Undergraduate Writing Assignments in Mechanical Engineering: Targeting Attribute 7

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Agenda

- Quick Overview: The Context
- The Writing Assignment Project: Targeting Attribute 7
- The Faculty-Wide Initiative: Developing the Rubrics
- Some Conclusions & Connections
The 12 Attributes in Engineering

1. Knowledge base for engineering
2. Problem analysis
3. Investigation
4. Design
5. Use of engineering tools
6. Individual & team work
7. Communication skills
8. Professionalism
9. Impact of engineering on society/environment
10. Ethics & equity
11. Economics & project management
12. Lifelong learning
Accreditation process – must identify indicators for the 12 attributes & establish outcomes [i.e., what students know & can do] ([http://www.engineerscanada.ca/accreditation-resources](http://www.engineerscanada.ca/accreditation-resources))

Outcomes–based assessment – requires evaluation of student learning + encourages accountability, taking a step back & reflecting on such things as

- The “design readiness” of our graduates – their technical proficiency
- The communicative competence of our graduates – their proficiency in communicating the engineering work

Implicit in the list of 12 attributes – all are equally important to the Engineering program & the engineering professional [though the expected competency level can vary]
Attribute 7: Communication Skills

- Also called “professional skills” – i.e., they are integral to the profession
- We know the skills will include proficiency in writing & speaking
- But more difficult to define & measure than the traditional technical skills
This difficulty can lead to....

- “sterile notions of traditional grammar” – because grammar can be more quantifiable

- The engineering penchant for *templates* – reduces an engineering genre to a “static recipe” rather than an “adaptive response to rhetorical exigencies”

  [Broadhead, pp. 24-25]
Working definition – the ability to:

• communicate complex engineering concepts within the profession and with society at large;
  • includes reading, writing, speaking and listening;
  • also includes the ability to comprehend and write effective reports and design documentation;
  • also means the ability to give and effectively respond to clear instructions

• More than just remediation of writing deficiencies
Targeting Attribute 7 in a course

- Developing students’ communicative competence
- Developing their disciplinary knowledge, including knowledge of the discipline-specific genres
- Developing “layered literacies” that encompass all the ways that engineers can “use language in producing information & solving problems” [Cargile Cook, pp. 5-6]
“Reality Check” – in Engineering

- Communication – rarely mentioned as contributing to engineering success [Davis, 2010]

- The technical work – often viewed as the “real work” [Ford and Riley, 2003]
“Reality Check” - in Engineering programs:

- limited number of course options available for developing communication skills throughout a student’s program - but even were this not the case –

- “paucity of requirements for writing instruction” – few guidelines as to what communication skills require – mastery of the material or correct grammar?

[G. Broadhead, 1999]
At the University of Manitoba

- Received 6 years of accreditation in 2012

- Our dean initiated an ambitious project to:
  - Analyze & define what the proficiency levels of our graduates might be for all 12 attributes at the student, course & program levels
  - Evaluate & improve our performance –

- Overarching goal is the continual improvement of student learning

- For Attribute 7 – 2 initiatives may help us meet these objectives and fulfill the C.E.A.B.’s requirements
The Writing Assignment Project

Targeting Attribute 7 at the U of M
Objectives of the National Study

- Provide systematic research about the writing demands placed on students in a variety of disciplines

- Identify the goals of discipline-specific student writing

- Map these writing demands & create a “program profile”

- Ultimately, promote discussion at the department & the faculty level – curriculum, pedagogy, ……

- Findings can help to initiate the way writing is taught & supported within the departments/faculties
Variables studied include:

- “Nesting” or linking of assignments
- Audience
- Length of an assignment
- Time to complete the assignment
- Grading criteria & feedback provided
- Genre
- Frequency of assignments according to program year
Definition of “written assignment”

“course assignments where students were required to write extended prose in the documents that they handed in; a self-contained unit of discourse” [included writing reports in class time & reports that received a separate grade]
The Project at the U of M

- Collected course syllabi from all the departments [of Mechanical Engineering, Electrical and Computer Engineering, Biosystems Engineering, Civil Engineering and Design Engineering]

- Coded and reported on the data collected from 36 Mechanical Engineering course syllabi offering 102 written assignments [2013-2014] – focus today
Findings

Mechanical Engineering
Written Assignments in M.E.

