AC 2007-938: TEACHING AND ASSESSMENT OF PROFESSIONAL ETHICS IN THE NUCLEAR ENGINEERING EDUCATION ACCORDING TO THE ABET ENGINEERING CRITERIA

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Teaching and Assessment of Professional Ethics in the Nuclear Engineering Education According to the ABET Engineering Criteria

Abstract

There is a general agreement that engineering students should receive ethics instruction as a part of their undergraduate education. However, there are diverse opinions on how engineering ethics instruction should be carried out. Abiding by the American Board of Engineering and Technology (ABET) criteria puts more emphasis on ethics teaching in a systematic manner that is subject to continual assessment and feedback. Preliminary surveys of ethics teaching in the nuclear engineering programs reveal adapting the trend of teaching professional ethics through ethics courses. The survey also indicates that existing code of ethics in the nuclear field need to be more comprehensive, and integrate issues related to education, and work environment, as well as industry.

It is argued that proper teaching and assessment needs to follow the triangulation approach by using multiple methods to obtain and verify the results. It is also argued that there is more to engineering ethics than dwelling on the negative, wrongdoing and its prevention. There is the more positive side that focuses on doing one's work in a responsible and ethical way.

In this work, analysis of existing methods of ethics teaching and assessment in the nuclear engineering field is presented. Proposal for integrating ethical issues in the different nuclear engineering courses are discussed. Finally, recent ethics teaching methodologies are applied to the nuclear engineering education through out-of-classroom activities such as the use of service learning approach, and use of student outreach programs directed to the local communities, as well as other on-campus activities.

Introduction

There is a general agreement that engineering students should receive ethics instruction as a part of their undergraduate education. This is true irrespective of the accreditation system under consideration. However, there are diverse opinions on how engineering ethics instruction should be carried out. Traditional approaches in teaching professional ethics include[1]:

1. Teaching engineering ethics on the basis of moral theories, concepts for professional ethical behavior, and codes of ethics
2. Case-based approach views engineering ethics as encompassing the more general definition of ethics, but applying it more specifically to situations involving engineers in their professional lives.
3. Solving ethics problems by using hypothetical cases and problem solving tools to create what might be called ethics construction kits.
4. Linking ethical instruction with engineering practice

With the ABET Engineering Criteria (EC 2000), which requests engineering programs, among other things, to demonstrate that their graduates have “an understanding of professional and ethical responsibility” (outcome 3f) engineering ethics courses are likely to grow more in engineering programs. Thus, focus is not just to teach ethics foundations but rather to demonstrate the understanding of the students of the professional ethics. Having to write objectives for some of the outcomes throws most engineering professors into completely unfamiliar territory. Little in their background or experience provides a basis for knowing how students might demonstrate an understanding of professional or ethical responsibility[2]. Adding to that, it is known that according to the ABET criteria; the assessment plan should specify who is responsible for each part of the assessment, when the assessment will be performed, and who will receive the results[2]. It is thus clear that more in-depth analysis is still needed in this area.

Teaching Ethics According to the ABET Requirements

If the vision for understanding ethical and professional responsibilities as articulated in ABET is to become reality, educators must answer a number of questions[3]: What is the appropriate content? What teaching methods and curriculum models are preferable? Which works best: required course, ethics across-the-curriculum, integration of ethics and science, technology and society, or integration of the liberal arts into the engineering curriculum? Which outcome assessment methods are most suitable?

According to a "Survey of Ethics-Related Instruction in U.S. Engineering Programs"[4], it was found that only 27 percent of ABET-accredited institutions listed an ethics related course requirement, even though an increasing number of philosophers, engineers, and ethicists focus their research and teaching on engineering ethics. What complicates the problem is that different faculty have provided varying definitions for what "understanding ethical and professional responsibilities" means consistent with ABET's intent[3].

Even when the different engineering programs include ethics elements in their curricula, it is usually argued that the true test of engineering ethics education is how graduates behave in the workplace during their careers, which is a difficult outcome to measure a priori[3]. Besides, even if the student provides a creative solution to a posed ethical dilemma, there is no assurance that he or she could carry that solution to completion or behave in an ethical manner when confronted with a dilemma in practice.

Finally, it needs to be stressed that because engineering ethics is highly situationally dependent, the exact characterization for assessment purposes may be imprecise. In this section, a review of some of the methods proposed for ethics teaching and assessment in engineering programs are presented.

