2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
Paper ID #39735

Using a Framework to Define Ways of Integrating Ethics across the Curriculum in Engineering

Dr. Laura Bottomley, North Carolina State University at Raleigh
Cynthia Bauerle
Lisette Esmeralda Torres-Gerald
Carrie Hall

Using a Framework to Define Ways of Integrating Ethics across the Curriculum in Engineering

Ethics are an important part of engineering and computer science education for many reasons, ABET accreditation being only one. Historically, engineering ethics have been taught as a part of a specific class, often outside of the engineering and computer science disciplines. Additionally, ethics is an important part of education in other disciplines, including medicine and law. Movements for teaching ethics across the curriculum emerged in these fields before comparable movements in engineering that became more common in the early 2000's.

Integration of ethics across the engineering and computer science disciplines remains isolated, with examples most common in biological and biomedical engineering. It is possible that, despite the availability of ethics workshops and other resources, many teachers of engineering and computer science are limited in their ability to fit ethics into their classes. After all, engineering statics or circuits do not immediately present themselves as easy courses to insert ethical case studies. Because of this, ethics remains, in many cases, confined to external courses or to senior design.

What constitutes an ethical issue in engineering is typically defined loosely, by looking at professional codes of ethics and concomitant case studies. This paper presents an alternative approach based on an ethical framework developed at James Madison University as a part of an ethics across the curriculum effort. The framework was used as a basis for work at an NSF-sponsored workshop on the future of STEM education by a small group of researchers. During the workshop, the group focused on application of the framework to biology. After the workshop, they re-visioned the outcome to apply to engineering and computer science. The framework is presented together with a tool developed to guide any instructor at the college level to select ways to insert ethical considerations into their class. These insertions could come from case studies, every day examples, or even instructional approaches.

Introduction

This paper begins with a discussion of one of the outcomes of an NSF-sponsored project around the future of STEM education at the university level. After this introduction, we present an example of how to implement the Ethical Reasoning Instrument™ (ERI™) in a first-year introductory engineering class. We hope that this example might inspire others to use the instrument to embed ethics in disciplinary engineering courses.

The Future Substance of STEM Education project (https://serc.carleton.edu/stemfutures/index.html) brought together educators from a variety of universities to develop framework-guided curricula that align with the dimensions of 21st century learning by Kereliuk et. al [1]. The framework, found in figure 1, illustrates how three types of knowledge, foundational (to know), meta (to act), and humanistic (to value), relate to learning in STEM subjects. The framework is designed to "account not only for what ought to be known, but also for the unique contexts, cultures, and challenges that would-be innovators need to include in their approach to improving the world." [1].

