Present Status of the Engineering Education in Japan
- Innovation in Global environment -

Masahiro Inoue, Ph.D., PMP, PEJp
Director, Chair for International Affairs, JSEE
Vice President, Professor
Shibaura Institute of Technology
JSEE
Japanese Society for Engineering Education

- Founded in 1952.
- JSEE accommodates universities, colleges of engineering, government laboratories and industrial companies.
- The purpose of JSEE is to develop creative manpower and encourage students to study with enjoyment and take pride in their future calling.
JSEE Journal

- The first journal was issued in 1953.
- Six numbers per volume are published annually.
- The journal contains the following sections: papers on engineering education, Editorials, case study, review of advanced technologies, technical education in companies, round table discussion, news, voices from the readers.
- The papers are peer-reviewed.
- The electronic files of papers and Editorials are available on Web (J-stage: https://www.jstage.jst.go.jp/browse/jsee).
Innovation in Engineering Education

• Fostering Human resource who creates Innovation in Global environment

• Generic Skill in Engineering Education
  – Soft-skills, Human skills, Competency as working person
  – Problem solving, Communication, Teamwork, Project management, Ethics, Life long learning

• Paradigm shift of Education
  – From Instruction to Learning
  – Teacher centered to Student centered
  – Quality Assurance based on Learning Outcomes

• Passive Learning to Active Learning
  – Project Based Learning, Problem Based Leaning

• Assessment of Generic Skill
Top Global University Project in Japan

- Japanese government has selected 37 universities as the Top Global Universities among 775 universities in Japan in order to enhance their international competitiveness.

- FY2017 Budget 6.3 billion yen
- FY2016 Budget 7.0 billion yen

Top Global University Project in Japan

• Since 2014, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) has been carrying out the Top Global University Project to provide prioritized support to those universities that are leading the internationalization of Japan’s education by launching new programs to encourage and deepen interactions and partnerships with the world’s top universities, reforming personnel and educational systems, enhancing educational systems to help students develop the ability to act globally and accelerating other globalization initiatives.

Targets Example of SIT, as a Top global university

International Students
- In 2016: 842 students (10%)
- In 2023: 2,820 students (29.4%)

International professors
- In 2015: 76 Professors (25.2%)
- In 2023: 180 Professors (60%)

Domestic Students
- In 2016: 1,070 Students
- In 2023: 2,700 Students

Courses offered in English
- Undergraduate: 200 Courses (34%)
- Graduate: 150 Courses (93%)

Study-abroad experience among Domestic Students
- In 2016: 1,070 Students
- In 2023: 2,700 Students (100% once in 4 years)

Courses offered in English
- Undergraduate: 200 Courses (34%)
- Graduate: 150 Courses (93%)

Plan to provide at least one Study-Abroad Opportunity

SHIBAURA INSTITUTE OF TECHNOLOGY
Established 1927
Dispatching SIT Students to Study Abroad (2011-2016)

Shibaura Institute of Technology

AY 2011 | 55
AY 2012 | 20
AY 2013 | 43
AY 2014 | 57
AY 2015 | 59
AY 2016 | 164

- English Learning Programs
- Global PBL Programs
- Other Programs

Total: 1070
International Students Intakes (2011-2016)
Shibaura Institute of Technology

- **AY 2011**: Short-term (34), Mid-term (3), Long-term (119)
- **AY 2012**: Short-term (41), Mid-term (3), Long-term (147)
- **AY 2013**: Short-term (28), Mid-term (22), Long-term (103)
- **AY 2014**: Short-term (67), Mid-term (115), Long-term (158)
- **AY 2015**: Short-term (207), Mid-term (145), Long-term (115)
- **AY 2016**: Short-term (136), Mid-term (149), Long-term (193)

- **Total**: Short-term (513), Mid-term (501), Long-term (297), Total (842)
GTI (Global Technology Initiative) Consortium
~Industry-Academia-Government Collaboration ~

【Objectives】
Foster global engineers
Generation of Innovation

【Activities】
1. Global PBL (Project Based Learning)
2. International exchanges among universities
3. International Internship
4. International Collaboration Research
5. Intergovernmental Projects
6. GTI Consortium Symposium

Industry

Governmental Organization

Academia

- Established in December, 2015
- 180+ members as of July, 2017
Why Global Technology Initiative (GTI)?