Possible instructional Methods that ABET EC 2000 address outcomes 3f [2] are:

1. Include elements of ethical and professional responsibility in course learning objectives and on tests in at least one core engineering course in each year of the curriculum, including the capstone design course. Provide instruction in engineering ethics in the form of lectures or supplementary handouts. (A less effective alternative is to offer an elective course on professional and ethical responsibility.)
2. Include several course-related professional/ethical dilemmas in each engineering course that has professional and ethical issues in its learning objectives. Have students formulate responses and justifications individually, then reach consensus in pairs or teams of three. Provide constructive feedback and several alternative models of good responses, being

sure to convey the idea that there is not one "correct" response and that what matters is the clarity and logical consistency of the justification. Have the students reformulate their initial responses to the dilemmas in light of the feedback.

As part of a recent National Science Foundation in the US, a sponsored study of engineering education assessment[5], a framework was developed for organizing each ABET outcome's possible attributes by adapting Bloom's general taxonomy based on six levels of the cognitive domain: knowledge, comprehension, application, analysis, synthesis, and evaluation[6]. A seventh affective domain – valuation - was added. Outcome elements and associated attributes were then expanded within each of these levels. McBeath's action verbs for each level[7] were used to translate the attributes into learning outcomes in order to facilitate measurement. The specification of outcome 3f served to inform the rubric that was developed.

As for the assessment process, it is known that triangulation (using multiple methods to obtain and verify a result) is an important feature of effective assessment. The more tools used to assess a specific program outcome or course learning objective, the greater the likelihood that the assessment will be both valid (meaning that what the chosen method is actually assessing matches what is supposedly being assessed) and reliable (the conclusion would be the same if the assessment were conducted by other assessors or again by the same assessor)[2].

Following are some of the previously proposed program-level (P) and course-level (C) assessment tools[2]:

1. Performance in co-op and internship assignments and in problem-based learning situations (P,C)
2. Behavioral observation, ethnographic and verbal protocol analysis (analyzing transcripts of student interviews or working sessions to extract patterns of problem-solving, thinking, or communication) (P,C)

Case Studies from Some Engineering Disciplines

When addressing the criteria related to the safety and environmental aspects in the department of chemical engineering, Michigan Technological University[8], one of the chosen assessment method was the student participation in the Safety Program in the Unit Operations Laboratory. A faculty committee evaluates the level of participation to assess professional responsibility and safety awareness. The desired "Achievement Level" was chosen to be continued improvement; i.e., greater than 70% of internal safety forms to be generated by students not in the Safety Committee.

In the Mechanical Engineering, Florida A&M University, Florida State University[9], the criteria "An understanding of professional and ethical responsibility" is achieved through:

1. Emphasis on Mechanical Engineering as a profession early in the curriculum. This is done by openly discussing ethics and professional activities in the course "Introduction to Mechanical Engineering" class. The term profession is defined in terms of public safety, moral and ethical responsibilities and the need to constantly update the knowledge through the life-long learning process. Various professional organizations are introduced

and their roles in shaping the professions are outlined. The students are strongly encouraged to join professional societies.

2. Invite engineering practitioners to address students on ethics and other professional considerations in a senior seminar course.
3. Encourage students to participate in professional activities such as American Society of mechanical Engineers (ASME), Society of Automotive Engineers (SAE) regional and national conferences, and competitions. Needless to say that such participation would expose the students to the world of the professional engineers with its professional problems and ethical conflicts.
4. Require students to participate in educational outreach activities such as Industry Day design competition, ASME meeting, assume professional society leadership positions, etc. Students must fulfill specified outreach requirements during their college career before they can graduate.
5. Place more emphasis on professionalism and ethics in a senior capstone class: Two full lectures of the senior design project are devoted to these topics. One of the lectures (in the context of engineering standards) is devoted to the role of professional societies in the development and maintenance of standards. The students are made aware of the need to become involved with the professional societies, and the importance of their service in standard-setting committees. Another lecture is devoted to the topic of ethics in engineering practice. This lecture is structured around the ethical guidelines of the ASME and (Institute of Electrical and Electronics Engineers) IEEE 'Codes of Conduct'. Each item in the Code of Conduct is thoroughly discussed in class as a group, not just by the instructor, allowing ample opportunity for the students to ponder each ethical guideline. The lecturer presents an example, drawn mostly from industrial experience, in which an engineer could be faced with the situation covered by the specific coded item such as conflict of interest, knowledge of impropriety, discrimination, etc. The class then engages in a moderated discussion of the item.

