Online Ethics Center
FOR ENGINEERING AND SCIENCE

Active Learning Bibliography

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Description

An annotated bibliography of web sites, books and journal articles looking at how to integrate active learning into ethics education. Includes material on what active learning is and how it is done, how active learning can be done in an online environment, and how it can be integrated into ethics education.

Body

What is Active Learning and How is it Done?

Bonwell, Charles C., and James A. Eison. 1991. *Active Learning: Creating Excitement in the Classroom.* 1991 ASHE-ERIC Higher Education Reports. ERIC Clearinghouse on Higher Education, The George Washington University, One Dupont Circle, Suite 630, Washington, DC 20036-1183, 1991.
The classic book on active learning strategies.

Bromley, Pam. 2013. “Active Learning Strategies for Diverse Learning

Styles: Simulations Are Only One Method.” *Ps-Political Science & Politics, 46*(4), 818-822. doi: 10.1017/s1049096513001145.
Although political science instructors increasingly recognize the advantages of incorporating active learning activities into their teaching, simulations remain the discipline's most commonly used active learning method. This article explores six active learning techniques: simulations, case studies, enhanced lectures, large group discussion, small group work, and in-class writing.

Bruff, Derek. 2009. *Teaching with classroom response systems: creating active learning environments*. San Francisco: Jossey-Bass.
This book gives a number of examples and teaching activities from a range of disciplines that show how classroom response systems can be used to incorporate active learning in undergraduate and graduate courses.

Dadach, Zin Eddine. 2013. “Quantifying the Effects of an Active Learning Strategy on the Motivation of Students.” *International Journal of Engineering Education, 29*(4), 904-913.
The main objective of this paper is to quantify the effects of an active learning strategy on the motivation of students in a process control course. In the first part of the investigation, the relative performance of students was used as a tool to gauge the effects of the active learning strategy on the motivation of students. The results indicate that the active learning strategy enhanced the performance of 38 (69%) students. The author also describes the development of a measure looking at the effects of the active learning strategy on the motivation of students.

Ford, Michael. J. 2010. “Critique in academic disciplines and active learning of academic content.” *Cambridge Journal of Education, 40* (3), 265-280. doi: 10.1080/0305764x.2010.502885.
This article argues for increased theoretical specificity in the active learning process. Whereas constructivist learning emphasizes construction of meaning, the process articulated here complements meaning construction with disciplinary critique. This process is an implication of how disciplinary communities generate new knowledge claims, which is comprised by an interaction of roles - authors construct claims and peers critique them. The author’s account of active learning in a science course sheds new light on both historical and contemporary characterizations of active learning in terms of taking a critical stance toward content, in which the learner questions and challenges content. Thus students, rather than teachers, should actively challenge their emerging understanding of content.

Freeman, Scott, Eddy, Sarah L., McDonough, Miles, Smith, Michelle K., Okoroafor, Nnadozie, Jordt, Hannah., & Wenderoth, Mary Pat. 2014. “Active learning increases student performance in science, engineering, and mathematics.” Proceedings of the National Academy of Sciences, 111(23), 8319–8320. doi: 10.1073/pnas.1319030111.
An important meta-analysis of studies of active learning.

Hadjerrouit, Said. 2005. “Designing a Pedagogical Model for Web Engineering Education: An Evolutionary Perspective.” *Journal of Information Technology Education, 4*, 115-140.
n contrast to software engineering, which relies on relatively well established development approaches, there is a lack of a proven methodology that guides Web engineers in building reliable and effective Web-based systems. To meet the challenges of Web engineering, current education must be aligned with a pedagogical model capable of empowering and supporting the acquisition of critical skills. To do this, a new, active learning environment must be created that promotes change in both pedagogy and course material, in effect, altering the role of the teacher, the expectations for students, and many other educational aspects.

Kitazono, Ana. A. 2010 “A Journal-Club-Based Class that Promotes Active and Cooperative Learning of Biology. “*Journal of College Science Teaching, 40*(1), 20-27.
A journal-club-based class has been developed to promote active and cooperative learning and expose seniors in biochemistry and cellular molecular biology to recent

research in the field. Besides giving oral presentations, students also write three papers: one discussing an article of their own choosing and two, discussing articles presented by other groups. This report describes how the class is organized as well as the different strategies tried and their results.

