

PURDUE UNIVERSITY · ENGINEERING EDUCATION

Graduate Competencies

Engineering Education Graduate Competencies

The aim of the listed graduate competencies is to help each student develop the ability to create and synthesize knowledge; think critically and reflectively; master written and oral communication skills; demonstrate engineering skills, engage in professional development; participate actively in professional field or engineering education; teach engineering, and apply their knowledge of instruction, curriculum design, and assessment of engineering science, problem-solving, and design appropriately. These competencies are simultaneously complemented by, and support achievement of, an overarching principle promoting student engagement in the advancement of justice, equity, diversity, and inclusion (JEDI) in engineering education. That is, the overarching principle impacts how students ought to conduct the activities listed under the other ten competencies. Activities which can be used to demonstrate that a student has achieved an acceptable level of competence are listed under each competency. Opportunities for developing materials to demonstrate competencies will occur in coursework and other settings. Competencies gained through prior education and/or experience can also be applied to the requirements, with appropriate documentation in the portfolio.

Overarching Principle

Engage With and Act Upon Advancement of Justice, Equity, Diversity, and Inclusion (JEDI) The graduate will consistently engage with JEDI considerations as a central, unavoidable, and necessary component of their professional work, and will seek out opportunities to advance social justice in their field(s) of activity through action towards JEDI-related initiatives and in counteraction to JEDI-related inequities. Students will demonstrate achievement of one or more of the following to satisfy this competency:

- Develop and implement strategies for teaching, research, and service that purposefully engage self and others in critical conversations pertaining to JEDI that include diverse perspectives
- Demonstrate in writing an understanding of JEDI concepts, issues, terminology, and theories (e.g., in dissertation, articles, blogs, and/or other written forums)
- Demonstrate self-reflection resulting in personal growth to improve understanding of self and others
- Serve on school, college, or university committees focused on JEDI or related initiatives, or actively participate in similarly focused initiatives of local, state, regional, or national organizations
- Identify and counteract JEDI-related injustices with appropriate evidence

Ten Engineering Education Graduate Competencies

1. **Synthesize Knowledge** The graduate will read and synthesize educational literature, describe fundamental theories of human learning, and apply knowledge of human learning, JEDI, and effective pedagogy to the solution of practical problems in their field(s). Students will demonstrate achievement of one or more of the following to satisfy this competency.
 - Write a critical literature review
 - Write a conference paper based on the standards of either a state, regional or national conference
 - Write a grant proposal based on published grant guidelines
 - Write a journal article based on the publication guidelines for a national or comparable journal
 - Write a project report based on a research project
 - Design and implement an instructional development project
 - Actively participate in the design and implementation of a course or a workshop and write a critical report
2. **Create Knowledge** The graduate will describe common research methods in their field(s), read and evaluate educational research, and apply research findings to the solution of practical problems in their field(s), with particular consideration of the impacts of those solutions on a diverse population. Students will demonstrate achievement of one or more of the following to satisfy this competency.
 - Conduct a mini-research project individually or collaboratively with peers or faculty
 - Conduct engineering education research
 - Develop instructional materials based on research findings and/or theory
3. **Communicate Knowledge** The graduate will communicate effectively in both oral and written formats, including the ability to communicate content from their field(s) through the design and delivery of effective teaching/learning activities that integrate content and pedagogy, adapt instruction and support services to the needs of diverse learners, and

appropriately assess learning outcomes. All of this is to be demonstrated using inclusive and non-biased language in both written and oral communication. The graduate should also be explicit about how various knowledge claims may or may not apply to different groups. Students will demonstrate achievement in an appropriate combination of activities from the following list to satisfy this competency.

