

Preparing Ethical Leaders in Engineering Research and Practice: Designing an Ethical Leadership Module

Dr. Xiaofeng Tang, Ohio State University

Xiaofeng Tang is an Assistant Professor of Practice in the Department of Engineering Education at the Ohio State University. He worked as a postdoctoral fellow in engineering ethics at Penn State University. He received his Ph.D. in Science and Technology Studies from Rensselaer Polytechnic Institute.

Dr. Lisa Elanna Burris, Ohio State University

Lisa Burris is an assistant professor of Civil Engineering at the Ohio State University. Dr. Burris' expertise lies in the areas of cement and concrete optimization, durability of construction materials, forensic evaluation of structural and material deficiencies, and infrastructure construction and repair best practices. Dr. Burris holds a B.S. in Architectural Engineering and M.S. in Civil Engineering from Kansas State University, a Ph.D. in Civil Engineering from the University of Texas at Austin, and has over a decade of experience in construction materials research.

Dr. Nan Hu, Ohio State University

Dr. Nan Hu is an Assistant Professor at The Ohio State University's College of Engineering in the Department of Civil, Environmental, and Geodetic Engineering. His areas of research interest include advanced structural concepts, architected materials, smart structures, structural stability, structural art, biomimetics, fiber-reinforced composites, sustainable infrastructure and bridge engineering. He co-authored more than 40 publications, actively presented in national conferences, and received multiple student awards during his graduate studies. Beyond research activities, Dr. Hu has six years of teaching experience through a variety of roles and have mentored more than 10 undergraduate students on different research programs.

Dr. Natassia Brenkus, Ohio State University

Natassia Brenkus is an Assistant Professor at The Ohio State University. Her research interests include prestressed concrete behavior and structural durability.

Preparing Ethical Leaders in Engineering Research and Practice: Designing an Ethical Leadership Module

Abstract

Recent occurrences of high-profile ethical scandals in industry and the academy attest to the need for strong leadership in upholding ethical standards and cultures in business and academic organizations. Many engineering graduate students become leaders of research groups or industry projects after finishing their education. While many institutions train their graduate students in research and professional ethics, such training tends to focus on students' individual conduct. To date, few programs have explicitly sought to improve graduate engineering students' ethical leadership, i.e. the ability to demonstrate, model, and promote ethical behaviors in the organization one leads. This paper proposes an ethical leadership development module that is embedded in a civil engineering graduate seminar course.

Section one of this paper reviews two bodies of literature: ethical leadership (EL) and leadership development in engineering (LDE). Our module design is guided by a theoretical model that bridges these two bodies of literature. Section two presents the ethical leadership module in three interrelated aspects. First, we report the formulation of learning objectives based on literature on EL, LDE, as well as graduate engineering students' educational and professional needs. Second, we discuss plans for directly and indirectly assessing students' ethical leadership development. Third, we report instructional strategies for engaging students to explore ethical leadership in a graduate engineering seminar course. In section three, we share considerations for adopting this module in other engineering graduate programs, considering factors like building relationships with engineering faculty, accommodating students' workload, and aligning topical foci with students' academic and professional development.

Introduction

Frequent occurrences of ethical scandals in politics, business, non-profit, and the academy, which range from misuse of public funds and consumer fraud to sexual misconduct, make an urgent call for, among other things, leaders that can uphold ethical standards and build ethical cultures in the organizations in which they preside. Accordingly, studies of ethical leadership have grown in fields like business, government, and educational administration in the past two decades (Brown and Trevino, 2006; Tuana, 2014; Den Hartog, 2015; Bachmann, 2017). Ethical leadership (EL) refers to leaders' ability to demonstrate, model, and promote ethical behaviors in organizations (Brown et al., 2005; Brown and Trevino, 2006; Den Hartog, 2015). This paper reports an effort to introduce EL into the education of engineering graduate students.

