A Web-based Interactive Approach for Engineering Ethics Training in a Global Learning Environment

Day Radebaugh, Ph.D.
Department of Philosophy

Kurt A. Soschinske, Ph.D.
Department of Mechanical Engineering

Glyn Rimmington, Ph.D.
Boeing Distinguished Professor of Global Learning

Mara Alagic, Ph. D.
Department of Curriculum and Instruction

Wichita State University
Wichita, Kansas

Abstract

Globalization has affected the very fabric of business and engineering activities. Increasingly, new products are now designed, developed and manufactured through a collaboration of engineering, business, and manufacturing personnel from different parts of the world, many of whom significantly differ from each other in their cultural backgrounds and perspectives. This diversity entails differences in recognition and awareness of ethical issues, which must be addressed within the additional context of the increasing complexity of new technology development. A main challenge is how to address the educational requirements for engineering students and current engineering professionals to assess awareness and facilitate development of ethical reasoning skills within a cross-cultural context. This paper proposes an adaptation of an existing metaphorical approach to intercultural communication (ICC) called "cage painting" to explore the complexities and uncertainties of ethical decision-making. The current methodology of ethics training in a university environment includes case-based learning, which provides specific instances of ethical decision-making scenarios with clearly established options, but may not include the complexity and uncertainty factor of new technology, which may cloud the decision-making process. Or the scenarios may be so open-ended that no discernable course of action can be determined. The cage painting approach utilizes mutual perspective exchange and reflection to resolve a preconception or misconception – based scenario. Multiple scenarios have been previously developed into an interactive computer-based ICC tool. This paper proposes development of similar ethics-based scenarios for ethics training. A sample scenario is included in this paper which can be part of a larger ethics scenario database. The existing cage painting assessment methodology may also be useful to assess the student's ability to resolve the ethics problem.

Introduction

The term globalization captures the ever increasing interconnectivity between people of diverse cultural and political perspectives, who collaborate on endeavors of mutual benefit. In business, regarding product design and development, the trend has been changing from a vertically-integrated perspective following product inception to construction, to a horizontally-integrated one, where essential design and construction tasks are shared in a symbiotic relationship[1]. Originally product value such as design form and function, component construction, and product assembly was incorporated with local collaboration, such as the Ford motor company in the early part of the 20th century. Interactions were interpersonal, between individuals with differing local perspectives within a country but having an understanding of cultural standards and expectations within a country. Interconnectivity tools, such as the Internet, opened up collaboration opportunities between individuals and companies not available previously. This helped "flatten" the business playing field and allowed access to talent found throughout the world[1]. Geography became a simpler factor, than before, in forming partnerships in order to minimize product development time, and reduce overall design, development, and manufacturing costs. The development of the Boeing 787 "Dreamliner" is an example of such collaboration which goes beyond a customer/supplier relationship to partnerships between globally located companies tied together in research, design, and capital investment[2].

To meet the challenges of producing globally-designed products such as the Boeing 787, effective collaboration strategies are needed between globally-located engineers working under a diversity of cultural backgrounds and perspectives. This diversity includes differences in recognizing and addressing ethical issues. The importance of incorporating ethical awareness and responsibility into the cross-cultural collaboration process cannot be overstated.

For example, the University of Connecticut's policy on plagiarism recognizes that not all students have the same ethical perspective as that taken by the faculty with regard to reference citation for reports and thesis work[3]. Ethical decision-making skills are a significant part of the professional skills required of a globally-engaged engineer[2,4]. Ethical decisions can be product design-oriented, involve balancing various design criteria such as functionality, cost, and safety within a context of differing societal and personal ethical priorities between the culturally diverse groups of engineers. It can also involve the professional ethics of conduct between collaborating individuals.