Lord, Susan M., Prince, Michael J., Stefanou, Candice R., Stolk, Jonathan D., & Chen, John C. 2012. "The Effect of Different Active Learning Environments on Student Outcomes Related to Lifelong Learning." ***International Journal of Engineering Education,*** **28(3), 606-620.**
This research investigates how instructor choices of active learning pedagogies affect student outcomes related to their development as lifelong learners at four institutions. The results of this mixed-method design suggest that students' development as self-regulated learners involves a complex interplay between many factors that are influenced by faculty choices in the course design.

Michael, Joel. 2006. "Where's the evidence that active learning works?" ***Advances in Physiology Education, 30*****(4), 159-167. doi: 10.1152/advan.00053.2006.**
Calls for reforms in the ways we teach science at all levels, and in all disciplines, are wide spread. The effectiveness of the changes being called for, employment of student-centered, active learning pedagogy, is now well supported by evidence. The relevant data have come from a number of different disciplines that include the learning sciences, cognitive psychology, and educational psychology. There is a growing body of research within specific scientific teaching communities that supports and validates the new approaches to teaching that have been adopted. These data are reviewed, and their applicability to physiology education is discussed.

Prince, Michael. 2004. "Does Active Learning Work? A Review of the Research." ***Journal of Engineering Education*** **93(3): 223-231.**
Provides a good overview of the literature and arguments for active learning. It also does a good job of explain the terminology and different strategies for active learning.

Raghallaigh, Muireann Ni, & Cunniffe, Rosemary. 2013. "Creating a safe climate for active learning and student engagement: an example from an introductory social work module." ***Teaching in Higher Education, 18*** **(1), 93-105. doi: 10.1080/13562517.2012.694103.**
This article explores the experiences of students who participated in a series of seminars that employed active learning methodologies. The research findings

suggest that the students were highly engaged and that the mix of doing', observing' and reflecting' contributed to their engagement. However, in addition, the students' perspectives suggested that the learning environment in which the seminars took place was of particular importance. Overall, the study highlights that while active learning methodologies contribute to student engagement, the atmosphere in which the methodologies are used is also of central importance.

How Can Active Learning Be Done In An Online Environment and Using Multimedia Tools?

Alley, Lee. R. 2001. "What Makes a Good Online Course? The Administrator's Role in Quality Assurance of Online Learning." *Converge, 4* (11), 50.
Considers administrators' new roles and obligations in facilitating quality online learning. Topics include designing Web courses for knowledge construction; more detailed syllabuses; student assessment; motivating students; learning and teaching styles in online environments; active learning possibilities; social interaction; and nonlinear learning.

Austin, Diane and Nadine D. Mescia. Undated. "Strategies to Incorporate Active Learning into Online Teaching." Presentation at the International Conference on Technology and Education.
This brief article gives an overview of active learning and then identifies five components of good active learning strategies. It also lists active learning strategies that can be adapted for the online classroom.

Bangert, Arthur W. 2006. "Identifying Factors Underlying the Quality of Online Teaching Effectiveness: An Exploratory Study." *Journal of Computing in Higher Education, 17*(2), 79-99. doi: 10.1007/BF03032699.
Describes a method to allow assess the effectiveness of online instruction based on the "Seven Principles of Effective Teaching" authored by Chickering and Gamson (1987). This study was an initial effort toward the development of a student evaluation of online teaching instrument based on this framework. The "Student Evaluation of Online Teaching Effectiveness" (SEOTE) was found to be highly reliable and yielded four interpretable factors. The four factors were interpreted as Student-Faculty Interaction, Active Learning, Time on Task, and Cooperation Among

Students.

Bollinger, Doris and Armier, David Des 2013. "Active Learning in the Online Environment: The Integration of Student-Generated Audio files. *Active Learning in Higher Education*. 14(3) 201-2011.
This article focuses on one route for active learning: the use of faculty and student generated audio files. It gives details about a specific strategy for an online active learning environment.

Bouchard, Paul. 2009. "Some Factors to Consider when Designing Semi-Autonomous Learning Environments." *Electronic Journal of e Learning, 7* (2), 93-100.
This research aims to answer the question, "in what ways do mediated learning environments support or hinder learner autonomy?" Learner autonomy has been identified as one important factor in the success of online learning environments.