- Analyzed course syllabi that cited 102 written assignments given in 36 courses

- Missing or incomplete information about:
  - the feedback provided [only lab reports did] or criteria used [1 course syllabus did]
  - the relative weightings of the written & technical elements
  - assignment length & the time given to complete the assignment
  - the genre
Genre (instructor’s term used)

<table>
<thead>
<tr>
<th>Term Used</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Assignment”</td>
<td>48</td>
</tr>
<tr>
<td>Research, project, progress or draft report</td>
<td>22</td>
</tr>
<tr>
<td>Lab assignment, report, laboratory</td>
<td>16</td>
</tr>
<tr>
<td>Design project, problem, work</td>
<td>11</td>
</tr>
<tr>
<td>Mini-project</td>
<td>3</td>
</tr>
<tr>
<td>Meeting minutes</td>
<td>1</td>
</tr>
<tr>
<td>Poster</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total # of Assignments</strong></td>
<td><strong>102</strong></td>
</tr>
</tbody>
</table>

Observations

- 29 course syllabi identified A7 [102 assignments]
- Most writing assignments identified A7
- “reports/projects” represent over ½ of all assignments [most common genre]
- Lab reports – most common genre in 2nd & 3rd years
Most writing assignments asked students to apply knowledge (combine separate elements into whole)

Determined by the instructors

Expected Competency Levels: A7

Number of Assignments

- 1 (knowledge)
- 2 (comprehension)
- 3 (application)
- 4 (analysis)
- 5 (synthesis)
- 6 (evaluation)

Expected Competency Level

A. Parker, Edmonton, April 2015
### Frequency of Written Assignments

<table>
<thead>
<tr>
<th></th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td># of courses in sample</td>
<td>4</td>
<td>10</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>Total # of written assignments</td>
<td>16</td>
<td>18</td>
<td>68</td>
<td>102</td>
</tr>
<tr>
<td>Average # of written assignments per course</td>
<td>4.0</td>
<td>1.8</td>
<td>3.1</td>
<td>2.8</td>
</tr>
</tbody>
</table>
Observations

- Amount & type of written work required – varies in each year of a student’s program – but significantly higher in 4th year

- On average - students write almost 3 assignments per course (2.8) throughout their undergraduate M.E. degree

- CEAB attributes & outcomes were clearly indicated on each syllabus, but assignment-specific detail was not
More observations

- Engineering – very adept at creating charts – of attributes, outcomes & competency levels

- Less adept – at such pedagogical “stuff” as clarifying assignment genres, evaluation protocols, intended audience or even the requirements of the assignment

- And what are the relative weightings given to the written & the technical components of an assignment? – is the “real work” the technical work after all? – hard to tell
The Faculty-wide Initiative

Developing the Rubrics
For Attribute 7 –

How do we include it in our engineering curriculum?

How do we show that the desired outcomes have been met?

Rubrics may help us do that........
Rubrics help us to

• outline the performance levels [including the expected competency level]

• develop a comprehensive assessment tool

[J. Seniuk Cicek, Nariman Sepehri & J.P.Burak]
Finally…….. Rubrics help us to

• Develop a common language [a foundation for developing a shared understanding & common goals between all the stakeholders]

• Prepare our students to be “academically qualified to begin the process to be licensed as professional engineers”

• (http://www.engineerrscanada.ca/accreditation-resources)
E.G., For “Communication Skills,” A7

- “Written Communication Skills” – one focus area for A7

- “genre & disciplinary conventions” – one “indicator” for the focus area [of written communication skills]

- performance levels – strong, competent [benchmark], developing or needing work
**“Genre” indicator: “competent” performance level**

| Competent | Demonstrates familiarity with, understanding of and use of the conventions inherent within the engineering genre and context/discipline |
Developing the Rubrics: Some Added Benefits

- Has created a “culture of engagement” in engineering education – includes the Faculty, the professors, our industry partners, our students [Seniuk Cicek, Sepehri & Burak]

- Has helped all of us consider what attributes & competencies an engineer must possess, including communicative competence
Some Conclusions & Connections

Connecting the Written Assignments Project & the Faculty Initiative
Communication & Engineering

- Communication skills within the engineering curriculum – should be integrated & iterative

- practice-based [not an “add-on”] – leads to a stronger performance

- acknowledged as “equally important to engineering practice” - recognition by the program & the students as integral to the job & employer expectations

[M. Davis, 2010]
Written Assignment Project & Rubrics

- Writing project illustrates the importance of time spent on
  - Clarifying our pedagogical goals
  - Defining our expectations, such as the length of the assignments, feedback provided & genre required

- Illustrates the need for thinking deeply about what we need to teach, how we teach it & how we assess it
What Engineering now needs to ask:

- What do we want students to learn when they do a written assignment?
  - Increase the student’s knowledge of the discipline?
  - Improve the student’s skill in communication – in particular, writing?
  - Both?
  - If so – HOW?
Written Assignment Project & Rubrics

- Writing project can help to inform the continued development of the rubrics – by highlighting what needs to be included & the language we use.

- Likewise – the rubrics can help us to tailor our course assignments and syllabi so that accreditation outcomes are met, & attributes, indicators & assessment are clearly targeted.
Thanks!
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- Ken Ferens, Industry Forums 1-6
References