Current Professional Ethics Teaching Modules and Assessment Methods in the Nuclear Engineering Field

In an attempt to assess the current teaching methodology of professional ethics in the nuclear engineering field, a brief survey of related courses in leading American nuclear programs as well as other nuclear programs was performed. The survey included both professional ethics courses and technical courses with embedded ethical points. It is to be stressed that the actual course contents are not available to the authors. As such, no further analysis could be made on the depth of the ethics topics and their assessment. It is to be noted that, according to the authors' survey, other leading nuclear programs in the US like MIT or University of Wisconsin-Madison do not include ethics related courses in their curriculum.

Table 1: Examples of ethics teaching modules in nuclear engineering programs

University	Course title	Ethics related topics
Ethics courses		
University of California, Berkeley	Ethics and Development of Technology[10]	The course examine what contemporary philosophy, religion and art, and contemporary views of natural and social science have to say about issues such as nuclear technology. The course focuses on the nature of emerging technical issues, their ethical, legal and social ramifications, and what individuals and society value in relation to these issues.
University of Tennessee	Senior Seminar[11]	Professional ethics are addressed in two classes one of which is devoted to an outside speaker with expertise in the area.
The Pennsylvania State University	Issues in Nuclear Engineering[12]	Societal and technical issues facing nuclear engineers, including safety, operations, waste, regulation, public acceptance, economics, ethics, and radiation
Purdue University	Introduction To Energy Engineering[13]	The relation between energy usage and quality of life, the social impact of energy use, and the environmental constraints on energy usage. The full impact that the various energy alternatives have on economic and environmental issues are reviewed
	Senior Seminar[13]	Professional ethics
Texas A&M	Technical Communications Issues in the Nuclear Industry[14]	Introduction to a variety of topics that present communication challenges
University of Ontario, Canada	History of Science and Technology[15]	History and philosophy of science and engineering with special emphasis on scientific technology and the cultural significance of technology to civilization. Critical analyses of the nature and problems of industrial technology, benefits and risks of technological progress.
	Ethics and Law for Professionals[15]	Ethical and legal aspects of the engineering profession, occupational health and safety, environmental laws and regulations.
McMaster University, Canada	Engineering: Its History, Philosophy, and Workings[16]	Aspects of professional practice: Intellectual property, professional ethics, projections in time, historical illustrations…
Alexandria University, Egypt	History of Engineering Sciences*	Nuclear energy and public opinion, ethical behavior in the nuclear engineering field, code of ethics for the nuclear engineering field
Technical courses with ethics-related topics		
University of Michigan	Introduction to Nuclear Engineering and Radiological Sciences[17]	History of Nuclear Engineering, Environmental Effect of Nuclear Radiation, Ethical Issues Surrounding Nuclear Technology.
Texas A&M	Environmental nuclear Engineering[14]	Evaluation of effects of radiation and radioactivity on the environment and on humans

**As taught by the second author*

As an example on assessment, reference is made to the nuclear engineering program, North Carolina State University[18]. One of the program outcomes is that "Graduates will have an understanding of professional and ethical responsibility". This was explained as "graduates should be able to identify an ethical dilemma, identify resources to cope with ethical and moral conflict, and understand the implications of engineering decisions for employers, colleagues, family, environment, and local and global communities". The assessment tools include: (1) Final Exam (subject area Ethics), (2) Graduating Senior Survey, (3) Faculty Perception Survey, (4) Alumni Survey, and (5) Employer Survey.

It is obvious from the above preliminary survey of ethics teaching modules that nuclear programs adapt the trend of teaching ethics through ethics courses and assessment through exams and surveys. One of the resulting drawbacks is that these courses are given to the students in the first semesters. As such, the students don't have enough technical background to realize the problems of ethical practices as related to the real working environment.

Professional Codes of Ethics in the Nuclear Engineering Field

Teaching professional ethics in engineering disciplines, specifically in nuclear engineering, necessitates having some agreement on elements of code of ethics in the nuclear engineering field. The code of ethics is needed to serve as a platform to determine what constitutes professional ethics practices. Thus, educators would have a common background whenever ethics issues are taught. This would ensure that ethics teaching would be comprehensive and not to focus only on certain issues related to the public or the workers or the industry.

