Online Ethics Center
FOR ENGINEERING AND SCIENCE

Chapter 0. Introduction: Pedagogy and Assessment

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Description

Chapter 0 of "An Instructor's Guide for Ethical Issues in Physics."

Body

Introduction: Pedagogy and Assessment

Learning is an active process - it requires engaging the mind. Numerous strategies can be employed for engaging minds in traditional physics classes. A classic approach is to assign students problem sets on a regular basis. Although this strategy has the advantage of being possible with almost any size class, much of the work is done without interaction between the student and the instructor, which might slow down the learning process. Other techniques for engaging the mind require small groups (typically twenty or less) and include lab activities and recitations in which students present their solutions to assigned problems. Recent research in physics education has led to a wide range of additional approaches, many of which are based on breaking the class down into smaller groups where all members have the opportunity to actively participate in discussion and group work.

Just as an instructor should not expect much learning to take place in a classical mechanics course when students are not required to solve any problems themselves, instructors should not expect much learning to take place in an ethics class without students grappling with the issues themselves. One way students can do this is through a discussion of professional codes of ethics. This is the focus of Chapter 1 and can be viewed as setting up the investigation of the case studies that are the focus of the remaining chapters, in the same way one can introduce classical mechanics by discussing Newton's Laws before proceeding to the real goal of seeing how those laws can be applied to solve problems.

Using case studies

Case studies can be broken down into two groups, fictional and nonfictional. Fictional case studies give the instructor more control over what information the students have access to and what ethical issues will be raised. Just like textbook problems in mechanics can be cleaned up by phrases such as "ignore air resistance," fictional case studies can be cleaned up by introducing information that will keep students focused on a small number of ethical issues. An instructor can also choose to use or develop case studies that have complexities and ambiguities. For this type of case study, part of the discussion can include deciding what additional information would be useful for completing the ethical analysis. Another advantage of fictional case studies is that they have more easily adjustable length. Often, the case study ranges in length from a paragraph to a page and thus is suitable for reading in class.

Nonfictional case studies have the advantage of realism. The students understand that the nonfiction case is not a manufactured story but rather one that physicists have actually confronted. The case will most likely include uncertainty about some of the knowledge, and students need practice dealing with this. Information on the case can likely be found that has been written by physicists, and often by physicists with direct involvement in the case. Thus, students have access to the perspective of someone who had to grapple with the issues *as* the situation was evolving. There are some potential pitfalls in using nonfiction cases, however. Some students may have prior knowledge about the case, so that during class discussion, not all students are working with the same knowledge base. The instructor can turn this around to an advantage by pointing out to students that when a group of people are

confronting an ethical issue, it is often the case that the members of the group start out with different knowledge bases. Being able to evaluate information arising during a discussion for its reliability and relevance is an important skill to develop. It is also possible that students with prior knowledge may form premature conclusions, so the instructor needs to remind students to keep an open mind while reading about the case. Students might also use their hindsight to make unfair judgments about individuals involved in the case. To address this problem, the instructor should remind students that those individuals may not have had access to all of the information that is now available. Keeping students focused on what they would do in that situation based on the facts they know rather than on judging what the people involved with the case did is one way to make this retrospective analysis more productive. Students might also apply present day ethical standards that were not formally in existence at the time of the case. In that case, the instructor can remind the students that ethical standards change over time and then shift the focus to what the students would do if confronted with a similar situation in the present. For additional information on how to use case studies in ethics, see “Thinking Like an Engineer: The Place of a Code of Ethics in the Practice of a Profession” by Davis.Michael Davis, “Thinking Like an Engineer: The Place of a Code of Ethics in the Practice of a Profession,” Philosophy and Public Affairs 20 (2) 150-167 (1991). Stable URL: http://www.jstor.org/stable/2265293.

Managing class discussions

A group size of about a dozen students with an instructor moderating the discussion can be very conducive to exploring case studies. If the group is much larger than this, some students will likely not participate. If the group is much smaller, it may be difficult to keep the discussion flowing. The instructor may want to come prepared with a list of issues that should be addressed but where possible allow the students to take the lead in the discussion. It may be necessary to actively manage the discussion to ensure that all students contribute to it. For instance, making classroom participation a part of the grading scheme provides incentive for less outgoing students to join in. Having a technique for guiding who speaks next ensures that a few people are not dominating the class. Another strategy is not allowing students to contribute for a second time until all students in the class have spoken up once.

Many instructors will be working with classes that are much larger than a dozen students. While it is possible to run a large class discussion, many students will likely not participate, if only for lack of time. A common practice in this situation is to break the class up into smaller groups, often of roughly half a dozen students. This presents several challenges, including keeping all of the groups on task, making sure that each group is exploring the issues in depth, rather than racing through a list of instructor-supplied questions as quickly as possible, finding a way to assess whether the groups are exploring the issues in sufficient depth, and finding a way to share group-generated insights with the rest of the class. One way to promote discussion quality within each group is to have a short, written assignment for the groups.

