Engaging teaching staff with continuous curriculum improvement in engineering education

Isabel Hilliger @isahilliger
Associate Director For Assessment and Evaluation
Engineering Education Unit
Pontificia Universidad Católica de Chile (PUC-Chile)
Friday, May 24th, 2019
Table of Contents

• Context
• Research question and objective
• Methods
• Results
• Discussion and implications
• Considerations and recommendations
• Questions and answers
CONTEXT
Is anyone familiar with this report?

The global state of the art in engineering education

MARCH 2018

DR RUTH GRAHAM
PUC-Chile as an emergent leader in Engineering Education

Source:
Engineering Education Unit

Jorge Baier
Director

Isabel Hilliger
Subdirectora de Medición y calidad

Ximena Hidalgo
Asesora docente

Jorge Maldonado
Coordinador

Constanza Melián
Coordinadora

Marjorie Oliveros
Encargada apoyo académico Tr1
Curriculum reforms

- 2008: Skills-based curriculum
- 2013: Flexible Interdisciplinary Curriculum
Core courses on design, innovation and entrepreneurship

First year
- ING1004: Engineering Challenges

Second year
- Undergraduate research credits

Third year
- ING2030: Research, Innovation and Entrepreneurship

Fourth year
- Capstone courses

- Pre-post questionnaires to assess students’ self-efficacy in related skills
Flexible disciplinary and interdisciplinary MAJORS and MINORS

<table>
<thead>
<tr>
<th>Major</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTONOMOUS ROBOTIC SYSTEMS</td>
<td></td>
</tr>
<tr>
<td>ENGINEERING, DESIGN AND INNOVATION</td>
<td></td>
</tr>
<tr>
<td>ENGINEERING AND ARQUITECTURE</td>
<td></td>
</tr>
<tr>
<td>BIOLOGICAL ENGINEERING</td>
<td></td>
</tr>
<tr>
<td>GEOSCIENCES</td>
<td></td>
</tr>
<tr>
<td>BIOMEDICAL ENGINEERING</td>
<td></td>
</tr>
<tr>
<td>MATHEMATICAL ENGINEERING</td>
<td></td>
</tr>
</tbody>
</table>
Internationalization of curriculum

- 2008
  - Skills-based curriculum
  - First ABET Accreditation

- 2011
  - Second ABET Accreditation

- 2013
  - Flexible Interdisciplinary Curriculum

- 2015
  - Third ABET Accreditation
ABET Engineering Accreditaton Criteria

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Currículum
6. Faculty
7. Infrastructure
8. Apoyo Institutional
Technical skills

(a) an ability to **apply knowledge** of mathematics, science, and engineering

(b) an ability to **design and conduct experiments**, as well as to analyze and interpret data

(c) an ability to **design a system, component, or process** to meet desired needs within realistic constraints (…)

(e) an ability to identify, formulate, and solve engineering **problems**

(k) an ability to **use the techniques, skills, and modern engineering tools** necessary for engineering practice
Professional skills

(d) an ability to function on multidisciplinary teams
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in lifelong learning
(j) a knowledge of contemporary issues
Teaching staff engagement is critical for a continuous improvement culture

• Collect meaningful data to identify learning challenges
• Improve course methods based on curricular reflections
• Level knowledge and skills of students
• Align course methods with skills expected to be developed

Sources:
Teaching staff are facing barriers to engage with continuous improvement tasks

- Accreditation agencies
- Governmental agencies
- Employers
- Professional associations

External demands

- Administrative tasks
- Students
- Extended teaching periods
- Research requirements

Faculty workload

Sources:
Research Problem
Understand how to engage teaching staff with continuous curriculum improvement

Sources:
RESEARCH QUESTION AND OBJECTIVE
Research question and objective

RQ How does the teaching staff of a higher education institution engage and disengage with continuous curriculum improvement?

RO To illustrate mechanisms used to engage and disengage teaching staff of an engineering school during a continuous improvement process.
METHODS
Methods
Case study about a continuous improvement process implemented at PUC-Chile

• Convenient context to understand teaching staff engagement:
  • Continuous improvement is part of ABET accreditation criteria
  • Engineering teaching staff are familiar with quality assurance

Source:
Case Study Context

6-semester assessment plan to evaluate student attainment of ABET technical and professional skills at a course-level
Document Analysis

97 Assessment Plans
- High-level of detail
- Non-traditional assessment methods
- Multiple assessment methods
- Indirect assessment methods

27 Meeting Minutes
- Reflections on teaching
- Reflections on assessment
- Reflections on curriculum
Continuous Improvement Participants
64 Teaching staff affiliated to 5 programs out of 11 engineering degrees (35% of the undergraduate enrollment, 1,500 out of ~4,100 students)