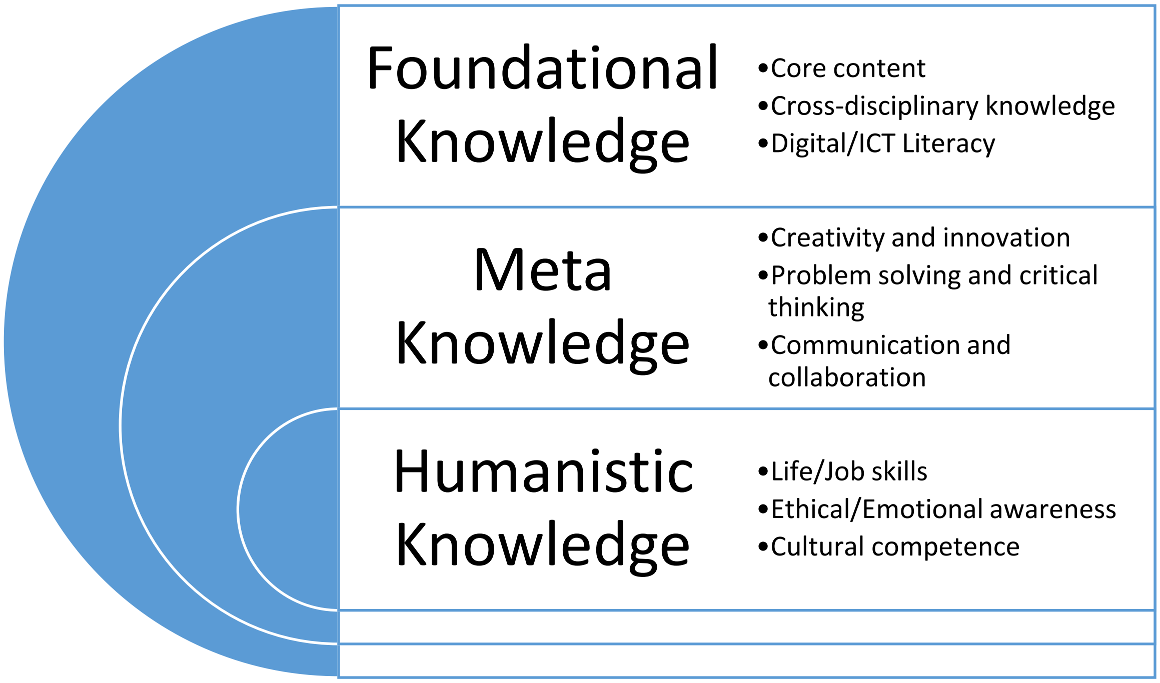

Figure 1: Depiction of the three types of 21st Century knowledge as conceived by Kereluik, et al [1]

The Ethical Reasoning Instrument (ERI™) was developed by a team of researchers for use in the integration of values context, ethical context, epistemology/positionality and pedagogy in the development of STEM courses, specifically biological science courses. After the conference, the team adapted the instrument to engineering courses as well. The ERI™ supports the integration of foundational, meta, and humanistic knowledge by utilizing the Eight Key Questions ethical reasoning framework first developed at James Madison University to inform three instructional dimensions: student learning activities, learning outcomes assessment, and pedagogy [2]. The ERI™ provides a way to approach formal course design through intentional mapping of these ethical dimensions during the course design process.

The ERI™ addresses both meta knowledge and humanistic knowledge in the context of ethics. Meta knowledge and skills considered include collaboration, communication and reflection about ethical decision-making, problem solving, and how to understand the potential consequences of decisions. Humanistic components include consideration of various epistemologies contextualized by different backgrounds and social identities, which includes relationship building, teamwork, and intentionality. Two of the most important considerations are the understanding that science and engineering are not value-neutral and that knowledge does not reside in a fixed coordinate system, but changes over time and may mean different things for different people.

The ERI^{TM} guides a course designer or instructor through consideration of eight ethical dimensions in order to incorporate both personal and disciplinary values frameworks alongside the core content of a course. It is chiefly designed for the incorporation of ethical considerations across the curriculum rather than a single course on ethics. Such courses have their place, but literature [3, for example] supports the idea that "what constitutes effective professional learning…is intensive, ongoing, and connected to practice." The focus on adult learning that is ongoing and connected to practice argues that inculcating ethics in actual disciplinary engineering classes might result in students' learning ethics as a practice more effectively.

Many teachers of engineering and computer science are limited in their ability to fit ethics into their classes, perhaps because the connection between ethics and the engineering science is not direct, except in bio-related engineering, like biomedical and biological [4]. Teaching about Kirchoff's Laws in an engineering circuits class seems remote from ethics, until one considers how those Laws are applied in electrical safety applications. Historically, ethics remains, in many cases, confined to external courses or to senior design, despite engineering education theory that shows advantages of using real applications to illustrate theory.

Ethics integrated across the engineering curriculum is not a new idea [5 and 6, for example]. Case studies used in classes are a relatively common occurrence. But the inclusion of ethics in a variety of classes has not been implemented widely, perhaps due to a number of issues. The idea that the science and mathematics of engineering, as found in an engineering statics class, for example, are completely neutral seems reasonable. After all, torque doesn't appear to have an ethical dimension. However, effective teaching of engineering should encourage that the concept of torque be taught in the context of a real world example. For example, torque is often associated with the collapse of cantilever bridges like the collapse of the Quebec bridge in 1907 that resulted in the death of 75 people [7] and [8].