Since 1977, Alvin Weinberg, one of the pioneering scientists in the nuclear engineering field, has called for such attention on professional ethics and code of ethics for nuclear engineering educators[19]. Following is a summary of the salient features of two codes of ethics related to nuclear engineering.

World Nuclear Association, Charter of Ethics[20]

1. Sustainability must be the guiding principle of global development
2. Nuclear science is proving equally valuable in supporting industrial societies and in helping the world's poorest countries to advance
3. Need to strengthen and sustain public confidence, both in the reliability of nuclear technology and in the people and institutions responsible
4. Ensuring that nuclear technology is used safely and peacefully
5. Preventing and exposing unsafe or illicit practices regarding nuclear material
6. Practice of transparency regarding all types of civil nuclear activity
7. Supporting availability of commercially valuable knowledge to enhance and maintain nuclear safety
8. Supporting the work performed by governments, industry, and the International Atomic Energy Agency (IAEA), to promulgate nuclear safety standards for the worldwide nuclear industry and preventing the spread of nuclear weapons arising from the civil nuclear fuel cycle
9. Developing and maintaining, using a comprehensive system of technical exchange and operational peer review, a rigorous safety culture at nuclear facilities worldwide
10. Upholding respective international legal commitments

11. Cooperation, in a spirit of partnership, with those engaged in the research, development and operation of other technologies that yield energy without adverse effect on the biosphere
12. Promote an ongoing debate on energy resources that focuses citizens and governments alike on the real choices facing humankind and on the severe dangers - for the prospects of global development and for the biosphere

World Council of Nuclear workers, Nuclear code of Ethics[21]

1. The search for security of nuclear installations has priority over the search for financial and commercial profitability.
2. Concern for continuous improvement of safety management.
3. Transparency must be understood as a systematic attitude which serves to dissipate the many misunderstandings that have bedeviled nuclear energy.
4. Importance of pursuit of research and development in the nuclear field
5. Cost must be comprehensive and integrate a social component and an ecological component
6. working environment, specifically including the remuneration due to the nuclear workers, must not be detrimental nor tend to reduce the incentive for a safety culture
7. Optimization of working conditions designed to minimize human failures detrimental to the safety of the installations, environmental protection and health of the workers and the public
8. Continuing education of the personnel working in nuclear installations and raising of their level of technical skills
9. Continuous improvement of safety management systems with emphasis on the evaluation of process controls.
10. Development of a general safety culture including all the persons concerned by the applications of the civil nuclear industry
11. Excellence of a social dialogue, its quality and its permanence are the best guarantee of the high level of safety of nuclear installations

Close examination of the above two codes reveals that the charter of ethics for the World Nuclear Association is a comprehensive one. However, the code of ethics of the World Council of Nuclear Workers complements it especially in areas related to the working environment. It is the authors' opinion that stress should be placed on the following issues:

1. Proper handling of nuclear waste
2. Providing more funding and conducting more research in the area of nuclear waste disposal should be a priority
3. Exchanging technical information to ensure equal sharing of the benefits of civilian nuclear programs
4. Supporting the formation of societies at the national and international levels and strengthening their activities and coordination to ensure the cooperation among those involved in the field for the better use of civilian nuclear energy.
5. Ensuring proper public education in the area of radiation, its effects and the impact of nuclear energy.

Linking Ethics Principles to the Nuclear Engineering Courses

As mentioned in previous section, integrating ethical issues in nuclear engineering courses is a far better method of ethics teaching than just teaching a course on ethics. To provide better illustration of the idea, following are two proposals on how ethics teaching can be linked to the different technical subjects in two nuclear engineering departments. Table 2 shows the ethics topics proposed for the nuclear engineering program, King AbdulAzzi University, Jeddah, Saudi Arabia. Table 3 shows the proposed ethics topics for the nuclear engineering program, Alexandria University, Alexandria, Egypt.

As for assessment, it is proposed to include one question in final exams of the different courses on an ethics-related issue. Compilation and analysis of the students' performance in answering such questions would serve as indication of the students' understanding of the related professional ethics. It is worth mentioning that teaching ethical points across-the-curriculum would circumvent the problem of ethics teaching in the early semesters of the program curriculum. Thus, the students would be exposed to ethical issues as related to all parts of their professional practice.

