Systems Thinking and Engineering-based Global Project Based Learning

Shibaura Institute of Technology

Hiroshi Hasegawa
The University’s Educational Aims, Performance and Special Features Realize Useful Global Human Resources

The University’s Educational Aim (School Philosophy)
The Education of Engineers by Society to Contribute to Society

Mission: Global Human Resources
Training whereby “An engineer can contribute to the world and society with integrated problem solving skills.”

Global Human Resources Mission-critical capability

Global Manpower
Problem-solving ability

Communications Skills

Cross-cultural Understanding

International • Cross-cultural Communication PBL

ESP
English for Specific Purposes

Exchange Student • International Intern

Specialty Engineering Foundation • Specialized Knowledge • Applied Skills

What Industry requires: Manufacturing human resources for overseas expansion

Global Engineer ★

International-class quality built into the framework of a system of education guaranteed by PDCA cycle

University Policy: Development of positive human resources with engineering identity

★ Global Engineer: human resources with these capabilities as defined by the American Society of Mechanical Engineers (ASME)

(H22 University Reform Promotion Project “Quality assurance of education by IR framework and PDCA transformation”)
Graduate and Faculty Cooperation

Systems Engineering Education Program:

- Global PBL
- Industry-University Cooperation PBL
- Thesis Research (Multidisciplinary Research)
- Systems Engineering Special Exercises
- Systems Engineering Exercises B
- Systems Engineering Exercises C
- Systems Engineering Exercises A
- Workshop of System-Thinking

Admission

Completion

Master’s Program

Undergraduate Program

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SEATUC
South East Asian Technical University Consortium

• Shibaura Institute of Technology & 7 South-East Asian technological institutes participate in the consortium (established in May, 2006)
• The SEATUC Symposium has been held every year since 2006.
• International Cooperation & Exchange programs among the participants
• Participants
  – Shibaura Institute of Technology (SIT)
  – King Mongkut’s University of Technology, Thonburi (KMUTT), Thailand
  – Suranaree University of Technology (SUT), Thailand
  – Institut Teknologi Bandung (ITB), Indonesia
  – Universitas Gadjah Mada (UGM), Indonesia
  – University of Teknologi Malaysia (UTM), Malaysia
  – Hanoi University of Technology (HUST), Vietnam
  – Ho Chi Minh City University of Technology (HCMUT), Vietnam

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Goals for Global PBL

Through exercise and experience of Global Project Based Learning, the following three skills are acquired:

- Synthetic (Integrative) problem-solving skills in order to become marketable and international.

- Concepts and technologies of "systems thinking", "system approach", and "System Management (Project Management)"

- Ability to work as a member of an international, interdisciplinary team.
Global PBL: Synthetic (Integrative) problem-solving process

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
Schedule & Participants

Dates: 2013/02/24 – 2013/03/03 (8 days)
Place: King Mongkut’s University of Technology, Thonburi in Thailand

Team Member Totals*: 27 from SIT, 23 from KMUTT

The Ability to Communicate in English:

Students who is weak in English can use a PC, smart phone, Internet, or a variety of devices or services. This way students are encouraged to seize opportunities to speak and bolster confidence in English.

*Both sides should be composed of 1st year Graduate School students, and Third- and Fourth-Year Undergrads.
Day 1:
Icebreaking & Team-forming

Icebreaking:
Self introductions and team-forming through simple games for communication and a questionnaire

Everyone at the Self-introduction Game

Nickname announcement

Japanese and Thai students form pairs (become buddies)
Project Theme-setting

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Day 2: Team-setting

Using sticky notes during discussions open to any challenge

Agreed upon theme announced

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)
Problem Analysis & Definition

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Day 3 & 4:

Requirements analysis and goal setting, budget planning and activity scheduling

On the second day, the schedule was suddenly changed. The venue was moved to Hua Hin, a beach in southern Thailand, for two days and one night, and when the schedule resumed in Bangkok, "Design Review (submission of execution plan that includes an estimate of the cost of the survey, announcement, and evaluation)" was implemented.

Surprise!

Lunch facing the beach

Group work here, too
Design Review

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Day 4:
Design Review (DR)

The A3 material and budget planning document are used for DR. The A3 material should include the following points.

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

Back on campus, at last the DR!
Green Room (緑の部屋)  Group 6: 2013/3/2

**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 two 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.

- 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.**

- HoTi
- Cook
- Sea
- Game
- Table
- Table
- Table
- Help
- Growing Forest
- Tree Bank
- Green Game
- Water
- Tree Bank flow chart
  - Tree exchange money
  - Grow the tree for 3-6 months
  - Tree Bank young plant
  - Implant

**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)

**Survey result**
- In your opinion, which topic is important for children about the environment?
  - Why the forest is... 28%
  - The effect when I... 24%
  - How to help the... 24%
  - How to separate... 10%
  - Harm to water... 11%
  - Other... 2%

**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.
Scheduled Actions

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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
<table>
<thead>
<tr>
<th>Day 5</th>
<th>Thu 28, Feb</th>
<th>Activities (Research/Survey/Production etc.) in accordance with the planned schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9:00–12:00</td>
<td>Bangkok City Tour (Royal Palace)</td>
</tr>
<tr>
<td></td>
<td>13:00–16:00</td>
<td>Workshop</td>
</tr>
<tr>
<td></td>
<td>18:00–20:00</td>
<td>Cultural Exchange</td>
</tr>
<tr>
<td>Day 6</td>
<td>Fri 01, Mar</td>
<td>Activities in accordance with the planned schedule</td>
</tr>
</tbody>
</table>
Sightseeing & Cultural exchange activities
The solution would be formed by correlating various science and technology each other, which has been obtained through environment and social activities.
Final Presentation

What is described in A3 material:

- 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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# Evaluation of Outcomes

## Achievement & PROG Test

### 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></td>
<td></td>
<td></td>
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<tr>
<td>Engineering Design</td>
<td>Design system, service and process which satisfies needs and constrains</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>“System Thinking”</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>
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</tr>
<tr>
<td>“Engineering Methodology”</td>
<td>1. Understand engineering methodologies and apply them to model, and determine system.</td>
<td></td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Project Outcomes</th>
<th>Self Assess</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>
</tbody>
</table>

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**Knowledge**

**Experience**

**Generic Skills**

**Competency**

**Literacy**

**Report & Training**

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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: 4.27
- Systems Engineering Special Exercises (n=64)
  - Level: 4.28
- What is Systems? (n=121)
  - Level: 3.94
- Undergraduate’s average (n=7,800)
  - Level: 3.22

Communication skills  Self-control skills  Problem-solving skills
Summary

A team of Japanese and Thai students was formed to collaborate and communicate in English to carry out the implementation of an international system of PBL engineering.

Final presentation and design review were completed in only one week. Moreover, the PBL practice, “Surprise!” was undertaken with schedule changes without prior announcement.

International PBL was also validated by PROG test.

Satisfaction was very high in the interviews with graduate students and students of the two countries after the end of the program, confirming the effectiveness of the international PBL.