An additional impediment is the amorphous definition of ethics itself. Engineers and computer scientists are usually familiar with codes of ethics in their various disciplines. These codes of ethics are further elucidated by specific ethics board rulings and case studies. The job of finding examples and contexts to use in a variety of classes remains difficult except for very specific disciplinary classes and senior design.

The ERI^{TM} instrument was designed to be used in virtually any engineering or computer science class to guide the instructor to find ways to incorporate ethics into course activities, assessments, and pedagogy. By making use of the eight key questions [2], the instrument also offers a more defined definition of ethics in the engineering domains.

The Instrument

The ERI^{TM} is formatted as a wizard with a series of questions. Under each outcome are questions to be answered within the context of the course being designed or revised. The question format was chosen to make it easy to use. The entire instrument is designed to be completed by responding to each question, with the understanding that some questions may be more or less relevant to particular circumstances given the subject, level, and curricular context for the course.

Because doing course revision can seem intimidating, we emphasize that all eight dimensions are not required for each course. Setting a goal of implementing two or three as a first effort may be appropriate, followed by more iterations in the future. The goal is to encourage course designers to engage with the topic of ethics in disciplinary engineering courses to the degree with which they are able, and then improve as they become more comfortable. If the response is *'No'* to all of the questions in an Outcome section, the course designer may want to think about ways to infuse that element into the course.

The eight dimensions of the instrument are outlined below. The full tool is in the appendix. Each of the dimensions is divided into the three areas of learning activities, learning assessments, and pedagogy that exemplify that dimension in the classroom.

1- Fairness
2- Outcomes
3- Responsibilities
4- Character
5- Liberty
6- Empathy
7- Authority
8- Rights

The tool is designed to provide examples and suggestions that can be used by instructors to add each of the three pieces of each dimension to their classroom practice. Translating the ethical dimensions to questions allows instructors to more easily think through the tool, since the time involved in course planning is often a limiting factor to whether an instructor successfully integrates new ideas into their classroom practice.

Using the tool

In the course of either creating or revising a course, an instructor can work through the eight dimensions, considering the questions and the examples provided to find ideas for their own courses. Not every course will incorporate all eight dimensions. An initial goal of one or two changes is a reasonable approach. The questions included in the tool are not intended to be a complete set, but they will, hopefully, engender thinking that will allow the course designer to find examples and ideas relevant to their own discipline and topic.

To further illustrate the use of the tool, a case is described in which a course designer applied the tool in the context of the first-year engineering course at NC State University. The course is taught to 1800 students at a time, in some 20 sections. The College had a problem with ensuring that the material taught across all of the sections was uniform, so a textbook was created for required use in every section [9]. It was during the course of the writing of this textbook that the tool was used to develop ideas and examples that included engineering ethics throughout the course, rather than during the delivery of a single class session, as had been done historically.

The eight dimensions were written into the textbook for first year engineering, together with examples appropriate to the educational level of the students [9]. Some of the examples used in the book are outlined in the list below. Because the topic is first year engineering, the examples span the various disciplines, so they also serve to give ideas for other courses in different engineering curricula.

1-Fairness: An extended example involving fairness is the use of conflict minerals in the design of components for cell phones. Conflict minerals are defined according to the original Congressional legislation [10]. A world map showing where the minerals are available precedes a discussion of political and sociological implications of the use of those minerals. Students are asked to balance the world demand for cell phone technology and the impact on the local communities of these mines.

2-Outcomes: The example used to illustrate outcomes is the use of lithium for batteries to support the electric car industry. A brief by Volkswagen on the uses of lithium for electric car batteries allows students to assess the issues and look for bias in a source [11]. The history of lithium mining has traditionally involved mining that destroys surface resources, but a recent discovery found that some hot springs have large amounts of dissolved lithium in the water. The water can be pumped to the surface and allowed to evaporate away, leaving lithium salts. Some claim that this allows lithium to be harvested with significantly less environmental impact. Additionally, some of the sources of this sustainable lithium are located in places where the economic benefits to the area are greatly needed.