Dixson, Marcia. D. 2010. "Creating Effective Student Engagement in Online Courses: What Do Students Find Engaging?" *Journal of the Scholarship of Teaching and Learning, 10*(2), 1-13.
While this paper set out to discover what activities and/or interaction channels might be expected to lead to more highly engaged students, what it found was a bit different. After first creating a scale to measure online student engagement, and then surveying 186 students from six campuses in the Midwest, the results indicate that there is no particular activity that will automatically help students to be more engaged in online classes. However, the results also suggest that multiple communication channels may be related to higher engagement and that student-student and instructor-student communication are clearly strongly correlated with higher student engagement with the course, in general. Thus, advice for online instructors is still to use active learning but to be sure to incorporate meaningful and multiple ways of interacting with students and encouraging/requiring students to interact with each other.

Foertsch, Julie, & Gernsbacher, Morton. A. 2008. "When the Medium Illustrates the Content: Exploiting the Unique Features of Online Communication." *Innovate: Journal of Online Education, 4*(3).
Describes an online undergraduate course in psychology that adhered to the seven widely accepted principles of effective online teaching and suggests an eighth principle: using the unique benefits and constraints of online communication to prompt critical thinking about various facets of human communication, psychology, sociology, or human-computer interface design.

Friedman, Linda W., & Friedman, Hershey. H. 2013. "Using Social Media Technologies to Enhance Online Learning." *Journal of Educators Online, 10* (1).
The number of college students taking online classes continues to grow. The social media technologies encompass a wide variety of Web-based technologies such as blogs, wikis, online social networking, and virtual worlds. This paper examines the relevant published literature, looking at online learning activities through the prism of the defining characteristics of today's new communication technologies.

Hardin, Karen. 2004. "Teach Them to Fly: Strategies for Encouraging Active Online Learning." *Online Submission. Turkish Online Journal of Distance Education TOJDE, 5*(2), 10-14.
On one of the author's online course evaluations, a student criticized that, "she's not doing the teaching, I'm doing the learning." As an instructor who encourages active learning, she began to ponder the reluctance of students to take control of the learning process.

Ke, Fengfeng, & Kwak, Dean. 2013. "Constructs of Student-Centered Online Learning on Learning Satisfaction of a Diverse Online Student Body: A Structural Equation Modeling Approach." *Journal of Educational Computing Research, 48*(1), 97-122.
This study investigated the relationships between constructs of web-based student-centered learning and the learning satisfaction of a diverse online student body. Hypotheses on the constructs of student-centered learning were tested using structural equation modeling. The results indicated that five key constructs of student-centered learning in online courses--learner relevance, active learning, authentic learning, learner autonomy, and computer technology competence--predicted students' perceived satisfaction with online courses and web-based distance education at a statistically significant level.

Kraus, Rachel. 2008. "You Must Participate: Violating Research Ethical Principles Through Role-Play." College Teaching 56(3): 131–136.
This role-play exercise can easily be incorporated in classes in many subjects, and the assessment method is effective.

Lewis, J. Scott, & Harrison, Marissa. A. 2012. "Online Delivery as a Course Adjunct Promotes Active Learning and Student Success." *Teaching of Psychology, 39*(1), 72-76. doi: 10.1177/0098628311430641.
Describes the use of an online lecture to free up time in class for more active learning activities in a psychology course.

Milner-Bolotin, Marina. 2012. "Increasing Interactivity and Authenticity of Chemistry Instruction through Data Acquisition Systems and Other Technologies." *Journal of Chemical Education, 89*(4), 477-481. doi: 10.1021/ed1008443.
Data acquisition systems are an extremely useful form of educational technology that can be used alone or in conjunction with other technologies to bring about active learning and enable students to move beyond memorization to the verification strategies and knowledge base they need to successfully master chemistry concepts. This article describes the use of data acquisition systems and analysis software in combination with other technologies such as electronic response systems and online video.

Moreno, Roxana. 2006. "Learning in High-Tech and Multimedia Environments." *Current Directions in Psychological Science*, 15: 63-67.

This article, while less accessible to the novice audience, provides a useful table of the ten design principles for learning with media. It also emphasizes the importance of multimedia tools providing a necessary benefit to the education that another medium wouldn't be able to provide, such as a flight simulator doing a better job of immersing the student in how it will be to fly than just reading and looking at diagrams.