Table 2: Proposed linkage of ethics related topics to nuclear engineering courses in the nuclear engineering department, King Abdul Aziz University, Jeddah, Kingdom of Saudi Arabia

Course title	Ethics related topics
Engineering Management	Professional ethics (in general)
Object-Oriented Computer Programming	Internet and computer ethics
Introduction to Nuclear Engineering	Ethical issues on the early use of nuclear energy, need for environmental protection, radioactive waste disposal
Nuclear Materials	Materials problems in the nuclear industry, proper use of nuclear materials
Radiation protection I	Societal implications of the ALARA principle, how radiation standards are agreed upon, cost-benefit analysis when dealing with radiation standards
Energy and the Environment	Ethics of environmental protection, need for lifecycle analysis
Fundamental of Radiation Biology	Ethics of experimentation involving radiation
Nuclear Power Planning and Project Implementation	Addressing public opinion, whistle blowing
Nuclear Reactor Safety	Cost-benefit analysis, design standards vs. safety, Risk-benefit analysis, whistle blowing
Nuclear Power Plant Operation	Environmental protection, addressing public concerns
Nuclear Reactor Design	Ethics of cost-benefit analysis
Environmental Radioactivity	Ethics of environmental protection, cost of environmental remediation
Engineering economics	Ethics of cost-benefit analysis, Environmental remediation costs
Economics of nuclear fuel cycle	Ethics of cost-benefit analysis, nuclear wastes

Table 3: Proposed linkage of ethics related topics to nuclear engineering courses in the nuclear engineering department, Alexandria University, Egypt

Course title	Ethics related topics
History of engineering sciences	Nuclear energy and public opinion, ethical behavior in the nuclear engineering field
Introduction to Nuclear Engineering	Ethical issues on the early use of nuclear energy, need for environmental protection, radioactive waste disposal
Environmental Sciences-II	Ethical problems related to setting radiation level standards, nuclear waste
Nuclear Metallurgy	Materials problems in the nuclear industry, proper use of nuclear materials
Environmental Science-III	Radiation pollution and cleaning, ethical issues in licensing nuclear facilities
Nuclear Reactor Design	Ethics of cost-benefit analysis
Radiation Protection Engineering	Societal implications of the ALARA principle, how radiation standards are agreed upon, cost-benefit analysis when dealing with radiation standards
Nuclear Fuel Cycles	Impact of every step in the cycle on the environment especially nuclear waste disposal, environmental impact analysis
Safety of Nuclear Power Station	Cost-benefit analysis, design standards vs. safety, risk benefit analysis, whistle blowing
Radioactive Waste Management	Civilian vs. defense nuclear waste, funding and research for nuclear waste disposal
Law and Legislation	Commitment to national and international laws
Thermal Performance of Nuclear Stations	Impact of efficiency on waster pollution from nuclear power stations
Power Economics	Ethics of cost-benefit analysis, environmental remediation costs

It is clear from the above two examples that integrating ethical issues in the technical courses can be done. However, care should be practiced not to affect the scientific content of the courses. Also, agreement need to be reached among academic staff to ensure harmony between the ethical issues covered in the different courses.

Use of Service Learning to Implement Professional Ethics Principles

Much of the engineering ethics literature dwells on the negative, wrongdoing, its prevention, and appropriate sanctioning of misconduct. These will always be fundamental concerns. But there is more to engineering ethics than this. There is the more positive side that focuses on doing one's work responsibly and well, whether in the workplace or in community service[22].

Service learning may be defined as[22]: Credit-bearing educational experience in which students participate in an organized service activity that meets identified community needs and reflect on the service activity in such a way as to gain further understanding of the course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility.

The concept of service learning is not new to higher education, or to the engineering profession[22]. The idea of integrating service with education has its roots in the creation of the land grant universities and their extension offices through the Morrill Act in the 1860s. John Dewey's work in the early decades of the 20th century brought a philosophy of experience into education. The 1960s saw numerous campus and community-based initiatives arise in connection with public issues[22].

Service learning has been widely adopted within higher education nationally in many disciplines and offers engineering a compelling environment to meet many of the ABET EC 2000 criteria that may be difficult to integrate into traditional engineering courses[23]. The multidimensional reflection and analysis embedded in the service-learning process ensures that students will explore these issues in a guided manner to deepen their overall understanding of their roles as engineering professionals[22].