3-Recognition of personal responsibility: Engineers are involved in the creation, maintenance and improvement of many products and processes. Because these products and processes are important to society, their failure can affect many. The supply chain around toilet paper during the Covid 19 pandemic is an example, as well as initial vaccine designs that required extreme cold for storage. Each of these examples has a different impact on various communities, and the engineer has responsibility for designs that keep people safe. Another example is around issues of product testing using crash test dummies that accurately represent different heights and weights of humans to produce results that work across the population, instead of using a scaled down male dummy to represent a female.

4-Develop empathy: Understanding the perspective of others is an important part of the development of engineering solutions. Doctors were reluctant to use computer displays to examine test results, like X-rays, when applications first became available, because their professional practice was to hold the films in their hands and inspect them. Even though the computer-based applications had higher resolution, doctors did not trust the new images. The engineers who developed the solution did not seek first to understand or empathize with the potential users, which delayed the use of the new technology.

5-Consider the rights of others: What is considered to be a “right” may vary according to societal context, ethnic context, country, common practice, and so on. In addition, what is legal may not be ethical. The case of cancer cells removed from Henrietta Lacks without her knowledge or permission is a famous ethical case study. The use of HeLa cells to test cancer treatments, to study the human genome, and to develop the Polio vaccine has saved millions of lives. Mrs. Lacks, a poor Black woman, and her family, were never informed that her cells were being duplicated and distributed widely in the research community, and they never received compensation from the companies that used the cells to make a profit. What took place was legal, but was perhaps not ethical.

6-Recognize the dictates/opinions/policies of relevant authority: Engineers have many regulations set by agencies like the EPA, the SEC, and others, as well as building codes, electrical codes, manufacturing codes, etc. Engineers must know about and abide by these, as well as being familiar with the progress of knowledge as published by experts. Situations where regulations seem to be overly onerous make good examples of authority. An example is FDA regulation on vaping materials. Another example would be building codes in coastal regions.

7-Develop and display character: Character involves honest reporting of test results, with the Volkswagen scandal of 2015 as an example. Some Volkswagen cars were able to detect when they were being tested for emissions and alter their performance to give readings that were more favorable. Another example is whistle-blower cases like that of Roger Boisjoly and the space shuttle Challenger.

8-Recognize the implications of liberty: Personal freedoms and autonomy vary across countries and cultures. During the year 2020, the reaction to the Covid19 pandemic in the US versus that in China illustrate the implications of liberty. In the United States, people disagreed over what responsibilities individuals have to protect the population as a whole during a pandemic. Industrial engineers worked with others to design protocols for stopping the spread of disease, but the population was resistant to masking, staying at home, or being vaccinated. In China, where personal liberties were considered subservient to society as a whole, people complied with such orders much more readily.

The course for which these examples was developed is for students from all disciplines of engineering, which explains the range of examples. Examples 1 and 2 would also be appropriate for a materials science class. Examples 3 and 8 would be fit a variety of industrial engineering classes. Four and five would apply in biomedical engineering, or perhaps chemical engineering. Example 7 could be computer science and aerospace engineering, and example 6 could fit any discipline.

Even applying the ERI tool to a first-year engineering course may seem like an easier task than using ethics examples in a disciplinary course in the sophomore or junior year. Engineering program accreditation by ABET requires that student outcome number 4, “an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts” be met. A program that only includes ethics in its first and last year or in a single course is at a disadvantage with regards to showing evidence of this outcome. The ERI tool can help discover additional ways to help students recognize ethical situations and make informed judgements.

The instrument also allows other ABET criteria to be illuminated as well, in particular criteria 2, “an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors," and criteria 5, "an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives."

These ABET criteria are often met using ethics case studies. Most disciplinary faculty are aware of case studies in their discipline, but not every course is suitable for the use of case studies. A little creativity can find the engineering applications for specific classes in the case studies. For example, engineering statics may not be a class where ethics is integrated commonly. Consider the example of the walkway collapse of the Hyatt Regency in 1981 [12]. Two relatively straightforward statics problems can be developed from the design as originally specified and as implemented. Students can draw the free body diagrams and do calculations, which will then make the engineering ethics discussion very engaging.