National Research Council. 2003. *Information Technology (IT)-Based Educational Materials: Workshop Report with Recommendations*: The National Academies Press.
This report identifies critical components that support the development and use of IT-based educational materials. The report points to three high priority action areas that would produce a transitional strategy from our fragmented environment to an IT-transformed future in engineering education--Build Community; Create Organizational Enablers; and Coordinate Action. The report stresses the need to pursue open architectures and to engage multidisciplinary researchers, including social scientists and others who address the transformation of faculty cultures. The report also discusses the need to engage users and developers of the IT-products in activities that are driven by student learning outcomes.

Nelson, Erik. 2010. "Elements of Problem-Based Learning: Suggestions for Implementation in the Asynchronous Environment." *International Journal on E Learning, 9*(1), 99-114.
This article explores some of the challenges of using problem based learning concepts in asynchronous online environments.

Phipps, Linda R. (2013). "Creating and Teaching a Web-Based, University-Level Introductory Chemistry Course that Incorporates Laboratory Exercises and Active Learning Pedagogies." *Journal of Chemical Education, 90*(5), 568. doi: 10.1021/ed200614r.
An introductory, nonscience-majors chemistry course was converted to a Web-based course. The differences in student populations, teaching strategies, laboratory methods, and learning outcomes are described. Practical information is also given on the use of software and other online technology to implement course conversion.

Ralph, Michael and Lynette Ralph. 2013. "Weapons of Mass Instruction: The Creative Use of Social Media in Improving Pedagogy." *Issues in Informing Science and Information Technology.* Vol. 10.

This article explores how social media can be used for delivering active learning in online classes. It presents some interesting ideas about using Facebook, Twitter, and YouTube for engaging students that could be applied to teaching materials.

Wang, Fu Lee, Fong, Joseph, & Kwan, Reggie. 2010. *Handbook of Research on Hybrid Learning Models: Advanced Tools, Technologies, and Applications*. Information Science Reference.
Hybrid learning is now the single-greatest trend in education today due to the numerous educational advantages when both traditional classroom learning and e-learning are implemented collectively. This handbook collects emerging research and pedagogies related to the convergence of teaching and learning methods.

Wang, Lih Ching Chen, & Morgan, William R. 2008. "Student Perceptions of Using Instant Messaging Software to Facilitate Synchronous Online Class Interaction in a Graduate Teacher Education Course." *Journal of Computing in Teacher Education, 25*(1), 15-21.
This study investigated student perceptions of using instant messaging software for online interactive chapter discussions in a graduate teacher educational technology course.

Weerasinghe, Thushani A., Ramberg, Robert, & Hewagamage, Kamalanath P. 2012. "Inquiry-Based Learning with or without Facilitator Interactions." *Journal of Distance Education,* 26(2).
This paper discusses findings of a study investigating how students, in four online courses, engaged in inquiry-based learning with and without support from a facilitator. The results of the study imply that students in online discussions can engage in deep and meaningful learning, even when there is no facilitator interaction. Further, the findings of the analysis suggest that successful inquiries are possible without teacher or facilitator interactions, if learning environments are designed to support students being interactive and the students have motivation, regulatory skills and a willingness to collaborate with their peers.

How Can It Be Done for Ethics Education?

Acevedo, Jorge, Barros, Ricardo, Ramirez, C., & Realpe, N. 2009. "Engineers and their role in public policy: an active learning experience

for enhancing the understanding of the state.” *European Journal of Engineering Education, 34*(2), 171-182. doi: 10.1080/03043790902835932.
To achieve effective intervention of engineers in the public sector, engineers should develop skills to comprehend their ethical and professional responsibility, and they should gain the necessary education to understand the possible impact of engineering solutions in a global and social context. An active learning process has been conceived, which enables engineering students of Universidad de los Andes to comprehend the scope and limitations of public management, in general, with the objective of solving public problems.