Thus, service learning provides both an opportunity and a challenge to engineering educators. It is needed to think of how to incorporate real-world experiences into the engineering curriculum while providing a valuable service for either a nonprofit organization, a disadvantaged community, or a rural village in a less developed country and do it all without reducing academic content[3].

As such, service learning is one of the important avenues to teach and assess the professional practices of the nuclear engineering students and how they would adhere to the professional ethics behavior after graduation. This can be done by involving the students in projects such as:

1. Public campaign in local communities on nuclear energy
2. Radiation monitoring around nuclear facilities
3. Cost benefit analysis of new reactor designs
4. Environmental impact analysis of nuclear facilities

Example on Proposed Use of Service Learning for Ethics Teaching in Nuclear Engineering

To further illustrate the use of service learning, details are given below for a proposed project on radiation monitoring around nuclear facilities. Besides the technical issues, ethics teaching can be done as follows:

1. Students are encouraged to follow the guidelines on radiation monitoring around nuclear facilities as given in their technical courses. Procedures need to be checked against what is followed in the nuclear installations. Students are instructed to point out any inconsistencies.
2. Students need to be instructed to evaluate the performance of their team members in performing their part of the monitoring process. They need to be encouraged to report any deficiency by their team members to the project supervisor.
3. Students may look for any reported abnormal radiation releases and check how the public was informed.
4. Students are encouraged to be involved in discussions with the local community on how they perceive radiation monitoring around the nuclear facility and how any abnormal releases were dealt with.
5. Students are encouraged to contact any anti-nuclear movement local branch and to be involved with them in a discussion/debate on radiation monitoring issues.

As for assessment, it may be performed along the following lines:

1. The above mentioned activities should be included in the project report and part of the grade should be given to performing such activities.
2. Another part of the grade should be given to an in-depth analysis of the involved ethical issues. This may be done during oral discussion by the evaluation committee of the project.
3. Issues of concern during the final evaluation may involve:
    a. Adhering to the technical practices and reporting any inconveniences.
    b. Honesty when dealing with the public
    c. Reporting malpractices
    d. Design flaws (if any)

Further Steps to Complement Ethics Teaching in the Nuclear Engineering Programs

Acquiring the professional outcomes may not result simply from participation in a particular class or set of classes. Rather, these outcomes are more often acquired or influenced through sources both in and outside the classroom. This necessitates paying attention to the proper planning and monitoring of out-of classroom activities to be able to properly use them for ethics teaching[24].

It is thus proposed to enhance ethics teaching and assessment in the nuclear engineering filed through:

1. Making use of the radiation labs as well as research reactor experimental courses to stress ethics of use of radiation, and safety practices. Assessment methods may include adhering to the assigned safety practices as well as reporting minor incidents.
2. Benefiting from On-Campus activities such as any existing recycling programs and activities of environmental protection. Student participation in these activities may help in the assessment plan.
3. It is also proposed to create the assignment of professional ethics teaching coordinator at the program level. His/her job is to participate in curriculum development and assessment plans with the focus on using any academic activity to enhance the ethics teaching activities. The job may include developing the proper assessment forms as well keeping the students records related to any on-campus as well as the service learning activities.
4. Enhancing the role of student societies for the active participation in local community activities related to nuclear engineering and use of radiation. Number of outreach programs, newspapers articles and public debates may serve to monitor and assess the adherence of the students to the professional ethics practices.

Conclusions

Abiding by the ABET EC 2000 puts more emphasis on ethics teaching in a systematic manner that is subject to continual assessment and feedback. Preliminary surveys of ethics teaching in the nuclear engineering programs reveal adapting the use of ethics courses. Assessment is done through exams and surveys. The triangulation approach using multiple methods to obtain and verify the results need to be the norm for ethics teaching in nuclear engineering. Integrating ethical issues in the nuclear engineering courses can be done. Care should be practiced not to affect the scientific content of the courses. Also, agreement need to be reached among academic staff to ensure harmony between the ethical issues covered in the different courses. Thus, to have a common platform for teaching ethics, current code of ethics in the nuclear field need to be more comprehensive and integrate issues related to education, and work environment, as well as industry. Service learning may be implemented through various projects to actually involve the students in real life situations of the nuclear engineering profession. Out-of –classroom activities such as student outreach programs directed to the local communities as well as other on-campus activities need to be well planned and monitored to help assessing the ethical behavior of the future nuclear engineers.

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