Writing in the Disciplines for Engineers: Implementation and Assessment of Student Learning

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Jordan Trachtenberg received her PhD in bioengineering from Rice University. She has been passionate about STEM education and outreach throughout her undergraduate and graduate studies. Her broad teaching interests include teaching K-12 outreach programs in 3D printing and computer-aided design, mentoring undergraduate laboratory and design teams, and organizing graduate professional development opportunities in science communication. She works on collaborative pedagogical research projects to understand student learning in engineering problem-solving and design.
ABSTRACT

Research Questions:
1) What does writing look like in engineering?
2) Which skills do engineering students develop when they write?
3) How can we assess the development of these skills?

Writing in the Disciplines is an integrated approach that ties writing assignments to the learning outcomes of a technical course and provides relevant opportunities for students to develop expertise in their field. In order to ameliorate the public's scientific literacy, we need scientists to communicate in a clear and concise manner. As we prepare students for science and engineering careers, it is crucial to help them improve their technical presentation and writing skills. It is important that students who engage in discipline-specific writing develop important professional and critical thinking skills. Specific engineering writing assignments that facilitate student learning in laboratory, design, or research-related courses. After implementing these scaffolded writing assignments in the engineering curriculum, it is possible to qualitatively assess student performance on learning, development of critical thinking skills, and alignment of our courses with accreditation standards. Improvement of writing feedback and assessment methods in the future will help students understand the effectiveness of their teaching, as well as provide measurable standards for students as they pursue professional careers.

SIGNIFICANCE

“Soft skills” necessary for the professional world
What are the most important skills that we should teach our engineering students? Writing like an engineer is a way to learn... (Winston 1989).

LEARNING FRAMEWORKS AND ASSESSMENT METHODS

1) Situated cognition: Writing in engineering as apprenticeship

Theory of situated cognition: A new comer (engineering undergraduate) learns how to integrate into a professional community by engaging in activities that simulate the various communication exercises that engineers practice in academia and industry.

1) Development of higher-order critical thinking skills
2) Self-identification as a professional

Written, oral, and visual communication exercises:
- Help to assess students’ critical thinking skills
- Can be flexibly implemented to fit the learning objectives for a course

2) Students develop critical thinking skills by writing

Scaffolding writing in a... Lab course (Design/research course)

LABORATORY REPORTS

Create: New ideas, developing new viewpoints, diverse perspectives, judge value of evidence

Evaluate: Research, evaluate materials, critical analysis, data organization, conceptual models

Analyze: Write, research, comprehend, critical analysis, concepts, vanishes evidence

Apply: Application, exercises, computational problems

Understand: Informational searches, research

Remember: Technical information and ideas

LABORATORY POSTERS

Create: New ideas, developing new viewpoints, diverse perspectives, judge value of evidence

Present: Research, evaluate materials, critical analysis, data organization, conceptual models

Analyze: Write, research, comprehend, critical analysis, concepts, vanishes evidence

Apply: Application, exercises, computational problems

Understand: Informational searches, research

Remember: Technical information and ideas

PROPOSED IMPROVEMENTS

Approach feedback effectively:
- Increase peer and instructor dialogue in feedback (Chong 2012)
- Focus on content and skills-based feedback (Troy 2014)

Assess critical thinking skills:
- Follow up with in-depth qualitative and quantitative assessment (DeTurris 2012, Etkina 2010)
- Develop assessment rubrics (Frank 2015) that directly relate to national and institutional standards
- Standardize assessments for specific courses (Barlow 2007)

CONCLUSIONS

- How we teach writing will depend on the level of the course and learning objectives
- Writing teaches different skills depending on student’s prior knowledge
- Assessment can be used as formative feedback to improve course design and understand student learning

REFERENCES


ACKNOWLEDGMENTS

I would like to thank Dr. Jennifer Wilson, Dr. Tracy Vo, Dr. Ann Satterbak, and Dr. Tiffany Vo for their insight on this research.