Austin, Katherine A. et al. 2011. “Developing and Designing Online Engineering Ethics Instruction for International Graduate Students.” *Instructional Science* 6(39) 975-997.
This article describes an ethics education intervention, consisting of a series of online ethics learning modules, to aid international graduate students in overcoming the acculturation barriers to understanding and inculcating normative ethical obligations associated with engineering practice and research in the United States. The authors describe their instructional intervention, as well as to document the development, design, and assessment of the learning modules intended to provide students with a framework for learning ethical precepts and applying them in the engineering field.

National Academy of Engineering, Center for Engineering Ethics and Society. 2016. *Infusing Ethics into the Development of Engineers*. Washington, D.C.: National Academies.
This publication presents 25 activities and programs, many of them active-learning activities, that are exemplary in their approach to infusing ethics into the development of engineering students. It is intended to serve as a resource for institutions of higher education seeking to enhance their efforts in this area.

Brummell, Bradley J., Gunsalus, C.K., Anderson, Kerry L and Loui, Michael C. 2010. "Development of Role-Play Scenarios for Teaching Responsible Conduct of Research." ***Science and Engineering Ethics.*** **16(3)573-589. doi: 10.1007/s11948K010K9221K7.**

Describes the development and assessment of an active-learning approach to teaching ethics that asks students to participate in a role-play experience. Students were found to retain more than when they participated in a lecture or case-study discussion on the same topic.

Chung, Eun-Kyung, Rhee, Jung-Ae, Baik, Young-Hong & Oh-Sun, A. 2009. "The effect of team-based learning in medical ethics education." ***Medical Teacher, 31*****(11), 1013-1017. doi: 10.3109/01421590802590553.**

Describes the use of team-based learning (TBL) in a medical ethics course, and provides feedback on student engagement and satisfaction and assessed educational achievements. Most students perceived TBL activities to be more engaging, effective and enjoyable than conventional didactics.

Ellis, Lisa A. 2014. "Beyond a Common Approach: Teaching Students the Ethical Practice of Reference." ***Reference Librarian, 55*** **(3), 212-223. doi: 10.1080/02763877.2014.911009.**

This article describes the creation and use of case studies to help teach the ethical practice of reference. There are considerations for applying the case study method in reference that require cumulative preparation through the study and reinforcement of reference values, functions, behaviors, and ethical codes. The strategies for writing ethical case studies in reference are detailed. Overall, case studies on the ethical practice of reference are valued for promoting reflection and active learning in library science students through analysis and discussion.

Herkert, Joseph R. (1997).” Collaborative Learning in Engineering Ethics.” *Science and Engineering Ethics.* 3(4): 447-462. doi: 10.1007/s11948-997-0047-x.
Discusses the use of collaborative learning in an elective course on engineering ethics. Collaborative learning is a form of active learning in which students learn with and from one another in small groups. Collaborative learning strategies employed in the course include informal small group discussions/problem solving, role-playing exercises, and cooperative student group projects, including peer grading.

Jones, Nancy L., Peiffer, Ann M., & Lambros, Ann. 2010. “Developing a Problem-Based Learning (PBL) Curriculum for Professionalism and Scientific Integrity Training for Biomedical Graduate Students.” *Journal of Medical Ethics: The Journal of the Institute of Medical Ethics, 36*(10), 614-619.
Multidisciplinary faculty committee designed a curriculum to shape biomedical graduate students into researchers with a high commitment to professionalism and social responsibility and to provide students with tools to navigate complex, rapidly evolving academic and societal environments with a strong ethical commitment. The curriculum used problem-based learning (PBL), because it is active and learner-centered and focuses on skill and process development.

Jordan, Karin, & Stevens, Patricia. 2001. “Teaching Ethics to Graduate Students: A Course Model.” *Family Journal: Counseling and Therapy for Couples and Families, 9*(2), 178-184.
This article discusses the curriculum of an ethics course for marriage and family counseling students, focusing on (a) course objectives and course schedule, (b) active learning techniques in the classroom, (c) homework assignments (including the use of technology), and (d) midterm and final exams. The use of active teaching techniques is encouraged, for meeting today's learning styles.

Lau, Andrew. S. 2004. “Teaching engineering ethics to First-Year college students.” *Science and Engineering Ethics, 10*(2), 359-368. doi: 10.1007/s11948-004-0032-6.
Describes an active learning approach in teaching engineering ethics to undergraduates, using the case study method and student-led class discussions.