If the classroom discussion is to be based on reading done prior to the class meeting, then it may be necessary to provide some incentive for students to complete the reading assignment so that informed discussion is possible. One approach is to begin the class session with a short quiz on reading assignment. Allowing students to use notes that they have written about the assignment (but not the assigned reading itself) will eliminate the need for students to memorize material while also helping them to reinforce the material by constructing and writing out summaries.

A variation on the classroom discussion approaches described above is the role-play. Here each student participating in the role-play is assigned a character to portray. The instructor can choose whether to give all role-play participants exactly the same material to read or give each participant a different set of background notes. The latter approach is likely to be a bit more realistic since most parties involved in a situation have some relevant information that others do not. However, this approach can lead to somewhat more complex role-play scenarios, possibly concealing some of the ethical issues. Loui and Gunsalus have written nine role-play scenarios focused on the responsible conduct of research.Michael Loui and C. K. Gunsalus, “Role-Play Scenarios for Teaching Responsible Conduct of Research,” Online Ethics Center, https://www.onlineethics.org/Resources/RCRroleplays.aspx (accessed November 20, 2019).

Finally, the techniques described above have been put in the context of a course that has at least some class sessions devoted to ethics. With minor adjustments, they can work equally well with other types of gatherings, such as a weekly seminar time slot or a lab group meeting.

Other activities to engage the mind

Some ways of engaging the mind outside of the classroom can also be used for assessment purposes. Recently, game-like software has been developed for ethics education. For instance, Xenos and Velli created a choose-your-own-adventure computer game as a way to introduce software engineering ethics to undergraduate students.Michalis Xenos and Vasiliki Velli, “A Serious Game for Introducing Software Engineering Ethics to University Students,” (March 4, 2019) arXiv:1903.01333v1 [cs.HC] Also available through ICL2018, 21st International Conference on Interactive Collaborative Learning, pp. 263-274, Kos, Greece, 25-28 September 2018. Information collected by the software on each student can provide insight into how students respond to situations that raise ethical issues. As of this writing, however, apparently no such games in the field of physics exist.

Doing research and writing an essay is a more common approach to engaging the mind of individual students in ethics education. If the essay assignment includes the submission of at least one rough draft prior to the final version, the instructor will have the opportunity to provide important feedback on how the student’s ethical analysis can be improved. Peer reviews of essays can also be productive. Essays will be discussed below in the context of assessment techniques.

Assessment

A variety of assessment tools can be used to gauge student understanding of ethical issues. While these tools often overlap with those one uses for grading, they are specifically designed to provide instructors with information on student learning that can then be used to improve their instructional techniques. So, for instance, an essay may reveal that a student has an excellent grasp of a certain ethical issue but it may not receive a high grade because it was poorly written.

As noted above, student preparedness for class discussion can be assessed with short quizzes on assigned readings. Student participation in class can be used to qualitatively assess the ability of students to explore the issues brought out by the assigned reading. Short essay assignments can help reveal the level of understanding on targeted issues or concepts. These would all likely fall into the category of formative assessments: those designed to provide feedback during the

learning process.

Summative assessment, designed to provide insight into student learning after the instruction is complete, can be implemented through instruments such as tests, oral presentations, and essays. Several groups have developed multiple choice tests designed to assess the effectiveness of ethics education. While no instruments have been developed specifically for physics, there are some designed for sciences in general. The advantage of using one of these tests is that they have been validated, to ensure that they measure what they intend to measure, and they have been checked for reliability. By using one of these instruments, an instructor can compare their outcomes to those of other instructors who have used the same instrument. A disadvantage, however, is that the learning objectives measured by the instrument may not line up fully with the learning objectives of a given course. Mumford et al. developed a collection of Ethical Decision Making Measures, including one instrument designed for assessing ethics in physical science and engineering. Michael Mumford, et al., “Measuring Ethical Decision Making,” http://ethics.publishpath.com/ (accessed November 16, 2019). Borenstein et al. developed a measure of a student’s ability to recognize when situations involved ethical issues.Jason Borenstein, et al., “The Test of Ethical Sensitivity in Science and Engineering (TESSE): A Discipline-Specific Assessment Tool for Awareness of Ethical Issues,” Annual ASEE Conference, American Society for Engineering Education (2008). That same group has also developed and tested a more discipline-specific instrument for assessing ethical reasoning.Jason Borenstein, et al., “The Engineering and Science Issues Test (ESIT): A Discipline-Specific Approach to Assessing Moral Judgment,” Science and Engineering Ethics 16 (2) 387-407 (2010). https://doi.org/10.1007/s11948-009-9148-z. All of these assessment instruments are freely available from the authors.

