Faculty in a large, urban school of engineering designed a longitudinal study to assess the critical thinking skills of undergraduate students as they progressed through the engineering program. The Paul-Elder critical thinking framework was used to design course assignments and develop a holistic assessment rubric. The curriculum was re-designed to include deliberate teaching of critical thinking and assessment in at least one key course for every student each year of their undergraduate curriculum. The critical thinking scores for seniors using the holistic rubric were significantly higher than their baseline critical thinking scores as freshmen (p=.004). This case-study can serve as an exemplar for other units, departments, or programs to model or replicate.

ABSTRACT

The purpose of this study was to assess the development of critical thinking skills in undergraduate engineering students. The research question was, “How do the critical thinking skills of undergraduate engineering students change as they progress through the engineering program?”

Design:
The study was a descriptive, longitudinal study of three engineering student cohorts as they progressed through the four year undergraduate program. The study was approved by the university’s Institutional Review Board.

Sample:
Undergraduate engineering students at least 18 years of age as freshmen who would complete the undergraduate engineering program in four years and consented to participate in the study. Cohort 1 n=187, Cohort 2 n=240, Cohort 3=222.

Data Collection:
Freshman: “Introduction to Engineering” case-study that served as the baseline assessment. Sophomore: “Differential Equations” one-page assignment that required students to answer the question “If you had time to teach only one method to solve differential equations, which method would you pick and why?” Junior: Cooperative internship report summary which asked students to critically reflect on their primary responsibilities. Senior: Capstone design projects or other individual written assignments requiring critical analysis.

Conclusion:
Faculty involvement in the creation of critical thinking assignments across the curriculum and assessment of student responses to the critical thinking assignment can strengthen the students’ development of critical thinking abilities.

REFERENCES


CRITICAL THINKING RUBRIC

Consistently does all or most of the following:

1. Clearly identifies the purpose including all complexities of relevant questions. Accurate, complete information that is supported by evidence.
2. Completes, for presentation of all relevant assumptions and points of view. Articulates significant, logical implications and consequences based on relevant evidence.
3. Completes, for presentation of all relevant assumptions and points of view. Articulates some implications and consequences based on evidence.
4. Completes, for presentation of all relevant assumptions and points of view. Articulates all implications and consequences based on relevant evidence.

Unequivocally fails to recognize and/or generate valid implications and consequences based on relevant evidence.

UNIVERSITY OF LOUISVILLE

J.B. SPEED SCHOOL OF ENGINEERING

Holistic Critical Thinking Rubric