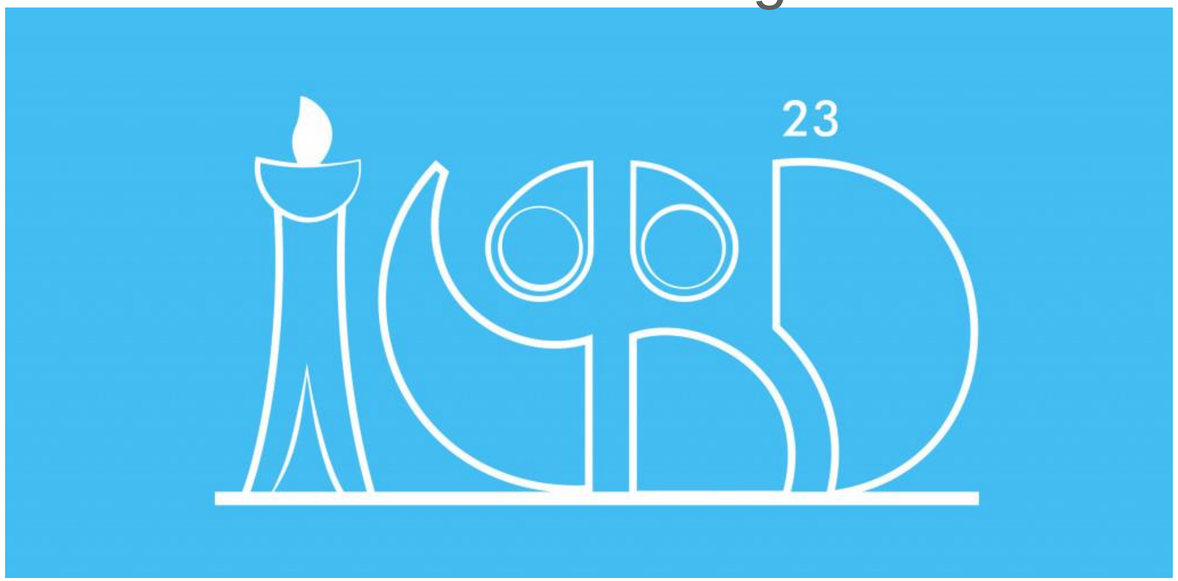
Dr. Srinivasan V
IIT Delhi

Dr. Srinivas Kota
BITS Pilani

Dr. K Vinayak
Texas A&M USA

Two established conference series

9th International Conference on Research into Design 2023



2nd Intl Conf on Industry 4.0 & Advanced Manufacturing 2022

South Asia

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Problem-based Learning (PBL) in undergraduate education

Design Thinking to Re-design Courses

Dr. Shakuntala Acharya
Mr. Apoorv Naresh Bhatt

Overview

Problem-based learning *(PBL) is known to help develop* ***critical thinking***, ***complex problem- solving***, ***self-learning***, ***collaboration*** ***and*** ***communication skills***, *thereby enabling graduates to be* ***industry-ready.***

KEYWORDS:
Design Thinking
Design Pedagogy
Problem-based Learning

South Asia

profound **implications on the motivations of the student to learn**,

"the freedom to select their (students) own resources to answer the learning issues gives them ownership over their learning", [18]

the **onus** of ensuring retained motivation **falls on the shoulders of the** students as peer-teacher [19].

Introduction

A survey across South Asian universities revealed that the **undergraduate curricula are predominantly instructional and not adequately hands-on** due to several constraints, such as;