We need a new generation of engineers able to function in global teams, appreciating and respecting professional and cultural diversity.

by Anthony Bright

The main mission

To foster a new generation of global engineers through collaboration among universities, government agencies, and industries.

Global PBL

- Short-term program for several weeks
- To engage graduate and undergraduate students, faculty, and staffs in multi-disciplinary and international PBL activities with international partner universities
- Evaluate learning outcomes (generic skills) before and after PBL

Students experienced global PBL overseas
288 students in 2015
509 students in 2016
Systematic Design of Project Based Learning

• Define Clear Educational Objectives
• Develop discipline specific skill as well as generic skills
• Integrate PBLs with Lectures in 4 or 6 year of under/postgraduate
• Evolutional improvement of knowledge and experience
• Collaborative efforts of Faculty members
Global PBL Course
For Innovation in Global environment

• The project teams are composed of international, multidisciplinary, and undergraduate-graduate mixed students.

• This culturally diverse team structure can realize a simulating global environment, which resembles the situation that students can encounter at workplace in their future.

• In the global PBL course, students form project teams, and each team decides on a project theme through team discussion
  – on keywords suggested by faculty members—such as ecology, energy, eco-tourism, mobility, welfare and medical systems, and disaster prevention.
Global PBL

Using sticky notes during discussions

Keywords:
Ecology, Energy, Eco-tourism, Community development, Service, Mobility, Welfare and medical systems, Disaster prevention, Multi-language communication, User experience, Innovation, Education systems, Global leadership, Others (student-generated)
Global, Industry-Academia Collaborating Project Based Learning
Global, Industry-Academia Collaborating Project Based Learning

- Term: December 2015, 2016, and 2017
- Venue: Shibaura Institute of Technology(SIT), Japan
- Patricians: 80 students from 14 countries: Japan, Thailand, Singapore, Indonesia, Vietnam, Cambodia, Malaysia, Germany, Russia, Algeria, Ethiopia, Rwanda, Mongolia, and Brazil
- Theme: Environment, Energy, Welfare, Education
- Collaboration: Honda, Richo, SMBC(Bank), Saitama-city, Showa village
- TAs: 6 students from Japan, Thai, and Indonesia
Process for global PBL

Keywords
- Requests/Needs from Environment, Society, and Market

Definition (Redefinition) of the Problem
- The theme will crossover multiple areas/disciplines

Proposal of Integrated Solution of the Problem

Collaboration of graduate students
- From various backgrounds/disciplines
- Requirement analysis & Definition: creation of various kinds of ideas

Deliverables

Review & Presentation
- The solution would be formed by correlating various science and technology each other, which has been obtained through environment and social activities
Global, Industry-Academia Collaborating 
Project Based Learning

Field Works

Final Presentation
Collaboration with local governments and Industries

“Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability” (IEA, 2013)

[Project Theme of gPBL at SIT 2015]

<table>
<thead>
<tr>
<th>Team</th>
<th>Project Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transportation support system for Olympic Game</td>
</tr>
<tr>
<td>2</td>
<td>SMART CITY IN MISONO- urban development in Saitma City</td>
</tr>
<tr>
<td>3</td>
<td>Mobile Banking Application for College Students</td>
</tr>
<tr>
<td>4</td>
<td>Kazelar System - solar panels and harnessing offshore wind energy</td>
</tr>
<tr>
<td>5</td>
<td>Microbeads - awareness campaign and innovation of wastewater treatment</td>
</tr>
<tr>
<td>6</td>
<td>Let’s start “英GO” - English conversation application</td>
</tr>
<tr>
<td>7</td>
<td>Multi-language Communication Application</td>
</tr>
<tr>
<td>8</td>
<td>Olympic Garbage Problem Solving</td>
</tr>
<tr>
<td>9</td>
<td>Parafamilympic - promotion event for Paralympic Game</td>
</tr>
<tr>
<td>10</td>
<td>Banking Services for Foreign Students in Japan</td>
</tr>
</tbody>
</table>
10 Project Team with multicultural, multidisciplinary and age mixed work in English