Oral presentations have the advantage of both providing assessment information and allowing the entire class to benefit from research done by fellow classmates. A disadvantage is that the instructor has somewhat less control over the information delivery: an underprepared student giving a presentation may not make effective use of class time. It can help to require the submission of a short essay in conjunction with an oral presentation as a means of encouraging the students to crystalize their thoughts prior to presenting.

When developing essay assignments, it is important to make sure that the assignment properly reflects course objectives. The grading rubric can then be

structured around the course objectives. Keefer et al. discuss many of the details of designing and implementing assessment instruments.Matthew W. Keefer, et al., “The Importance of Formative Assessment in Science and Engineering Ethics Education: Some Evidence and Practical Advice,” Science and Engineering Ethics 20 (1) 249-260 (2014). https://doi.org/10.1007/s11948-013-9428-5. While their focus is on formative assessments, their techniques apply equally well to summative assessment instruments such as a final essay. In particular, their Table 3 provides an example of how to create a scoring rubric based on course objectives. Their paper also describes another interesting approach that can be used for a summative assessment. The authors developed two similar, fictional case studies for students to examine. Prior to the students receiving ethics instruction, half of the class got the first case to analyze in a short essay, and the other half got the second case. After the ethics instruction, each student analyzed the case they had not yet seen. Finally, all of the case analyses were scored at the end of the course, with the scorers not knowing whether the paper they were scoring was written before or after the ethics instruction. By comparing student performance prior to ethics instruction to that after the instruction, insight is provided into the impact of the course. The two-case study design ensures that after ethics instruction, students are analyzing a fresh case study. Splitting the class into two groups allows the results to be adjusted, should it be discovered that one case study is harder to analyze than the other.

Requiring the submission of a preliminary draft of longer essay assignments is a useful educational tool, although it may make it a little harder to interpret assessment data derived from the assignment. It is not uncommon for students to misunderstand the full intent of an essay assignment and hence fail to show that they have learned but were not aware was essential to the assignment. For instance, suppose the final essay assignment was to write a thorough analysis of a case study involving research ethics. Some students might approach this assignment as if they were writing an op-ed piece in which opinions are given without the necessary, underlying evidence to support them. One can conclude from looking at an essay written this way that the student missed an important message in the course: professional ethics is not merely a matter of personal opinion but rather involves understanding, among other factors, the relevant facts of the case and the professional ethical standards involved. While that is useful feedback to the instructor about the course, it would be better to make one last effort to redirect this student before the course ends. Requiring students to submit a preliminary draft of their essay and then a final version, in which they have a chance to respond to

instructor feedback, turns this assignment into a crossover between a formative assessment and a summative assessment while driving home key course objectives.

Setting up an essay assignment in which preliminary drafts are required takes some care. First, in order to allow time for the instructor to provide feedback and for the students to revise their essays, the first draft may need to be due about two-thirds of the way through the course. Hence, the material covered in the essay must be chosen so that the assignment can be completed primarily based on information available to the student in the first half of the course. Second, students must be provided with sufficient incentive to turn in a meaningful first draft. Unfortunately, for many students it is not enough to tell them turning in a first draft will very likely improve their score on the final version; a point value to the draft will often be needed. Third, terminology is very important. The term “draft” can be interpreted in different ways. To some students, it may mean just an outline with some rough notes filled in. The quality of the feedback an instructor can provide will improve if the instructor makes it clear that the first submission should *look like* a final submission. It should be complete, have appropriate references cited, be carefully edited, etc. The two-draft approach can also be applied to shorter essay assignments. Due to the longer grading process, this approach may be especially easy to implement in a traditional physics course that has an ethics module in the first half.

About this guide

This Instructor’s Guide has been written with the assumption that some form of group discussion will be at the heart of the ethics education delivery method. Each chapter identifies textual resources, most of which are long enough that they should be read prior to the discussion session rather than in class. An attempt has been made to provide enough information about each resource that an instructor can make a preliminary judgment about its suitability without needing to access the resource itself. Endnotes in each chapter include embedded links for almost all of the resources. Most sections within the chapters have several suggested discussion prompts. Chapter 1 is considered foundational since it introduces professional codes of ethics, but the remaining chapters can be addressed independently of each other.

Continue to Chapter 1: Ethical Codes

Notes

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Rights

Resource Type

Instructor Materials

Topics

Pedagogical Approaches
Case Study Method
Evaluation and Assessment

Discipline(s)

Teaching Ethics in STEM
Physics
Research Ethics