Loui, Michael C. 2000. “Fieldwork and Cooperative Learning in Professional Ethics

.” Teaching Philosophy. 23(2): 139-156. doi: 10.5840/teachphil200023217.
In two courses on professional ethics, students collaborate in small groups on a fieldwork assignment. In this assignment, students visit a site and interview several professionals to learn about an actual ethical problem that occurred at that site. The students analyze the problem and write a group paper. Through this assignment, students develop skills for working in multidisciplinary teams, and they deepen their understanding of collective moral responsibility.

Loui, Michael C. 2009. “What Can Students Learn in an Extended Role-Play Simulation on Technology and Society?” *Bulletin of Science, Technology and Society.* 29(1): 137-47. doi: 10.1177/0270467608328710.
Describes the experiences of students in In a small course on technology and society during which they participated in an extended role-play simulation for two weeks. Each student played a different adult character in a fictional community, which faces technological decisions in three scenarios set in the near future. The three scenarios involved stem cell research, nanotechnology, and privacy. At the beginning, students were apprehensive, excited, and uncertain. During the first and second sessions, they experienced some frustration, but by the end, they were generally satisfied with the outcomes. Over the two weeks, students changed their definitions of success: Initially they tried to convince others to agree with their positions; at the end, they felt that a consensus represented success.

McWilliams, Victoria, & Nahavandi, Afsaneh. 2006. “Using live cases to teach ethics.” *Journal of Business Ethics, 67*(4), 421-433. doi: 10.1007/s10551-006-9035-3.
This paper describes a live ethics case project that can be used to teach ethics in a broad variety of business classes. The live case differs from regular cases in that it involves a current situation. Students select an on-going or current event that involves ethical violations and write a case about it. They then present their case and run a debate about the challenges and issues outlined in the case and the actions that could have or should have been taken.

Meyer, Tracy. 2012. “The Intercollegiate Ethics Bowl: An Active Learning Experience”. *Marketing Education Review, 22*(3), 215-224.
This paper introduces the Intercollegiate Ethics Bowl (IEB) as a means of promoting active learning in the realm of marketing ethics. The cases discussed in the competition are based on current ethical issues and require students to provide a coherent analysis of what are generally complex, ambiguous, and highly viewpoint dependent issues. The goal is for students to approach the intellectual controversy in such a manner that they are able to arrive at the best reasoned judgment

possible. Using an active learning technique consistent with constructive controversy theory, the generation of deliberate discourse is believed to enhance students' moral development.

Pimple, Kenneth.D. 2002. "Using Small Group Assignments in Teaching Research Ethics." *Ethics in Science and Engineering National Clearinghouse* Paper 339.
Paper gives clear instructions on how to run an ethics discussion using small groups as part of a class exercise or workshop. Includes numerous ideas for how organize this discussions.

Prince, Robert. H. 2006. "Teaching Engineering Ethics using Role-Playing in a Culturally Diverse Student Group." *Science & Engineering Ethics, 12* (2), 321-326. doi: 10.1007/s11948-006-0030-y.
The use of role-playing ("active learning") as a teaching tool has been reported in areas as diverse as social psychology, history and analytical chemistry. Its use as a tool in the teaching of engineering ethics and professionalism is also not new, but the approach develops new perspectives when used in a college class of exceptionally wide cultural diversity. Two and three-part scripts for case studies based on NSF or original scenarios were written to illustrate issues such as gifts, attitudes towards women and ethnic minorities, conflict of interest, whistle-blowing, sexual harassment, individual rights, privacy, environment, intellectual property, and others. Following the presentation, the actors lead group discussion based on previously specified questions. Once the initial shyness and reluctance of some cultures has been overcome through the building of rapport, students have written original scripts based on hypothetical or prior personal situations. The method is now being adopted in a short course format to assist the professional integration of foreign trained engineers.

Sadowski, Jathan, Seager, Thomas, Selinger, Evan, Spierre, Susan, & Whyte, Kyle. 2013. "An Experiential, Game-Theoretic Pedagogy for Sustainability Ethics." *Science & Engineering Ethics, 19*(3), 1323-1339. doi:10.1007/s11948-012-9385-4.
The wicked problems that constitute sustainability require students to learn a different set of ethical skills than is ordinarily required by professional ethics. The focus for sustainability ethics must be redirected towards: (1) reasoning rather than rules, and (2) groups rather than individuals. This paper describes a novel pedagogy of sustainability ethics that is based on non-cooperative, game-theoretic problems that cause students to confront two salient questions: 'What are my obligations to others?' and 'What am I willing to risk in my own well-being to meet those

obligations?'

