

Exam-less Engineering Education: A Provocative Thought Experiment on the Current State of Learning Assessment

“Assessment is the most powerful lever teachers have to influence the way students respond to courses and behave as learners.”

Graham Gibbs – Assessment Matters in Higher Education

Imagine a first-year engineering student entering their first fundamental engineering course (courses that teach students foundational technical engineering knowledge) in their engineering career this coming Fall. The student obtains a course syllabus stating that eighty percent of their course grade will depend on their performances on several exams, with the final exam representing a major portion of that grade. The student gets anxious days or weeks before the exams, regardless of whether it is a closed book or take-home exams. The anxiety stems from their past experiences in high school as they struggled with exams and had to confront various obstacles (supporting family and siblings, figuring out a way to get to college, high school lacking in resources to support them with the learning process, etc.). It does not help that the student has seen their peers doing extremely well with tests, especially those who have come from high schools with great resources and access in preparing students for various types of exam and the learning process. The student studies hard and constantly worries about not being able to answer the exam questions, which they would not know in advance of the day of the test. The student ends up not performing well on the test and obtains a barely passing grade on the course. They start questioning: “Is engineering right for me?”

Now, imagine a student with similar background walking into the course in the year of 2040. The course is part of the larger engineering curriculum structure that requires enrolled students to self-assess themselves through the use of electronic portfolios (e-portfolio). The student has gotten information about their graduation requirement, which is to create and sustain their individual e-portfolio throughout their four-year academic career that demonstrates the program learning outcomes by the end of their last semester. The student is excited because they are empowered to choose and reflect upon the types of projects and other forms of assessments, such as concept inventories and concept maps, they can work on to demonstrate learning outcomes. Instructors of the courses provide scaffolding, guidance, and advice on how to apply knowledge learned to work on the projects and structure and create a portfolio. The student is also happy that they get to work with their peers in the class who they think can help the student themselves learn. The student will meet with their academic advisor monthly to discuss their strengths and weaknesses of their academic progress based on the portfolio, and chart next steps to address those. Overall, the student takes control of their own learning and charts their own path toward an engineering degree, with decisions informed by their own personal contexts, backgrounds, and cultures.

The first scenario paints the current picture of how many engineering students experience their undergraduate careers, while the second describes a vision of future learning that is facilitated by effective use of non-test or exam assessments. Both of these ultimately point to the importance of learner-centered environment for learning. It has been two decades since the National Research Council published the seminal book “How People Learn”, bringing the inherent message that education settings should emphasize the learners’ backgrounds, contexts, and cultures while designing accommodating and inclusive learning environments. In engineering education, some instructors have embraced this mentality of a learner-centered approach in the teaching and learning process. It is yet to be mainstream, however, as many

instructors in engineering disciplines are still holding on to outmoded perspectives on teaching. By 2040, engineering education should become learner-centered, and assessments must play a part in achieving said goal. Exams as learning assessment, thus, become an important topic to address for efforts to improve engineering education by 2040.

Within the first vignette, the student has been disadvantaged by the use of exams. Exams can disadvantage certain groups of engineering students, going against the learner-centered philosophy. Because they are designed with specific standards and norms in mind, exams do not value students' knowledge equally. This means that students who bring different contexts and backgrounds in thinking about engineering knowledge may not perform well in exams designed to test students with specific standards in mind, even if the students have funds of knowledge that, though may not fit into the mold of a rigid engineering culture, will contribute substantially to the engineering fields. In addition, some students do not have access to certain college preparatory courses due to the lack of resources of high schools, creating an unequal playing field from the beginning when all students congregate in an engineering course. Many of these students form substantial parts of historically underrepresented groups in engineering. Exams, thus, can perpetuate further the disparity brought upon from students' high school experiences and the constant underrepresentation of minoritized groups in engineering.

At a higher level, engineering education strives to produce engineers who can practice and address societal problems the world is currently facing. Research has repeatedly shown that exams do not encourage deep learning, especially toward conceptual understanding of engineering materials. Encouraging conceptual understanding of engineering knowledge among students is vital toward building expertise and mastery among future engineers. Although exams are helpful for long-term knowledge retention and practicing procedural knowledge, other forms of assessments, such as concept inventories and concept maps, have proven to better assess student conceptual understanding.

Both of these reasons contribute to the idea of phasing out exams by 2040 in engineering education. Imagine having students complete short quizzes weekly that constitute about twenty percent of their final grade (low-stake instead of high-stake) and are based on existing concept inventory instead of a closed-book, two-hour exam. Both of these assessments can encourage conceptual understanding learning without putting students in unlevel playing fields and a constant state of anxiety. Thus, exam-less education should be part of 2040 engineering education.