Conclusions

Ethics is an incredibly important part of engineering practice, and therefore an important part of engineering education. The ERI™ instrument described in this paper is one way to make it easier for course designers to devise ways to incorporate ethics across the engineering curriculum, rather than relegating it to a single course, however engaging that one course may be. As an example, the use of the ethical dimensions in the first year engineering course at North Carolina State University has led to a more consistent, deeper, and more engaging treatment of engineering ethics.

Not only does the ERI™ aid the integration of engineering ethics across a broader range of courses, it also supports the demonstration of how a program is meeting ABET criteria. The combination can result in an engineering program that meets the need for a broad and deep engineering education that will prepare our students for the Grand Challenges of the future.

References

[1] Kereluik, Kristen, et al. "What knowledge is of most worth: Teacher knowledge for 21st century learning." *Journal of digital learning in teacher education* 29.4 (2013): 127-140.

[2] Linder, G. Fletcher, et al. "Teaching Ethical Reasoning: Program Design and Initial Outcomes of Ethical Reasoning in Action, a University-wide Ethical Reasoning Program." *Teaching Ethics* (2020).

[3] Loucks-Horsley, Susan, et al. *Designing professional development for teachers of science and mathematics*. Corwin press, 2009.

[4] Tang, Xiaofeng; Catchmark, Jeffrey M.; Mendieta, Eduardo; Litzinger, Thomas A., *Infusing Ethics across the Curriculum in Biological Engineering: Background, Process, and Initial Results,* Advances in Engineering Education, Sum 2020.

[5] Cruz, J. A., & Frey, W. J. (2003). An effective strategy for integrating ethics across the curriculum in engineering: An ABET 2000 challenge. *Science and Engineering Ethics*, *9*(4), 543-68. doi: https://doi.org/10.1007/s11948-003-0049-2

[6] Mitcham, C., Englehardt, E.E. Ethics Across the Curriculum: Prospects for Broader (and Deeper) Teaching and Learning in Research and Engineering Ethics. *Sci Eng Ethics* **25**, 1735–1762 (2019). https://doi-org.prox.lib.ncsu.edu/10.1007/s11948-016-9797-7

[7]Hartsfield, Tom, *I-5 and the Physics of Bridge Collapses, May 28, 2013,* https://www.realclearscience.com/articles/2013/05/29/i-5_and_the_physics_of_bridge_collapses_106544.html, accessed February 2023.

[8] Pearson, Cynthia, and Norbert Delatte. "Collapse of the Quebec bridge, 1907." *Journal of performance of constructed facilities* 20.1 (2006): 84-91.

[9] Bottomley, Laura, Creating a Better World: Innovation, Ingenuity, and Engineering, Great River Press, 2021

[10] SECURITIES AND EXCHANGE COMMISSION, "CONFLICT MINERALS," 17 CFR PARTS 240 and 249b, [Release No. 34-67716; File No. S7-40-10], RIN 3235-AK84, https://www.sec.gov/rules/final/2012/34-67716.pdf, accessed February 28, 2023.

[11] Volkswagen, Lithium Production, https://www.volkswagenag.com/en/news/stories/2020/03/lithium-mining-what-you-should-know-about-the-contentious-issue.html#, Volkswagen AG 2023, accessed February 28, 2023.

[12] McFadden, Christopher, "Understanding the Tragic Hyatt Regency Walkway Collapse," Interesting Engineering, July 3, 2021, https://interestingengineering.com/culture/understanding-hyatt-regency-walkway-collapse.

Appendix

ERI Tool Interpreted for Engineering

Dimension Outcome 1 - Fairness

1a: Learning Activities

YES or NO Does the course include opportunities for students to practice just and equitable practice of engineering by considering how engineering design solutions are impacted by the culture, ethnicity and gender of the engineers who create them?

Ex. Consider original airbag designs

YES or NO Does the course include examination of how selected designs and/or implementations may affect Indigenous populations and other marginalized peoples?

Ex. Consider levee failures in the New Orleans area during Hurricane Katrina juxtaposed with historical maps of red-lining in the area

YES or NO Does the course provide opportunities for students to learn about the effects of inequities in engineering design (e.g., cost, accessibility, not testing on diverse populations) and the consequences of ignoring inequities in the course of engineering practice?