Systems Engineering Knowledge & Skills
# Multicultural and multidisciplinary grouping

[Participants of gPBL at SIT 2015]

<table>
<thead>
<tr>
<th>Major field of study</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Information/communication</td>
<td></td>
</tr>
<tr>
<td>Knowledge Engineering</td>
<td></td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td></td>
</tr>
<tr>
<td>Aeronautical Engineering</td>
<td></td>
</tr>
<tr>
<td>Civil Engineering</td>
<td></td>
</tr>
<tr>
<td>Geotechnology</td>
<td></td>
</tr>
<tr>
<td>Transportation &amp; Logistics</td>
<td></td>
</tr>
<tr>
<td>Architecture</td>
<td></td>
</tr>
<tr>
<td>Industrial Design</td>
<td></td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td></td>
</tr>
<tr>
<td>Life Science</td>
<td></td>
</tr>
<tr>
<td>Production Technology</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Mathematical Science</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institution</th>
<th>Major fields</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITC</td>
<td>Cambodia</td>
<td>1 1 1 1 1 1 1</td>
</tr>
<tr>
<td>ITS</td>
<td>Indonesia</td>
<td>1 1 1 1 1 1</td>
</tr>
<tr>
<td>NUS-ISS</td>
<td>Singapore</td>
<td>3</td>
</tr>
<tr>
<td>KMUTT</td>
<td>Thailand</td>
<td>3 1 1 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td>SUT</td>
<td>Thailand</td>
<td>1 2 1 1 1</td>
</tr>
<tr>
<td>HUST</td>
<td>Vietnam</td>
<td>2</td>
</tr>
<tr>
<td>TDU</td>
<td>Japan</td>
<td></td>
</tr>
<tr>
<td>SIT</td>
<td>Japan(Vietnam/Malaysia/Ethiopia)</td>
<td>6 1 20 1 1 1 1 1 1 1</td>
</tr>
</tbody>
</table>

| Total                         | 3 8 4 26 2 2 1 1 1 1 3 5 1 4 1 1 | 63 |
Design Review (DR)

A3 sized Japanese-industry style integrated document are used for DR. The plan should includes:

1. Background and objective
2. Requirement analysis
   2.1. Present status and needs, Objective analysis
   2.2. Requirements, Strategy, and Goal
   2.3. Criteria plan for evaluation
3. Scheduled Actions

DR back on campus
Green Room (緑の部屋)

Background and objective
Decrease of tree by deforestation
Environmental problem

We want to implant the children to conserve the forests.

Strategy and goal
We propose the room that make children to understand the importance of protecting the forest and we create the Tree Bank. These 2 strategies can increase the forest.

Tree Bank
Tree bank is the area for exchange the young plant (from children) to money.

Summary and scope
Project
The project created for educate the children to get knowledge about the important of the forest.

Scope
* The interesting group who will join this project is the children and the elders.
* Make good habit in children for good starting point to grow up to nice people.

Space design (room) for this project.

Tree Bank flow chart

Conclusion and future work
* We created the Green room that incorporates the ideas of many people.
* We must consider to build a place of the green room.

Survey result

Take the questionnaire
* Understanding of environmental issues (such as in which there is no problem that the tree would happen)
* Evaluation of the green room
* Awareness to the green room
* The advantage of working on environmental issues (Which becomes the money by selling the trees)
Final Presentation

Students’ document should have:

- Background and Objective
- Requirement Analysis
  - Present Status and Needs, Objective Analysis
  - Requirements, Strategy, and Goal
  - Criteria plan for evaluation
- Implementation
  - Summary and Scope
  - Implementation Plan
- Evaluation
  - Evaluation Method
  - Evaluation Result
- Conclusion

Evaluation criteria for Project Deliverables:

- Creativity
- Usefulness
- Completion
- Goal-appropriate
- Goal Achievement

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Quality Assurance of Engineering Education and PBL
International Engineering Alliance
Graduate Attribute profiles

1. Engineering Knowledge
2. Problem Analysis
3. Design/ development of solutions
4. Investigation
5. Modern Tool Usage
6. The Engineer and Society
7. Environment and Sustainability
8. Ethics
9. Individual and Team work
10. Communication
11. Project Management and Finance
12. Life long learning
Assessment of Learning Outcomes

• Assessments of learning outcomes in *generic skills* are very important for quality assurance in interdisciplinary and global PBL.