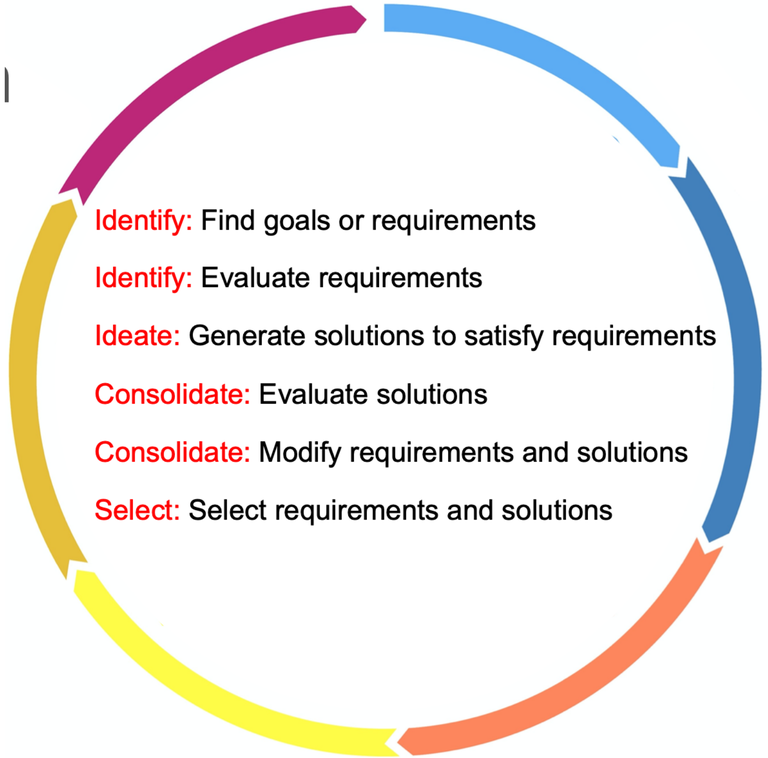
- University-directed lesson plans with **heavy syllabi** to cover and r**estricted time** for practical activities,
- **Fewer number of co-instructors** to guide in practical, real-world issues that can be addressed in courses
- **Dearth of motivation** in students to self-learn and innovate during the stipulated practical hours within a course,
- **Poor critical-thinking ability** due to a general lack of awareness on sustainable development goals and their local implications in the students,
- **Fewer collaborations** in these courses, and
- **Poor communication skills.**

Literature corroborates that in **traditional engineering education** [1];

- Programs are **content-driven instead of need-driven**
- Do not provide sufficient **design experiences** to students.
- Students **lack communication skills and teamwork** experience.
- Students **lack awareness** about social, environmental, economic and legal issues.
- Faculty **lack practical experience** and are not able to adequately relate theory to practice or provide design experiences and
- Having **outdated teaching and learning strategies**.

To imbibe the benefits of PBL approach, *re-design of existing courses in the institutes of Nepal and Bhutan was undertaken*, using the strategy of conducting **a five-day Design Thinking workshop at IISc, Bangalore.**

Characterised by **iterative steps**, summarised as follows;



- Step 1: **Identification of requirements** generated and clarified against needs, through *observations, interviews, role-play, stakeholder analysis and checklists*;

- Step 2: **Ideation of solutions** through creative methods, *such as, brainstorming and SCAMPER*

- Step 3: **Consolidation of solutions** into feasible solutions through *TRIZ and morphological Chart method*, and

- Step 4: **Selection of the most promising solution** as concept from amongst all other alternatives upon evaluation, by methods such as, w*eighted-objectives and concept selection methods*.

DESCRIPTIVE STUDY

Methodology

24 participants - 12 faculty from Nepal and Bhutan as the **key course designers**, supported by 12 faculty and research associates from the Indian and European Universities as **mentors**.

Four teams were devised (Table 1), based on two factors –

Status of institute (S) & **Intervention sought (i)**

	(i1) Process and Methodology focus	(i2) Domain and Technical focus	(i3) Soft skill focus
(S1) Autonomous	TEAM 1	TEAM 3	
(S2) Affiliated	TEAM 2		TEAM 4

The following **program** was followed ;

Day 1 – Team building

Day 2 – Identification / Exploration

Day 3 – Conceptualisation/ Ideation

Day 4 – Consolidation/ Discussion

Day 5 – Selection/ Reflection and Presentation

PROBLEM IDENTIFICATION : OVERVIEW OF THE INTERVENTION NEEDED

a) **Aim**: *To change the conventional passive learning into the active, problem- based learning.*

b) **Course to be re-designed** : Integrated Digital Electronics (Credits: 3) Level : B.Engg., 3rd Yr, Ist Sem

c) **Course Objective**: *To impart knowledge different types of Logic Gates, Memory and Switching Systems and apply the same through PBL approach.*

d) **Duration**: One Semester, 15 weeks

e) **Learning Outcomes**: On course completion, students should be able to:

i) Develop different digital logic gates using semi-conductor components.

ii) Analyse, design, simulate and implement digital logic circuits.

iii) Classify and compare different gates in terms of operation and performance.

iv) Classify different semiconductor memories.

v) Acquire the knowledge to address real-life applications of digital logic gates.