Ex. Consider bias in artificial intelligence, design of life saving medical devices, or design of automatic soap dispensers and their reaction to skin color

1b: Learning assessments

YES or NO Does the course include assessments that allow students to demonstrate their knowledge of and address inequity in the practice of engineering?

Ex. In the identification of design constraints for a bilirubin incubator, students are expected to identify the issue of whether different skin colors absorb blue light at different rates.

YES or NO Are learning assessments constructed in a way to ensure equity and fairness for all learners?

Ex. Consider the effects of timed tests on students with learning disabilities or the use of alternative assessment measures

1c: Pedagogy

YES or NO Does the course include opportunities for the instructor to model just and equitable engineering practice?

Ex. Consider use of case studies, personal narrative, or modeling the instructor's thinking processes

YES or NO Does the course include attention to principles of universal design of learning, including access and accommodation?

Ex. Consider use of visuals designed to include colorblind students or laboratories that accommodate students with visual or physical impairments

YES or NO Does the course include attention to highlighting the contributions of diverse exemplars of engineers?

Ex. Tell the full story of the origins of engineered designs, like including the role of Lewis Latimer in the development of the light bulb

Wizard Outcome 4 - Character

4a: Learning activities:

YES or NO Does the course include opportunities for students to reflect on how personal attributes and values factor into engineering practice?

Ex. Have students honestly reflect on their own contributions to a team project

YES or NO Do students have opportunities to practice applying their values and experiences in evaluating the impact of engineering in society?

Ex. Use authentic design problems that are place-based and require students to make decisions based on situational impact on environments or populations, like considering how spillage of hazardous chemicals from a rail system that passes through particular neighborhoods disproportionately impact certain populations

YES or NO Does the course provide opportunities for students to engage in teamwork and then reflect on their own behavior?

Ex. Assign teams for classwork exercises and have students each document their and others' contributions to problem solutions

YES or NO Does the course provide opportunities for students to acknowledge and respect values and identities different from their own?

Ex. Use first person narratives of engineering case studies from differing perspectives, like the competing priorities of an engineer that owes allegiance to a company versus revealing an unethical situation to the media

YES or NO Does the course provide opportunities for students to weigh decisions that challenge their value systems?

Ex. Use case studies in class that require the balance of competing benefits, like those involved in the design of Yucca Mountain

4b: Learning assessments

YES or NO Does the course include assessments that allow students to demonstrate their ability to act productively on teams?

Ex. Every team activity includes teammate evaluations, perhaps more than once for longer projects and project grades reflect individual contributions as well as team results.

YES or NO Are there opportunities for students to demonstrate how they contribute personal values and attributes to their engineering identities and as they participate in the local learning community of the course?

Ex. Engage students with personal knowledge that can enhance class activities like students from various origins or countries who can discuss how climate change is affecting their homes

YES or NO Are students required to demonstrate self-reflective processes in evaluating engineering in society?

Ex. Require students to express and defend opinions on engineering issues in the news on a regular basis, like the effects of ChatGPT on education

YES or NO Are there opportunities for students to demonstrate their ability to integrate multiple values into evaluation and decision making in an engineering context?

Ex. Ensure that projects are sufficiently open-ended and require students to document the justification for each design decision

YES or NO Are students provided the opportunity and guidance to assess their teammates on dimensions of teamwork?

Ex. Instead of simply asking students to rate each other's performance on a team, engage students in discussion about the design of the assessment for fairness

4c: Pedagogy

YES or NO Does the course include demonstration of character development for the instructor, perhaps through adoption of some pedagogical best practice?

Ex. As the instructor, spend time explaining pedagogical techniques and the justification for their choice. The instructor provides justified rubrics for all activities.

YES or NO Does the instructor demonstrate by example how to ground engineering analysis and decision making in the context of ethical values?

Ex. The instructor models solving an authentic engineering problem and discusses the justification for making different decisions

YES or NO Does the instructor actively model awareness and care in acknowledging the multiplicity and intersectionality of values, identities, and backgrounds represented in the class?