• Rubric, PROG (*Progress Report On Generic Skills*) and CEFR are utilized to assess the learning outcomes.
Assessments for gPBL

• Outcomes Assessment by Rubrics
  – Personal Outcomes
  – Project Outcomes (Group Outcomes)

• PROG (Progress Report On Generic skills)
  – Competency test
  – Literacy test

• CEFR
  – Technical English Can-Do-List
    • CEFR: Common European Framework of Reference for Languages
Outcomes Assessment based on Rubrics

### gPBL Outcomes Assessment Sheet
(for student)

<table>
<thead>
<tr>
<th>Personal Outcomes Self and Peer Assessment (High:5,4,3,2,1:Low)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bachelor/Master</strong></td>
</tr>
<tr>
<td>Competency</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Teamwork in multi-culture</td>
</tr>
<tr>
<td>Understanding design</td>
</tr>
<tr>
<td>Project Outcomes (team outcomes)</td>
</tr>
</tbody>
</table>

The actual evaluation will be conducted in three levels consecutively:
(a) Evaluation by students within the same group,
(b) Evaluation by students among groups,
(c) Evaluation by the professors and TAs.
**Outcomes Assessment based on Rubrics**

**gPBL Outcomes Assessment Sheet**
(for student)

<table>
<thead>
<tr>
<th>Bachelor/Master</th>
<th>Grade:</th>
<th>Number:</th>
<th>Name:</th>
</tr>
</thead>
</table>

**Personal Outcomes Self and Peer Assessment (High:5,4,3,2,1;Low)**

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Competency</th>
<th>Self Assessment</th>
<th>Peer #1</th>
<th>Peer #2</th>
<th>Peer #3</th>
<th>Peer #4</th>
<th>Peer #5</th>
<th>Peer #6</th>
<th>Average of Peer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work in multi-culture and interdisciplinary team</td>
<td>Communicate and teamwork in multi-culture and interdisciplinary team</td>
<td>–</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>–</td>
</tr>
<tr>
<td>Engineering Design</td>
<td>Design system, service and process which satisfies needs and constrains</td>
<td>–</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>–</td>
</tr>
<tr>
<td>“System Thinking”’</td>
<td>Solve interdisciplinary problem by understanding engineering process</td>
<td>1. Understand engineering process and apply it to solve interdisciplinary problem. 2. Recognize and analyze problem, and design and evaluate solution.</td>
<td>–</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>–</td>
</tr>
<tr>
<td>“Engineering Methodology”’</td>
<td>Apply engineering methodologies to solve interdisciplinary problem.</td>
<td>1. Understand engineering methodologies and apply them to model, and determine system.</td>
<td>–</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>Name</td>
<td>–</td>
</tr>
</tbody>
</table>

**Team Outcomes Self Assessment (High:5,4,3,2,1;Low)**

<table>
<thead>
<tr>
<th>Project Outcomes</th>
<th>Self Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originality</td>
<td>Propose original system and service</td>
</tr>
<tr>
<td>Usefulness</td>
<td>Propose useful system and service</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Based on scientific analysis and engineering design</td>
</tr>
<tr>
<td>Feasibility</td>
<td>Technically, socially and economically feasible</td>
</tr>
<tr>
<td>Goal</td>
<td>Set appropriate goal</td>
</tr>
<tr>
<td>Achievement</td>
<td>Achieve goal</td>
</tr>
<tr>
<td>Written and Oral Presentation</td>
<td>Written presentation</td>
</tr>
<tr>
<td></td>
<td>Oral presentation</td>
</tr>
</tbody>
</table>

The actual evaluation will be conducted in three levels consecutively:
(a) Evaluation by students within the same group,
(b) Evaluation by students among groups,
(c) Evaluation by the professors and TAs.
PROG test: Progress report on generic skills

Knowledge

Generic Skills

Experience

Literacy

Ability for problem solving based on knowledge: application capability of knowledge and an ability to continue learning

Competency

Behavioral characteristic mastered from experience: Capability which can be transferred to any work

Result report

Report & Training
Target Achievement Plan Worksheet

**Name**

Reflect on your strengths and weaknesses, and create a goal to help both develop in your strengths and overcome your weaknesses. At first, it’s good to set goals that are not too difficult. It’s also good to choose goals that seem to be fun to work on.