Current ethics training in many universities has used case-based learning, which focus on specific instances of ethical dilemmas. The scenarios provide established options, but may not include the complexity and uncertainty issues of new technology (i.e., nanotechnology, biotechnology) which may cloud the ethical decision-making process. The scenarios may be so open-ended that no clear course of action can be determined. The ethical requirements and expectations may be defined at a corporate-level, but it is at the individual level where a potential ethical dilemmas occur, courses of action identified, and corresponding results weighed. The process is complicated when the individuals involved are of different societal and cultural backgrounds. Intercultural communication preconceptions or misconceptions are often related to ethical issues, such as cultural differences in professional practice. Such communication restrictions can also affect resolution of ethical decisions involving product development as well. For example, in development of the Boeing 777 both Boeing and its Japanese partner considered environmental effects of using composites in the structure, however, the challenge of aircraft retirement and composite disposal was an issue which took additional time to resolve due to cultural differences[2].

The challenge of teaching engineering ethics in a multi-cultural environment must then include an approach to effective cross-cultural communication. This approach must identify preconceptions and misconceptions, and lead to successful resolution of ethical issues within an atmosphere of professional respect and understanding, which is itself a mark of ethical engineering practice. The goal of this paper is to describe the contribution of these authors to the methods of teaching ethical professional engineering practice for the globally integrated, interdependent business environment. The contribution is a dynamic cluster of ethics based-scenarios to an existing online repository that is designed to facilitate "teaching, research and learning" in the area of intercultural communication competence[5-7].

Ethics Education and Training: Current State

Most philosophers of education would agree that the teaching of ethical concepts to engineers is more effective when presented as case studies that are regarded as realistic by the student[8]. Case-study learning has therefore become extremely popular in current engineering ethics courses. However, there are widely-recognized limitations of case-based teaching, mostly related to the transfer of knowledge into other contexts[8-11]. For example, many times the subject matter is simplified, omitting much of the uncertainty, ambiguity and complexity[12]. Presentation of the question can be unrealistic as well. For example, the options can be stated in a closed fashion, suggesting that there is a single right answer; alternatively, the question can be stated as a dilemma, which would imply there is no good answer. Neither format does justice to the nuanced character of the real situation. A survey of current implementations of case-based online ethical learning suggest the following set of best-practice approaches: (a) presentation of the case, followed by a set of alternatives, which explore the options in the form of a decision-tree, (b) detailed discussion and commentary on these options, (c) the ability to comment or vote on the various alternatives, (d) contribution of cases by students and other professionals, and (e) emphasis on intercultural ethical issues. Therefore an educational approach that would incorporate all or most of these approaches would contribute to the current methods of teaching and learning ethical decision making in and for intercultural communication settings.

Cage Painting Metaphor and Associated Cage Painting Simulation

Engaging in an engineering design and development at the global scene requires intercultural communication competence for all players that encompass mutual understanding of each party's perspective in the various areas of their cultural, societal, and professional background. Rimmington et.al[13] defined this process of cultural awareness and sensitization process of global learning as a pedagogical methodology which incorporates elements of "global reach" and "global perspectives". Global reach implies the technologically and institutionally based capability to communicate in real or near-real time through Web-based telecommunication equipment and Internet-based communication. Global perspectives refer to the individual's point of view in a communication exchange, which is affected by professional and personal life experiences, cultural background, and current context. The "cage painting" communication metaphor[13] can be used as a means to develop this mutual understanding, especially in the area of ethics. As applied by the cage painting metaphor likens the world each individual sees as a "cage" which filters our perception of the world as well any incoming communication. This cage is made up of the various personal and professional life experiences, cultural backgrounds and the current context of the communication. The goal is to understand your own "cage" by "painting" it through self-reflective evaluation of your own personal and cultural perspectives, and then paint your colleague's cage as well by understanding their own perspectives. For engineering collaboration the result would be a communication framework which respects and understands the individual differences in culture, and facilitates more efficient problem-solving in engineering design and development.

