A Tale of Two Classes – Language Issues in Teaching Civil Engineering

Francis T.K. Au
Department of Civil Engineering
The University of Hong Kong
A List of Questions

• What is Civil Engineering?
• What are the pre-requisites for the study?
• How to learn Civil Engineering?

• How is performance affected by
  - English language capability?
  - prior experience in learning using English as the medium of instruction?
• What are the lessons learnt?
What is Civil Engineering?
The art of directing the great sources of power in nature for the use and convenience of man …
The Institution of Civil Engineers, London, 1818
Transformation of Hong Kong from a Fishing Village to a Modern Society

Hong Kong in 19th century

Hong Kong in 21st century
Civil Engineering Projects in Hong Kong

High Island Reservoir

Mass Transit Railway

International Airport

Lantau Link
Disciplines in Civil Engineering

- Structural Engineering
- Geotechnical Engineering
- Environmental Engineering
- Transportation Engineering
- Construction Engineering & Management
Pre-requisites for Studying Civil Engineering

- Languages: English (and Chinese)
- Mathematics
- Physics
- Computer literacy / Information technology (IT)
- Chemistry (to certain extent)
Types of Courses in Civil Engineering

Mathematics / Science
- Mathematics;
- Structural mechanics;
- Fluid mechanics

Language courses
- Theory & Design of Structures I

Construction project management

Language

Department of Civil Engineering
The University of Hong Kong
Programme Structure

Mainstream

<table>
<thead>
<tr>
<th>Secondary 7</th>
<th>Theory &amp; Design of Structures I</th>
<th>Year 0 (PRC universities)</th>
<th>Year 0 (Sun Yat-Sen U)</th>
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<tbody>
<tr>
<td>Year 2</td>
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<td>Year 3</td>
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“1+3 mode”

“2+2 mode”
Media of Instruction

Mainstream

PRC U’s: Chinese except for English language courses

Year 0

Year 1

Year 2

Year 3

HKU: English except for Chinese language courses

Year 0 (PRC universities)

Year 1

Year 2

Year 3

“1+3 mode”

“2+2 mode”

Year 0 (Sun Yat-Sen U)

Year 1 (Sun Yat-Sen U)

Year 2

Year 3

SYSU: half Chinese and half English
Moment-area Method

The tangents at P and Q to the elastic line cut off an intercept z on OY.

\[ \frac{dy}{dx} = -\frac{M}{EI} \]

Integrating between P and Q,

\[ \left[ \frac{dy}{dx} \right]_{P}^{Q} = \int_{P}^{Q} \frac{Mdx}{EI} \]

If EI is constant, \( \theta = \frac{dy}{dx} \bigg|_{P}^{Q} = \frac{A}{EI} \).
Class 1: Plastic
Class 2: Compact
Class 3: Semi-compact
Class 4: Slender

Figure 7. Typical moment-rotation characteristics of different classes of sections
Structural design; structural forms

Figure 3. A typical suspension bridge.

Figure 7. Suspension roof with parallel suspension cables, supported by crossed arches.

Figure 13. A typical arch bridge.
Concentrated load $P$ at mid-span

$$A = \frac{1}{2} \left( \frac{PL}{4} \right) \left( \frac{L}{2} \right) = \frac{PL^2}{16}$$

Slope at support = $A/EI = \frac{PL^2}{16EI}$

Deflection at mid-span

= deflection of support relative to centre

= $Ax/EI$

= $(PL^2/16) \left( \frac{L}{3} \right) / EI$

= $PL^3/48EI$

Figure 7: A simply supported beam under a central point load
Report on an existing structure
Data Collected from the Two Classes

• Questionnaires
  - background
  - civil engineering education
  - teaching methods

• Results from test and examination
  - individual questions and overall

• Interviews with students
The Questionnaire

Your background

1. How do you rate yourself among students in your region in each of the following areas?
   (a) English
   (b) Chinese (if applicable)
   (c) Mathematics
   (d) Computer literacy
   (e) Physics

2. What is your first language?
   Chinese
   English
   Others

3. How long have you had formal English language education before the year 2006-07?
   Up to 2 years
   3-5 years
   Above 5 years