- Take a look at the example, and write down in the box below.

**STEP 2**

Choose one strength, and write a specific experience that either resembles or helped develop that strength. If you have trouble recalling an experience, try reading the reference below and find a “similar experience.”

**Reference**

Strength resembling experience

<table>
<thead>
<tr>
<th>Strength</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self confidence</td>
<td>Ex) I had no experience surfing, but was invited by a friend and so decided to give it a try. I’d always been a fast learner in sports, and therefore had no reluctance in trying. I noticed that my desire to always enjoy myself, led to my self-confidence in sports.</td>
</tr>
</tbody>
</table>

**STEP 3**

Create a target achievement plan for other goals as well! Take action starting today!

**STEP 4**

Choose one from: 1. A strength to develop on or 2. A weakness to overcome, and think of an action plan to help achieve your goal. It’s important to divide the process into small steps.

I will make a target achievement plan based on:

1. **Strengths to develop**
2. **Weaknesses to overcome**

**What to work on**

<table>
<thead>
<tr>
<th>Detailed actions/methods (How to?)</th>
<th>Period</th>
<th>Deadline (by when?)</th>
<th>Check</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>I want to develop self confidence</td>
<td>Make sure to participate in every practice, to become a starting player.</td>
<td>I want to work on managing others</td>
<td>Find an internship that involves group work and fieldwork</td>
<td></td>
</tr>
<tr>
<td>Practice left-hand dribbling to become a better ball handler.</td>
<td>Participate in summer internships to gain experience working with other students.</td>
<td>Win the district championship, and gain confidence over achieving goals.</td>
<td>Be able to openly state opinions during group discussions.</td>
<td></td>
</tr>
</tbody>
</table>

*Plans are meant to be put into action. Check to see if each step is in good progress. If progress is not good, try reviewing “Detailed actions/methods”.*
Competency of Generic Skill:

Progress Report On Generic skills (PROG)

- Global human resource model (n=735)
  - Level: 5.04
- Global PBL(n=27)
  - Level: 5.35
- Business person of high-performer model (n=4,000)
  - Level: 4.20
- Systems Engineering Special Exercises (n=64)
  - Level: 4.28
- What is Systems? (n=121)
  - Level: 3.94
- Undergraduate’s average (n=7,800)
  - Level: 3.42

Communication skills: 3.22
Self-control skills: 3.42
Problem-solving skills: 4.28
Basic Structure of the CEFR-based Can do list
for engineering context

- **Basic User**
  - Can understand and use familiar everyday expressions and very basic phrases

- **Independent User**
  - Can understand sentences and frequently used expressions related to areas of most immediate relevance

- **Proficient User**
  - Can understand the main points of clear standard input on familiar matters

- **Can understand the main ideas of complex text on both concrete and abstract topics**

- **Can understand virtually everything heard or read.**

- **Can understand with ease virtually everything heard or read.**

- **Can understand a wide range of demanding, longer texts, and recognize implicit meaning.**

- **Can understand with ease virtually everything heard or read.**

- **Language Output (Production)**

- **Language Input (Reception)**

- **Language Exchange (Interaction)**

- **Overall Performance (Competency)**

---

**Technological Communication Can-Do-List extended from CEFR**
Conclusion

• Top Global University Project in Japan
• Invitation to GTI (Global Technology Initiative) Consortium
• Global PBLs foster students who contribute Innovation in global environment.
• PROG, Assessment tool for generic skill
  – Already implemented in multi-language
• CEFR based Can-Do-List, Assessment tool for communication ability of engineering students
References


Thank you for your attention

We are living in one world.

Global PBL in Thailand
March 2013-2017

Global PBL in Japan
December 2015-2016