The four levels of cage painting[5] include:

1. Questioning about the other's perspective
2. Presenting a self-critical perspective
3. Presenting one's self in terms of the other's perspective
4. Questioning to elicit an answer in your perspective

This may involve unlearning or "deconstructing" some beliefs or understandings toward the individual based on their cultural or societal identity[5,14].

To train engineers in use of the metaphor, an effective teaching method has been developed. Cage Painting Simulation[5] (CPS) was developed to integrate the four steps of cage painting into an interactive tool that challenges the learner to examine intercultural communication preconceptions and misconceptions, with a culturally unidentified synthetic individual named Simea.

The CPS uses interactive scenarios with scaffolded feedback for three levels of learner's choices: good, mediocre, and bad[5]. The character Simia has scaffolded feedback for the same choice level. The scenarios are based on a culturally-based preconception or misconception through which the learner and Simea must navigate to successfully complete a joint task. Through the scenarios, the learner reflects on the intercultural misconception, and works with Simea to resolve the issue. Through active participation in the misconception deconstruction and resolution, the learner develops intercultural communication skills and problem resolution tools. Another feature of the simulation is that the student develops new scenarios which involve working through a cultural misconception. Development of this scenario library makes the simulator self-sustaining and relevant to multiple collaborative endeavors. Alagic et. al[5] describes the process as one in which "The learner progresses from reflective observation to concrete experiences in a virtual environment, and then to active experimentation in designing new scenarios that lead to abstract conceptualization of the ICC strategies."

The cage painting scenario shown in Figure 1, concerned with timeliness of a project, demonstrates several points. First, the scenario gives a practical demonstration of how CPS can be used to help bridge cultural communication gaps in a real-world engineering context. The setting and context should be familiar to engineers working in a global environment, and in fact is based on a situation discussed in 21st Century Jet, by Karl Sabbagh[15] Sabbagh's book discusses the problems encountered in the design and construction of the Boeing 777, which was heavily dependent collaboration with partners a global environment. Secondly, the example shows that the resolution of a communication problem in a cross-cultural context is facilitated by the CPS process, which requires an understanding of the cultural perspectives of each of the parties, and the development of a solution which can be understood in the context of each of the participants. Finally, given that the scenario is commonplace in the current engineering marketplace, the example suggests that this technique can be effectively used by many technical disciplines, which are operating in the global arena.

SCENARIO CLUSTER: ***Project Status Reporting*** **SCENARIO*: Timeliness***
SETTING AND CONTEXT: *You are representing an airplane manufacturer who has redesigned their global business practices to remain competitive. Specifically, because of the complexity of the design and the amount of capital required to adopt recently emerging new technologies, you have had to rely on foreign vendors to make subcomponents of the airplane to a much larger degree than ever before. The plane you are building has been urgently requested by your government to address inadequacies in your country's preparedness for terrorist threats. You have developed detailed contracts with each vendor, incorporating your technical specifications, delivery expectations, and penalties to be imposed for being late. Furthermore, these contracts call for an unusual degree of cooperation among vendors who are building components which interact with one another. In the interest of ensuring that all these components will eventually be compatible, the contract requires vendors to share information which would normally be proprietary with other companies.*

Figure 1: Interactive Cage Painting Scenario: Project Status Reporting – Timeliness