Many graduate students in engineering become leaders in academic or industrial settings after finishing their education. EL is critical for preparing engineering graduates for both types of leadership positions. Although research on EL to date has focused largely on business and governmental settings (Treviño et al., 2003; Khuntia and Suar, 2004; Den Hartog, 2015), it is

imperative to enhance EL in the research community, given the alarming rate of research misconduct and questionable practice (Martinson et al., 2005; Fanelli, 2009). For example, in a survey of over 3000 scientists, 15.5% of the respondents reported having altered the “design, methodology, or results” of their research due to funding pressure, and 27.5% respondents admitted “inadequate record keeping” (Martinson et al., 2005). Although federal agencies like NIH and NSF mandate grantees to complete training on research integrity (Phillips et al., 2018), the ethical standards of research groups depend also on factors beyond individual training, such as group culture, communication mechanisms, and mentoring (Meyers, 2004; Anderson, et al., 2007). These factors highlight the importance of strong ethical leadership in research.

In addition, the ability to lead with ethics is critical for engineering graduates who pursue careers outside the academy. This is apparent for civil engineering graduates, who lead the development of next-generation sustainable and resilient infrastructure and make critical decisions concerning the timing and extent of needed repairs to failing infrastructure. The American Society of Civil Engineers (ASCE) *Code of Ethics* requires that “engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties” (ASCE, 2017). To live up to these responsibilities, leaders in civil engineering should not only behave as ethical individuals but also inspire and support ethical behaviors among colleagues, as well as build an ethical culture in their teams and organizations.

To prepare graduate engineering students to lead with ethics in academic and professional settings, this paper reports the design of an ethical leadership module for engineering graduate students. This module is currently being piloted in a civil engineering graduate seminar course at a large, public university. This paper reports the learning objectives, assessment plan, and instruction design of this module. We also share thoughts on adopting this module in other engineering programs.

Literature Review

Ethical Leadership (EL)

A recent and emerging body of literature investigates the ethical dimension of leadership (Brown et al., 2005; Brown and Treviño, 2006; Den Hartog, 2015; Bachmann, 2017). Brown et al. (2005) defines EL as “the demonstration of normatively appropriate conduct through personal actions and interpersonal relationships, and the promotion of such conduct to followers through two-way communication, reinforcement, and decision-making.” This definition encompasses four aspects; namely, an ethical leader 1) models ethical behaviors; 2) gives voices to others in the organization; 3) creates a structure to reward ethical conducts and discipline ethical violations; and 4) follows a process for ethical decision making (Brown et al., 2005). Research finds that EL is associated with a number of positive outcomes for organizations and employees, including increase in ethical behaviors, perceptions of the organization as an ethical context, and enhancing employee job satisfaction and psychological well-being (Brown and Treviño, 2006; Den Hartog, 2015; Bedi et al., 2016).

Several scholars have also attempted to quantify and measure a leader's degree of EL. Measurement of EL has focused primarily on people who already take leadership roles. This is evident in three major instruments developed by Brown et al. (2005), Kalshoven et al. (2011), and Yukl et al. (2013). All three scales of EL use questionnaires that ask employees to evaluate the EL of their supervisors. For leaders-in-preparation who have not had actual experiences of supervising employees, measurement of EL using self-report is more appropriate. This need is fulfilled recently with the ethical leadership questionnaire (ELQ), which assesses EL based on three interdependent ethical frameworks: justice, critique, and care (Langlois, et al., 2014).

While scholarship in EL has enriched its conceptual construction and empirical measurement, few studies have reported concrete plans for developing people into ethical leaders. To build a conceptual framework for developing engineering graduate students' ethical leadership, our work also draws from the literature on leadership development in engineering.

Leadership Development in Engineering (LDE)

Farr and Brazil (2009) recommend a leadership development model that recognizes every individual's unique "life stream." The model seeks to build on engineering students' "innate skills and attributes" through a process of assessment, challenge, and support. Other works in LDE also highlight the role of assessment and feedback in advancing students' leadership traits and skills (Riley et al., 2008; Schuhmann, 2010). Thus, the LDE literature emphasizes the development of leadership as a process, one that recognizes the innate leadership experiences and qualities students bring to their engineering learning while at the same time extends each individual's unique leadership trajectories.

Informed by the literature in EL and LDE, we strived to design an EL module that recognizes the leadership qualities of students, fosters self-reflection and assessment, and connects with students' ongoing academic and professional development.

Backward Design of an Ethical Leadership Module

We took a backward design approach to develop the EL module (Wiggins and McTighe, 2005). Following Wiggins and McTighe's suggestions, we started the design by articulating the learning objectives of this module and by defining student outcomes that indicate the attainment of the chosen learning objectives. In the following stage, the design team identified processes for assessing the targeted student outcomes. The resulting assessment plan provided the basis for creating course assignments. Finally, the design team considered what types of learning experience would assist students to complete the assignments, and these considerations guided the design of the instruction plan.