Stokes, Patrick. 2012. “Philosophy Has Consequences! Developing Metacognition and Active Learning in the Ethics Classroom.” *Teaching Philosophy, 35*(2), 143-169.

The importance of enhancing metacognition and encouraging active learning in philosophy teaching has been increasingly recognized in recent years. In this paper the author discusses the theoretical basis of the relevance of metacognition and active learning for teaching moral philosophy. Applying recent discussions of metacognition, intuition conflicts and survey-based teaching techniques, he then outline a strategy for encouraging metacognitive awareness of tensions in students' pretheoretical beliefs, and developing a critical self-awareness of their development as moral thinkers.

Sunderland, Mary. 2014. “Taking Emotion Seriously: Meeting Students Where They Are.” *Science & Engineering Ethics, 20*(1), 183-195. doi: 10.1007/s11948-012-9427-y.

Emotions are often portrayed as subjective judgments that pose a threat to rationality and morality, but there is a growing literature across many disciplines that emphasizes the centrality of emotion to moral reasoning. For engineers, however, being rational usually means sequestering emotions that might bias analyses-good reasoning is tied to quantitative data, math, and science. This paper brings a new pedagogical perspective that strengthens the case for incorporating emotions into engineering ethics. Building on the widely established success of active and collaborative learning environments, in particular the problem-based learning (PBL) philosophy and methodology, the paper articulates new strategies for incorporating emotion into engineering ethics education.

von Blottnitz, Harro. 2006. “Promoting active learning in sustainable development: experiences from a 4th year chemical engineering course.” *Journal of Cleaner Production, 14*(9-11), 916-923. doi: 10.1016/j.jclepro.2005.11.034.

Engineering educators in South Africa have to introduce students to a particularly complex set of issues in sustainable development, which can only be achieved through engaged, active learning. In 2003 the Chemical Engineering Programme at the University of Cape Town introduced a mandatory 4th year course on Business, Society and Environment. The coverage of topics and the set of intended learning outcomes is ambitious, spanning concepts of societal and financial benefits, engineering economic analysis, entrepreneurship, physical risk in terms of health, safety and environment, stakeholder involvement, clean production and clean

technology, and engineering ethics. Student success rates have been high in the first two years (100 and 93%), but some concern remains as to the actual learning outcomes, particularly in relation to the depth of learning, and the ability of non-first language speakers of English to fully engage with the course material.

Walling, Olivia. 2015. “Beyond Ethical Frameworks: Using Moral Experimentation in the Engineering Ethics Classroom.” *Science & Engineering Ethics, 21*(6), 1637-1656. doi: 10.1007/s11948-014-9614-0.
Although undergraduate engineering ethics courses often include the development of moral sensitivity as a learning objective and the use of active learning techniques, teaching centers on the transmission of cognitive knowledge. This article describes a complementary assignment asking students to perform an ethics 'experiment' on themselves that has a potential to enhance affective learning and moral imagination. The article argues that the focus on cognitive learning may not promote, and may even impair, our efforts to foster moral sensitivity. In contrast, the active learning assignments and exercises, like the ethics 'experiment' discussed, offer great potential to expand the scope of instruction in engineering ethics to include ethical behavior as well as knowledge.

Yueping, Zang, & Moore, Kevin E. 2005. “A Class Demonstration Using Demonstration Using Deception to Promote Student Involvement with Research Ethics.” *College Teaching, 53*(4), 155-157.
This article describes an active learning demonstration to increase student interest in and involvement with the topic of research ethics and deception. Students received false, low feedback on an exam and then completed a faculty evaluation form. The class was then informed about the deception and the research issue (the impact of grades on evaluations). Students then discussed their immediate reactions to the experience of deception. Two weeks later students wrote a reflective essay that described how their reactions and views had evolved. The discussion and essays indicated that the demonstration produced a high level of student involvement, empathy toward research participants, and self-examination.

Resource Type

Bibliography

Discipline(s)

Teaching Ethics in STEM