- Present at one university, state, regional, or national meeting, class or colloquium
 - Present the results of an independent study project at the Seminar in Engineering Education
 - Submit an article to an appropriate journal
 - Explain problem solutions (i.e. serve as a TA for an engineering course)
 - Develop instructional materials that communicate information to diverse end users
4. **Think Critically and Reflectively** The graduate will develop a personal vision of inclusive educational practice, identify the relationship of their field(s) to the broader field of education, and critically evaluate theory and practice. Students will demonstrate achievement of one or more of the following to satisfy this competency.
- Prepare a critical and reflective paper on scholarly topics in engineering education
 - Prepare a constructive critique of a research design
 - Prepare a constructive critique of a current research theory in engineering education
 - Prepare a journal or reflective piece on one's growth in understanding of what it means to be a teacher (i.e. for an engineering or engineering education course)
 - Prepare a constructive critique on how to address equity and diversity issues in engineering education
 - Critique research design in engineering education
5. **Apply Engineering Education Principles to the Solution of Instructional or Curricular Problems** The graduate will analyze engineering education problems and, when appropriate, design, develop, implement, and evaluate appropriate solutions to those problems with particular consideration of the impacts of those solutions on diverse populations. Students will demonstrate achievement of one or more of the following to satisfy this competency.
- Identify and analyze learning and performance problems in engineering
 - Design and conduct an analysis of needs, learners, and context with attention to systemic injustices
 - Design plans and develop instructional interventions using appropriate strategies and techniques
 - Based on appropriate analyses, plan and create a unit of engineering science, problem-solving, or design instruction that specifically addresses JEDI concerns
 - Implement and evaluate an instructional intervention that is deliberately inclusive, equitable, and just
 - Conduct a formative evaluation of existing instruction
 - Design and implement assessments of human learning
 - Develop an evaluation plan for a project based on stated goals and recognized standards
6. **Demonstrate Engineering Skills** The graduate will have the capacity to function as an engineer in a traditional, non-education area. This should include, to the extent possible, the knowledge and use of technology and tools for engineering practice and engineering education, and identifying and addressing JEDI concerns when formulating and addressing engineering problems. Students will demonstrate achievement of one or more of the following to satisfy this competency.
- Pass a qualifying examination in a traditional engineering discipline
 - Pass the Fundamentals of Engineering Examination
 - Successfully complete appropriate courses in engineering fundamentals and advanced engineering topics or focused on engineering problem-solving and design
7. **Engage in Professional Development** The graduate will demonstrate the disposition for life-long learning and continuous professional development. Students will demonstrate achievement of one or more of the following to satisfy this competency.
- Participate in workshops and other professional development opportunities related to engineering education, including Safe Zone workshops, critical conversation training, and other similar offerings
 - Attend professional conferences related to engineering education
 - Take part in K-12 or higher education workshops
8. **Participate Actively in Professional Community** The graduate will identify communities of practice within their field(s) and participate within these communities. Participation in such communities should include awareness of the moral and ethical importance of JEDI considerations, actions toward JEDI, and/or encouraging others to take such actions. Students will demonstrate achievement of one or more of the following to satisfy this competency.
- Demonstrate in writing an understanding of and adherence to the discipline's professional code of ethics (e.g., cite sources, obey copyright law, follow human subject research protocols, not engage in discrimination)
 - Participate actively in state, regional and national professional organizations
 - Provide engineering related volunteer service to community
 - Conduct professional development workshops in engineering education
 - Conduct K-12 or higher education workshops
 - Publish a manuscript in a related journal
 - Participate actively in engineering outreach events

- Leadership service to professional organizations that promote social justice (e.g., SWE, NAMEPA, ASEE Diversity Committee)
9. **Explain and Critique Education Policy** The graduate will demonstrate knowledge of educational policy issues including as related to JEDI. Students will demonstrate achievement of one or more of the following to satisfy this competency.
- Serve on a department/school, college, or university committee
 - Attend local, regional, or national professional society meetings focused on education policy issues
 - Write a reflective critique on one or more education policy issues.
10. **Teach Engineering** The graduate will participate in a mentored teaching experience at the K-12 or higher level. The experience must be of significant duration and involve actual teaching of students. Students must be able to evaluate how curriculum, assessment, and pedagogy address the specific needs of a diverse body of learners. The experience must also include formative and summative feedback (e.g. by peers, students, and faculty) and self-reflection. In addition, students enrolled in the Ph.D. program will be expected to develop and implement curricular materials as part of this experience. Examples of such activity, that include student evaluation and observation by a faculty member, are:
- Teaching in a K-12 or higher education setting for a semester. Ph.D. students would develop and implement materials for this experience.
 - Teaching in a K-12 or higher education setting that involves multiple days in the classroom. Ph.D. students would develop and implement materials for this experience.
 - Develop and implement a workshop or short course.
 - Develop and implement a distance learning module or course.
 - Develop and implement an outreach activity based on engineering.