Learning objectives and student outcomes

We were clear from the beginning that the EL module aims to impact both student cognition and actions. After initial brainstorming and several rounds of discussion, the design team agreed on two learning objectives for this module: 1. Understanding different dimensions of an ethical leader; and 2. Beginning to develop oneself into an ethical leader. Objective 1 seeks to help students develop basic literacy in the conceptual and practical dimensions of ethical leadership, while objective 2 seeks to affect student behaviors so that they adjust their graduate lives in ways that prepare them as ethical leaders.

For each learning objective, the design team developed two related student outcomes. Our definitions of student outcomes focused on what students are able to do as a result of successful completion of the module. The four student outcomes are listed as following:

- 1.1 Being able to construct the profile of an ethical leader, including visions, skills, and characters.
- 1.2 Being able to analyze ethical leadership in real world context.
- 2.1 Being able to apply ethical leadership skills in a group setting.
- 2.2 Being able to assess and reflect on one's own ethical leadership development.

Outcomes 1.1 and 1.2 are indicators for learning objective 1, and outcomes 2.1 and 2.2 indicate the attainment of learning objective 2.

Assessment

The assessment plan for the EL module combines direct and indirect assessment. For each student outcome, we developed assessment processes and associated course assignments. To assess student outcome 1.1, we designed a concept mapping assignment and accompanying rubrics. The assignment asks students to work in groups to develop a concept map that illustrates the visions, skills, and characters that describe an ethical leader in academic or professional engineering. Student outcome 1.2 is assessed in two assignments: 1) a group based ethical leadership case competition, in which student groups compete by creating, analyzing, and presenting a case study that demonstrates ethical leadership; and 2) creating a code of conduct for a research group or a project team. The code of conduct assignment requires students to analyze organizational context and to develop micro-policy that promotes an ethical culture. Therefore, this assignment also assesses student outcome 2.1, for it demonstrates students' ability to impact group culture. Finally, student outcome 2.2 is assessed through pre- and post-survey using the ethical leadership questionnaire (Langlois, et al., 2014) as well as a reflection paper completed by students at the end of the semester. As we suggest in the literature review, most published instruments for measuring EL are based on report from employees *led by* the person being measured. Given that graduate students have not had extensive experiences of leading other employees, we chose the ethical leadership questionnaire, which is base-on survey respondents' self-report. While the ethical leadership questionnaire provides indirect assessment of students' development in EL, the other assignments directly assess student performance and achievement.

Instruction plan

We developed the instruction plan for the EL module based on what students need in order to complete the assignments (and hence achieving the learning objectives). As the Assessment section indicates, students complete five assignments for this module: pre- and post- ethical leadership questionnaire survey, ethical leadership case competition, code of conduct creation, concept map, and reflection paper. The ethical leadership questionnaire survey requires no prior knowledge. Also, writing of the reflection paper will be supported by the experience of completing the EL module. Therefore, our instruction plan focuses on supporting students to complete the three assignments in the middle.

The ethical leadership case competition seeks to acquaint students with an ethical reasoning process and allow them to apply ethical reasoning in real-world context. The instruction plan takes three steps to prepare students for these tasks. First, we plan to engage students in a discussion of a case study that involves research misconduct, a situation that showcases ethical violation and ineffective leadership in a setting familiar to graduate students. The seminar course instructors will scaffold the discussion to explore three components of ethical reasoning: identifying ethical issues, clarifying relevant facts and stakeholders, and formulating possible actions. Following this case discussion, we will introduce a formal ethical reasoning process via readings and instructional videos. We chose to introduce a 12-step ethical reasoning process developed by the Rock Ethics Institute and illustrated in its videos (Tuana and Vasko, n.d.). Following this introduction, we will engage students in a more complex case analysis using the 12-step method.

Policies and cultural norms in important ways shape the ethical standards of organizations. Therefore, we seek to help students examine and engage with organizational culture through the creation of a code of conduct. Preparation for this assignment focuses on revealing the interplay between policy artifacts (such as a code) and relevant institutional contexts. Hence our instruction plan includes a reading that examines the history of the first ASCE Code of Ethics (Pfatteicher, 2003), and an in-class exercise of comparing the current and the 2009 versions of IEEE Code of Ethics. These activities are designed to help students contextualize the texts of ethics codes in evolving historical and organizational constraints.