4. How long have you had formal English-medium teaching in subjects other than English language before the year 2006-07?

Civil engineering education

5. How would you rate yourself in coping with English-medium study of civil engineering?
   Excellent
   Very good
   Good
   Fair

6. How important is English language capability to the study of each of the following areas?
   (a) Theory of structures - conceptual topics
   (b) Design of structures - design calculations
   (c) Design of structures - design calculations
   (d) Theory of structures - analysis topics

7. How important is English language capability to each of the following in this course?
   (a) Tutorials
   (b) Experiments and reports
   (c) Essay on an existing structure
   (d) Text and examination

Teaching methods

8. How important is capability in each of the following to the study of civil engineering?
   (a) Language(s) / English / Chinese
   (b) Mathematics
   (c) Computer literacy
   (d) Physics

9. How do you rate the usefulness of the following components of this course?
   (a) Lectures
   (b) Tutorial assignments
   (c) Experiments and reports
   (d) Essay on an existing structure
   (e) Test and examination

10. How do you rate the following methods of teaching in general?
    (a) Lecturing using overhead
    (b) Lecturing using transparency
    (c) Lecturing using powerpoint presentation
    (d) WebCT

Miscellaneous

11. How would you rate yourself in civil engineering practice?
    (a) In an English-speaking environment?
    (b) In a Chinese-speaking environment?
    (c) In a mixed language (Chinese-English) environment?

12. For this course, how many books have you:
    (a) Bought?
    (b) Borrowed?

13. How useful is each of the following materials to the study of this course?
    (a) Books
    (b) Notes
    (c) WebCT

14. How useful is this course in enhancing your capability in the use of English?

Thank you again for your help!

Frances T.K. Au (GR)
April 2007
Background of the two classes

English capability

Self-assessment

Percentage

Top 10%  Next 20%  Next 40%  Next 20%  Bottom 10%

HKU  SYSU

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Background of the two classes

First language

- **Percentage**
- **HKU**
- **SYSU**

- **Chinese (Putonghua)**
- **Chinese (Cantonese)**
- **English**
- **Others**
Background of the two classes

Formal English language education

- Up to 2 years: HKU 0%, SYSU 0%
- 3-5 years: HKU 0%, SYSU 0%
- Above 5 years: HKU 100%, SYSU 100%
Background of the two classes

Experience with English-medium teaching

<table>
<thead>
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<th>Experience</th>
<th>HKU</th>
<th>SYSU</th>
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<tbody>
<tr>
<td>Up to 2 years</td>
<td>30%</td>
<td>70%</td>
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<tr>
<td>3-5 years</td>
<td>40%</td>
<td>10%</td>
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<tr>
<td>Above 5 years</td>
<td>50%</td>
<td>40%</td>
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Civil engineering education

Self-assessment of capability in English-medium study of civil engineering

Percentage

Excellent Very good Good Fair

HKU SYSU

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Civil engineering education - topics

Importance of English language capability:
Theory of structures - conceptual topics

<table>
<thead>
<tr>
<th>Importance Level</th>
<th>HKU Percentage</th>
<th>SYSU Percentage</th>
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<tbody>
<tr>
<td>Most important</td>
<td>10%</td>
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<tr>
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Civil engineering education - topics

Importance of English language capability:
Design of structures - conceptual topics

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</tr>
<tr>
<td>Most important</td>
<td>40%</td>
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Importance of English language capability:
Theory of structures - analytical topics

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Civil engineering education - topics

Use of much more mathematics
Importance of English language capability:
Design of structures - design calculations

Use of much more mathematics
Importance of English language capability: Tutorial assignments

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Importance of English language capability:
Experiments and reports

Percentage

Most important

Very important

Important

Not important

HKU

SYSU

Importance of both language and engineering theory
Civil engineering education - coursework

Importance of English language capability: Essay on an existing structure

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<td>20%</td>
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Importance of various pre-requisites

Importance to study of civil engineering:

Language(s): English / Chinese

Importance to study of civil engineering:

Mathematics

Importance to study of civil engineering:

Physics

Importance to study of civil engineering:

Computer literacy

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Practice in Civil Engineering