<table>
<thead>
<tr>
<th></th>
<th>1st of semester 2015 (N)</th>
<th>2nd of semester 2015 (N)</th>
<th>1st of semester 2016 (N)</th>
<th>2nd of semester 2016 (N)</th>
<th>1st of semester 2017 (N)</th>
<th>2nd of semester 2017 (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Chairs (5 out of 11)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Teaching staff (57 out of ~300)</td>
<td>20</td>
<td>19</td>
<td>11</td>
<td>20</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Teaching assistants (63 out of ~600)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17</td>
<td>33</td>
<td>24</td>
</tr>
</tbody>
</table>
Semi-structured Interviews
Stratified Sample of teaching staff (11 out of 64 teaching staff)
Data triangulation

Findings on teaching staff engagement

Document Analysis Results

Interview Coding Results

RESULTS
Case study findings

Engagement mechanisms

- Count on evidence to improve teaching
- Rely on support for teaching practices

Disengagement mechanisms

- External demands for evidence
- Misaligned institutional policies related to teaching

Fuente:
Document analysis of assessment plans

High-level of detail
Nontraditional methods
Varied assessment methods
Direct and indirect methods

1st semester 2015 (N=24)
2nd semester 2015 (N=15)
1st semester 2016 (N=11)
2nd semester 2016 (N=12)
1st semester 2017 (N=14)
2nd semester 2017 (N=21)
It is essential that the teacher has clarity of (...) what the students must achieve at the end of the course, and what are the means that the teacher is going to give them (…)

The student has to do his or her part, that is irreplaceable, but it is also important that the teacher offers the tools, so the students-doing their part- can achieve those skills. In that sense ... (the continuous improvement process) helped me to be more aware of that.
Document analysis of meeting memos

- **1st semester 2015** (N=4)
- **2nd semester 2015** (N=5)
- **1st semester 2016** (N=6)
- **2nd semester 2016** (N=4)
- **1st semester 2017** (N=4)
- **2nd semester 2017** (N=5)

- Reflections about curriculum
- Reflections about assessment
- Reflections about teaching

<table>
<thead>
<tr>
<th>Period</th>
<th>N of reflections coded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st semester</strong></td>
<td></td>
</tr>
<tr>
<td>2015 (N=4)</td>
<td></td>
</tr>
<tr>
<td>2016 (N=6)</td>
<td></td>
</tr>
<tr>
<td><strong>2nd semester</strong></td>
<td></td>
</tr>
<tr>
<td>2015 (N=5)</td>
<td></td>
</tr>
<tr>
<td>2016 (N=4)</td>
<td></td>
</tr>
<tr>
<td>2017 (N=5)</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>57</td>
</tr>
</tbody>
</table>
The contribution of them (teaching assistants) it is fundamental because (...) they have another perspective on how to get to know the reality of the student and make it closer to the teacher, (...) they are the main grounding wire that we have, the permanent contact with the student.
Quote about collecting evidence for ABET
Interviewee 4 - Electrical Engineering Program

If they make me to follow-up two processes, three processes, (...) you start losing the thread and one day you ask yourself, ‘What are we monitoring? Are we monitoring ABET student outcomes? Or our curriculum?’ Then, we would expect a single process, where somehow everything is together, despite specific differences in the accreditations or other processes.
I think it would be ideal to have an autonomous mechanism, made in PUC; **our continuous improvement process, independent of ABET and the national accreditation.** That is, a macro system that (...) when we ask for a report for ABET, or for the national accreditation, it consists in just a query to a database, having only one system to assess student outcomes.
DISCUSSION AND IMPLICATIONS
Even motivated staff members resist continuous improvement tasks

Sources:
- Photo by Michał Parzuchowski on Unsplash.
Teaching staff could engage under proper conditions

Sources:
• Photos by UC-Engineering Communications.
Implications
For engaging teaching staff with continuous improvement

• Align policies to create an environment for continuous improvement
• Increase the opportunities to reflect about teaching practices
• Leverage existing instances to create a shared sense of purpose
CONSIDERATIONS AND RECOMMENDATIONS
Considerations
Implementing a continuous improvement process at your institutions

• Plan tasks throughout the academic period
• Document assessment tasks and curriculum discussions
• Obtain evidence for external agencies as a sub-product
**Recommendations**

Implementing a continuous improvement process at your institutions

- Recognize staff efforts to improve their courses
- Provide teaching staff support throughout the process
- Focus assessment tasks on providing students with quality feedback
Integrating a Curriculum Analytics Tool
To collect varied evidence and to visualize skills attainment

Selecciona una alternativa de solución a un problema no estructurado partiendo de una investigación o innovación tecnológica

![Bar chart showing skill attainment]

- Insatisfactorio
- En Desarrollo
- Satisfactorio
- Ejemplar

- 2016 – Segundo Semestre
- 2017 – Primer Semestre
Work towards a quality culture
Engaging teaching staff, managers and students
REFERENCES
References


References


Thank you! Questions? ihillige@ing.puc.cl