The concept mapping exercise is designed to help students make sense of ethical leadership using their own languages and visualization. In the assignment prompt, we include instructions and examples of how to create concept maps. Class discussions of ethical leadership cases, mini-presentations of ethical leadership definitions and frameworks would assist the completing of this assignment.

Figure 1 illustrates the alignment of the learning objectives, student outcomes, assessment (assignments), and instructional activities of our EL module. In addition to interaction between students and course instructors, we also took advantage of the seminar course style (which features seminar speakers) and a research grant we received for this work to create opportunities for students to interact with external academic and professional leaders. The course instructors invited one speaker who takes academic leadership roles to give a seminar talk. We are also in

the process of contacting one or two professional engineering leaders for a breakfast social with students in the civil engineering graduate seminar course. Interactions with practicing professionals may extend students' views of the importance and relevancy of ethical leadership, while also creating connections with current ethical leaders, who may serve as future mentors.

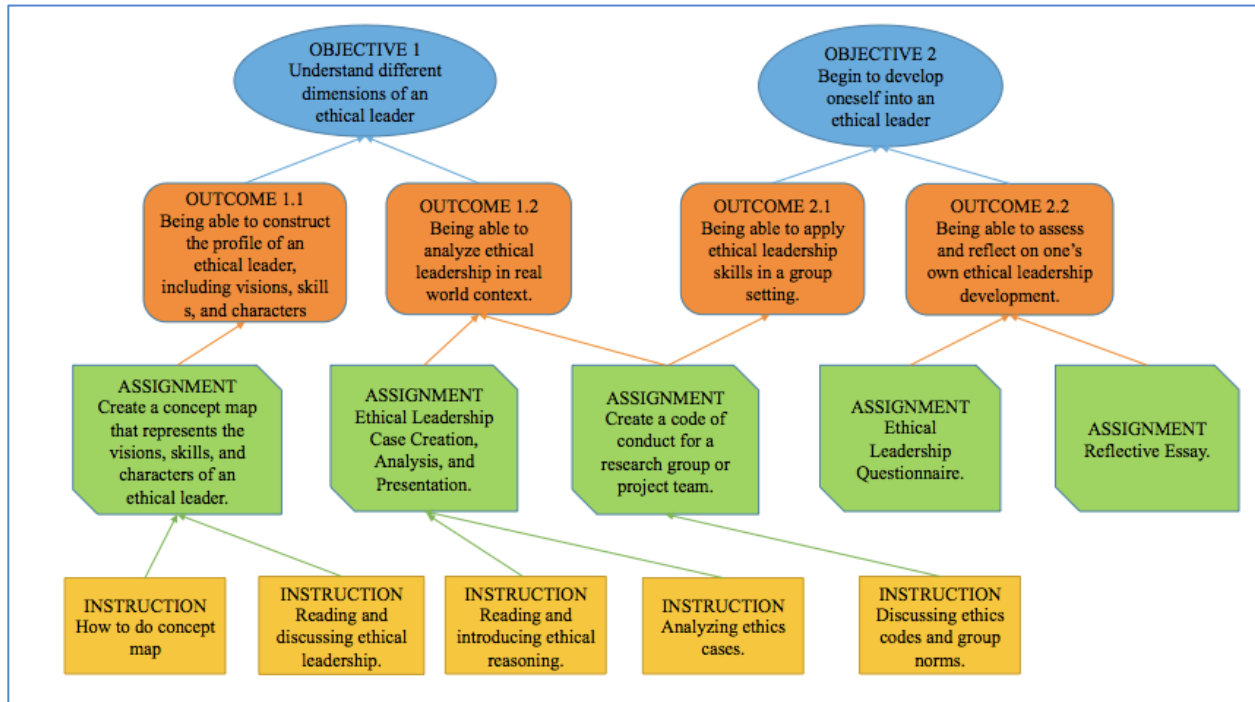


Figure 1. Alignment of Objectives, Outcomes, Assessment, and Instructions for the EL Module

Considerations for Adoption

As of this writing, the EL module is being piloted in a civil engineering graduate seminar course. This elective course, offered to both master and PhD students for improving their research and professional skills, typically enrolls between eight to fifteen students. Thus far in the module development and its preliminary implementation, we have learned the following three lessons with regard to creating or adopting an EL module in graduate engineering education.