Mathematics / Science

Language

With time and experience
Practice in Civil Engineering - Confidence

Self-assessment in civil engineering practice in an English-speaking environment

- Excellent
- Very good
- Good
- Fair

HKU
SYSU

Self-assessment in civil engineering practice in a Chinese-speaking environment

- Excellent
- Very good
- Good
- Fair

HKU
SYSU

Self-assessment in civil engineering practice in a mixed language (Chinese-English) environment

- Excellent
- Very good
- Good
- Fair

HKU
SYSU
Usefulness of the course in enhancing English capability

Usefulness of the course in enhancing capability in the use of English

Percentage

Most useful Very useful Useful Not useful

Related to experience in EMI learning
### Coursework – Report on an existing structure

#### Report on an existing structure

<table>
<thead>
<tr>
<th>Class or group</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>HKU</td>
<td>75%</td>
</tr>
<tr>
<td>HKU Local</td>
<td>74%</td>
</tr>
<tr>
<td>HKU Mainland</td>
<td>77%</td>
</tr>
<tr>
<td>SYSU</td>
<td>79%</td>
</tr>
</tbody>
</table>

- **U. quartile**: 73%, 70%
- **L. quartile**: 70%, 70%
- **Average**: 74%, 74%

Variations too small to be taken as indicator!
Overall test results

Difficult test!

Class or group

Marks

HKU
HKU Local
HKU Mainland
SYSU

U. quartile
L. quartile
Average

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Test results – Theory

More courses in related field?
Test results – Essay type

Students with least experience in EMI learning!
Overall examination results

Papers of comparable difficulty and one identical essay-type question

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Examination results – Essay type

Students with least experience in EMI learning!
Professional and technical written communication for engineers

Results of English course

Class or group

HKU HKU Local HKU Mainland SYSU

U. quartile 67% 67% 66% 68%
L. quartile 65% 65% 62% 65%
Average 71% 70% 71% 65%

Results are comparable!
Effect of language capability on learning

Correlation analysis is carried out on results of courses:

- Theory and design of structures I (by Department of Civil Engineering, HKU)
- Professional and technical written communication for engineers (by English Centre, HKU)
Effect of language capability on learning

Overall results vs. performance in English course

$y = 0.8037x + 0.0552$

$R^2 = 0.0643$
Effect of language capability on learning

Results of theory questions vs. performance in English course

\[ y = 0.4477x + 0.2343 \]

\[ R^2 = 0.0164 \]

Low sensitivity

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Effect of language capability on learning

Results of essay questions vs. performance in English course

\[ y = 0.8516x - 0.0022 \]

\[ R^2 = 0.0487 \]

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Effect of language capability on learning

Results of design questions vs. performance in English course

- Equation: $y = 1.0132x + 0.0136$
- $R^2 = 0.0554$

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A series of courses on T & D of Structures

- Theory and design of structures 1
- Theory and design of structures 2
- Theory and design of structures 3

Intermediate course with much more contents in mathematics and science

Basic course examined in this presentation
Next course in the series: T&D of Structures 2

Results of Theory & Design of Structures 2

Comparable performance!

Class or group

<table>
<thead>
<tr>
<th>Marks</th>
<th>HKU Local</th>
<th>HKU Mainland</th>
<th>HKU SYSU</th>
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<tr>
<td>100%</td>
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U. quartile
L. quartile
Average

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Next course in the series: T&D of Structures 2

Results in T&DStr2 vs. performance in English course

\[ y = 0.3529x + 0.454 \]

\[ R^2 = 0.0249 \]

Not sensitive to language capability because of increasing contents in math / science
Next course in the series: T&D of Structures 2

Results in T&D Str2 vs. results in T&D Str1

\[ y = 0.3748x + 0.4642 \]

\[ R^2 = 0.2992 \]

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Conclusions

Although the data collected are not yet conclusive, some conclusions can still be inferred:

• The two important factors in learning civil engineering are:
  (a) language(s); and
  (b) mathematics / science.

• Although the correlation of the data is not strong, language capability is still seen to enhance learning various topics in civil engineering.
Conclusions

• Language capability affects to various extent the study of different areas of civil engineering.

• The students examined in the study have different experience in learning in English, Chinese and a combination of the two. Provided that they have passed a certain threshold of language capability, the difference in subsequent performance is minimal.
Conclusions

• Using English as the medium of instruction in learning enhances the capability in the use of English, especially in the first few years.
Thank you!