f) **Learning Objectives** : Students must be capable of:

i) Independently managing a project;

ii) Solving real-life problems using digital logic gates/electronics;

iii) Critically thinking to identify and assess complex problems;

iv) Working in teams collaboratively, manage projects and people, show leadership;

v) Communicating one’s ideas and concepts with clarity and

PROBLEM IDENTIFICATION : LIST OF REQUIREMENTS

i) **Course must have** the following PBL course elements and ensure that the time is adequately planned :

   a) Lecture (L) delivery time

   b) Tutorial (T) time for mentoring/facilitating time

   c) Students' group/ self-learning time

   d) Students' collaboration time

   e) Communication time – presentations (Pr)

ii) **Course must imbibe PBL through several 'triggers' and 'methods'** that aid the process

iii) **Course Plan must have the stipulated minimum number of hours per week**, as per University ;

   a) 3 hours/week – Lectures (L) or Tutorials (T)

   b) 1 hour/week – Presentation (Pr)

   c) 1 hour/week – Lab for prototyping (P), or Field visit (F)

iv) **Internal Evaluation Scheme is required**, with consultation of department, as final exam will be conducted as per University.

v) **Availability and access to dedicated Team work space** / prototyping space

IDEATION AND SOLUTION CONSOLIDATION

Unit	Topic/Course Details	L	T	P	F	Pr
1	Review of BJT and MOS	✓	✓	✓		
2	Resistor – Transistor Logic (RTL) and Integrated _ In jection Logic (IIL)	✓	✓	✓	✓	✓
3	Diode – Transistor Logic (DTL)	✓	✓	✓		✓
4	Transistor – Transistor Logic (TTL)	✓	✓		✓	✓
5	Emitter – Couple Logic (ECL)	✓	✓	✓	✓	✓
6	NMOS and CMOS Logic	✓				✓
7	Comparison of Logic Families		✓			✓
8	Memories	✓			✓	✓
9	Switches					

ACTIVITIES AND SKILLS FOR EACH PBL COURSE ELEMENTS

L: Lecture	T: Tutorial	L : Lab work	F : Fieldwork	P : Presentation
Lecture Delivery	Assignment mentorship	Simulation	Industry Visit	Presentation / Communication
Question Answer Session	Analytical Thinking & Self-learning	Testing	Survey Data Collection	Report Writing/ Collaboration
Group Discussion/ Collaboration	Problem Finding / Identification	Prototyping	Problem reformulation	Evaluation (by instructor)
	Problem solving / Ideation		Solution validation	Feedback (from Instructor, mentor, peer)
			Feedback	

PROPOSAL FOR INTERNAL EVALUATION SCHEME

Attendance	Scheduled Tests	Lab test	Presentation	Report	Prototyping	Total
5	10	5	10	5+5	10	50

CONCEPT SELECTION

Week	PBL Tasks	Roles & responsibilities	Notes
1	Course introduction, orientation of teaching methodology, timeline, evaluation criteria. line, evaluation criteria.	Instructor	Introducing PBL
2-4	Lecture Delivery, Lab work, problem identification and analysis	Instructor and supporting lab staff.	Classroom and lab activities
5 -6	Case Preparation/field visit followed by presentation and preliminary report submission.	Instructor, mentor and supporting staff.	Group formation, Literature review, domain identification, field visit
7-9	Problem-solving Assignments, Group discussion, Lectures, Lab works and mentoring.	Instructor, mentor and supporting lab staff.	Brainstorming, Class room and lab activities
9	Mid-term Presentation /assignment evaluation	Instructor, mentor	Group discussion, feedback collection
10	Incorporating the feedback and generating final outcome	Students	Modification, prototyping
11	Deliverables	Students	Prototyping, assignment submission
12	Deliverables	Students	Final presentation and report submission
13-14	Preparation week	Student	
15	Final assessment. university examination	Student	

DISCUSSIONS

The proposed courses were conceptualised through **a systematic approach** that helped **mitigate conflicts** between current practice, University demands and the unorthodox approach of PBL.

CONCLUSIONS

The use of **Design thinking propelled** the faculty course-designers from institutes of Nepal and Bhutan, mentored by Indian and European partner universities, to **identify several issues** from different perspectives, **ideate** large number of solutions, **consolidate** them into viable solutions and **select the most promising one** to further detail.

At present, these proposals are being implemented at the home institutes and gathering feedback is in progress.

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Q & A

Thank you