Ex. Use an example of evolution of communication systems in various countries that had their first broad penetration with the advent of cell phones and why they skipped the installation of land lines

YES or NO Does the instructor expand opportunities for individual learners to express their values, attributes, and identities?

Ex. Projects require that solutions are situated in a community that the student chooses. Additionally, if students may not choose a project designed to serve others of different identities without first person input from representatives of that identity.

Wizard Outcome 7 - Authority

7a: Learning activities

YES or NO Does the course include opportunities for students to engage with the expectations of legitimate authorities associated with engineering, as appropriate (e.g., the National Society of Professional Engineers Code of Ethics, the IEEE Code of Ethics, engineering experts, government agencies, legal stakeholders, standards agencies)?

Ex. Projects require students to locate and use relevant standards in design

YES or NO Can the students express their understanding of the need for guidelines and rules (e.g., transfer of technology, genetically modified crops), and do they have the opportunity to practice creating guidance for team interactions?

Ex. Teams are required to devise their own contracts that include roles and expectations

YES or NO What opportunities do the students have for creating governance within their learning communities?

Ex. Classes choose due dates for projects under instructor guidance, considering the issues of students who are parents, students working part/full time, etc.

YES or NO Are there opportunities for students to explore the potential for human rights violations in the absence of legitimate authority?

Ex. Use case studies specifically outlining examples of equitable disaster relief distribution in unstable countries

7b: Learning assessments:

YES or NO Does the course include assessment of students understanding of the role of authority in forming relevant regulation, laws and/or policies? Can students articulate the necessity of authority in guiding ethical engineering practice, and conversely, can they articulate the adverse outcomes that can result from deregulation of authority? Is there opportunity to evaluate students' understanding of whether an authority is legitimate (e.g., analysis of sources)?

Ex. Students learn about the process for creating standards for the Internet. Require students to justify their sources using resources like adfontesmedia

7c: Pedagogy

YES or NO Does the instructor employ pedagogical techniques that allow students to actively engage with the role of authority in promoting engineering knowledge and applications (e.g., how ABET policies impact classroom content)?

Ex. Instructor includes discussion of which ABET criteria are met by course content, either in class or in the syllabus

YES or NO Does the instructor model adherence to the rules and regulations of the classroom (i.e. as established in the syllabus) and the campus, while also allowing deliberative or discursive democracy?

Ex. Instructor shows syllabus regularly in class to remind students of grading or scheduling of assignments

Wizard Outcome 8 - Rights

8a: Learning activities:

YES or NO Does the course include opportunities for students to engage with questions, topics or controversies centered on human, animal, and legal rights with regard to scientific practice?

YES or NO Does the course allow for the discussion of what rights apply, if any, in real-word examples related to issues such as the development of biotechnology, genetic editing and/or modification technologies, sustainability investments, climate change effects and mitigation, or environmental impacts?

YES or NO Does the course provide opportunities for students to consider the rights of Indigenous peoples with respect to science conducted on their lands, or with resources obtained from their lands?

YES or NO Does the course include opportunities for students to explore the rights of human subjects in biomedical research?

YES or NO Does the course include opportunities for students to reflect on the rights of non-majority groups in their interactions with the science enterprise?

YES or NO Does the course allow students to examine cases where the rights of different groups are in conflict?

8b: Learning assessments:

YES or NO Does the course include assessments that allow students to demonstrate their knowledge of the legal and innate rights of different societal stakeholder groups with respect to engineering?

YES or NO Does the course involve assessments of students' knowledge or understanding of animal and/or human rights related to engineering research?

YES or NO Are learning assessments constructed in a way to acknowledge the rights of students?

8c: Pedagogy:

YES or NO Does the instructor employ pedagogical techniques that are sensitive to the rights of students?

YES or NO Does the instructor use teaching approaches that allow students to decide whether the rights of one group were upheld or violated (e.g. building government installations on tribal/Indigenous lands, experimental drug testing using only majority groups, commercialized use of natural products at the cost of environmental quality)?

YES or NO Do approaches to teaching highlight the rights of both the students and instructor, and demonstrate reasonable resolutions where rights may be in conflict?