STEP 2: LEARNING POINT TWO – Presenting a self-critical perspective, encouraging the vendor to adopt the same approach.		
GOOD	**Choice:** *We understand that we have been forced to change the specifications, and that these factors have made the project more difficult for you. Let me try to explain the factors that have caused us to revise the specifications. These factors include data that were unclear at the beginning of the design, but also environmental and safety requirements that have only recently been finalized by the government. These requirements seem very legitimate, and will certainly result in an airplane that will have fewer safety and environmental concerns, and we feel they should be included in the initial version of the airplane, which should result in a product both companies will be proud of.*	**Feedback:** *Describes project from your perspective. Adopts objective and honest tone, rather than a personal or accusatory approach. Indicates that these design changes will lead to a safer and more environmentally acceptable product, which both companies will want to be associated with.*
BAD	**Choice:** *Regardless of how we got here, do you think you will be able to incorporate these latest changes in the final design?*	**Feedback:** *Does not provide any acknowledgement of your role in the changing of the specifications, nor attempt to argue for their ultimate benefit.*
STEP 3: LEARNING POINT THREE – Presenting self in terms of other's perspective; try to reach a middle ground that will involve both parties in the resolution of the problem.		
GOOD	**Choice:** *I fully understand your companies position, and we will do everything we can to find a way of working together to meet these deadlines. Given the way that I understand that you have structured the project, can you tell me how we can work with you to help you to succeed and meet the deadline?*	**Feedback:** *You have committed to jointly working through this problem. You are allowing the vendor to help you formulate a solution that will work within the structure and framework that they have established. You are offering assistance from your resources that will be used within the vendor's own project structure.*
BAD	**Choice:** *I'm going to assign a full-time engineer to monitor your progress through daily conference calls.*	**Feedback:** *Imposes a solution on them without respect to their framework.*
STEP 4: LEARNING POINT FOUR – Questioning to elicit an answer in your perspective; try to finalize a joint approach to resolving the issue.		
GOOD	**Choice:** *I appreciate your suggestion, and think it is a good one. Let me see if I understand what you are proposing. You are suggesting that we provide a full-time engineer on site at your factory to assist in working out these issues. And this engineer will be reporting to your project management, is this correct?*	**Feedback:** *Translates the suggestion offered back to your context, and openly acknowledges that the assistance will be used according to the vendor's own management structure.*
BAD	**Choice:** *I don't really agree with this suggestion, but there is probably no other choice than to offer you full-time assistance.*	**Feedback:** *Does not acknowledge that the solution must conform to the project structure that the vendor has already established.*
NOTE: A complete *Timeliness* scenario will include also a "Mediocre" choice for the learner.		

Figure 1, continued

Conclusion

This paper has argued that the teaching of engineering ethics must recognize that many of these issues stem from cross-cultural communications gaps. A commonplace example from current engineering practice is used to illustrate the resolution of these communications issues. This example can be augmented by many other similar scenarios, from engineering and other technical disciplines, to form a database that can be used broadly to enhance ethics education in the global environment.

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Biographical Information

DAY RADEBAUGH JR.

Dr. Day Radebaugh Jr. is a visiting assistant professor of Philosophy at Wichita State University (WSU). He previously was Assistant Director of the Information Resources Management Division, Board of Governors of the Federal Reserve System in Washington, D.C. for over 18 years. Research interests include risk assessment, ethics education, and information technology ethics. He holds a Ph.D. in Philosophy from John Hopkins University, and a M.S. in Computer Science from George Washington University.

KURT SOSCHINSKE

Dr. Kurt Soschinske is an Assistant Professor of Mechanical Engineering at WSU. He teaches the senior design project course and is implementing global learning intercultural communication methods. He was employed by the Boeing Company in Wichita Kansas for over 20 years in the areas of thermal/fluid analysis and test, ergonomics applications, manufacturing R&D, and acoustic testing. He holds a Ph.D. in Mechanical Engineering from WSU.

MARA ALAGIC

Dr. Mara Alagic is an associate professor of Mathematics Education in the Curriculum and Instruction Department, College of Education at Wichita State University. Her research interests in developing intercultural communication and global learning competence stems from having taught in culturally diverse environments and pioneered global learning projects at WSU. She holds a M.S. and Ph.D. in Mathematics from the University of Belgrade, Yugoslavia.

GLYN RIMMINGTON

Dr. Glyn Rimmington is the Boeing Distinguished Professor of Global Learning at WSU, leading the Global Learning program of intercultural communication learning. He previously was an Engineering Post-doctoral Fellow, senior faculty member of the Land & Food Resources Institute, and founder of the Multimedia Education Unit all at the University of Melbourne, Australia. He holds a PhD in Botany/Modeling from the University of Queensland.