First, it is very important for the module developers to build relations with the engineering faculty members who supervise or teach graduate students. Whether to develop an EL module for a graduate course or adopting an existing one, the module design/adopt team needs to communicate extensively with course instructors to understand the objectives, structure, and delivery format of the existing course. The module needs to be adjusted accordingly so that it “fits into” the course rather than appearing “tacked on” to an otherwise irrelevant learning experience. In our case, a relationship is catalyzed by the experience of applying for and winning an internal grant on leadership research. Planning for the grant proposal provided the design team—three faculty members in civil engineering and one faculty member in engineering

education—with an iterative process to articulate a shared vision that integrates perceived needs in the course and insights from the EL literature.

Second, the module designers/adopters should carefully consider the workload added to students. The civil engineering seminar in which we are piloting the EL module is a “pass or fail” course, and students who take the course have expectations of relatively light workload. Therefore, our design team has been very mindful of potentially disengaging impacts of a demanding workload. To balance the load for students, we spread out the module throughout the semester with brief, 15-20 minute in-class activities every other week. We also designed the assessment plan to feature frequent, low-stake assignments.

Besides a considerate workload, what ultimately motivates learning is a sense of community, consisting of emerging ethical leaders (students) in the classroom, as well as meaningful connections with students’ academic and professional pursuits. Therefore, our third lesson for developing or adopting an EL module highlights alignment of the teaching and learning with students’ academic and professional development. The breadth of EL enabled us to integrate in the module a variety of knowledge and skills related to students’ academic and professional experiences: navigating institutional contexts, understanding and changing cultural norms, creating policies, decision making, as well as written and oral communication. In addition, the module creates opportunities for students to explore ethical leadership topics they might encounter in their professional careers as a community. We strived to make the module not only a resource for developing ethical leaders but also for developing productive and successful researchers and professionals, and as an igniter for a community of emerging ethical leaders.

Conclusion

Upholding the standards of academic and professional engineering calls for strong ethical leadership. This paper reports a module for developing graduate engineering students as ethical leaders. The module, which includes learning objectives and student outcomes, assessment procedures, and instruction plans, is currently being piloted in a civil engineering graduate seminar course at a large, public university. Future work includes collecting assessment data, analyzing student learning, and improving the module based on assessment results. We plan to report the assessment results in future publications.

Acknowledgements

This work is supported by a Leadership Research Grant from the Fisher Leadership Initiative at The Ohio State University. The authors thank ASEE Ethics Division Program Chair Dr. Alex Mejia and anonymous reviewers for constructive comments.

References

- Anderson, M. S., Horn, A. S., Risbey, K. R., Ronning, E. A., De Vries, R., & Martinson, B. C. (2007). What Do Mentoring and Training in the Responsible Conduct of Research Have To Do with Scientists' Misbehavior? Findings from a National Survey of NIH-Funded Scientists. *Academic Medicine*, 82(9), 853–860.
- ASCE. (2017). Code of Ethics. Retrieved from <https://www.asce.org/code-of-ethics/>.
- Bachmann, B. (2017). *Ethical Leadership in Organizations*. New York, NY: Springer.
- Bedi, A., Alpaslan, C. M., & Green, S. (2016). A Meta-analytic Review of Ethical Leadership Outcomes and Moderators. *Journal of Business Ethics*, 139(3), 517–536.
- Brown, M. E., Treviño, L. K., & Harrison, D. A. (2005). Ethical leadership: A social learning perspective for construct development and testing. *Organizational Behavior and Human Decision Processes*, 97(2), 117–134.
- Brown, M. E., & Treviño, L. K. (2006). Ethical leadership: A review and future directions. *Leadership Quarterly*, 17(6), 595–616.
- Den Hartog, D. N. (2015). Ethical Leadership. *Annual Review of Organizational Psychology and Organizational Behavior*, 2, 409-434.
- Fanelli, D. (2009). How many scientists fabricate and falsify research? A systematic review and meta-analysis of survey data. *PLoS ONE*, 4(5).
- Farr, J., & Brazil, D. (2009). Leadership skills development for engineers. *Engineering Management Journal*, 21(1), 3-8.
- Kalshoven, K., Den Hartog, D. N., & De Hoogh, A. H. B. (2011). Ethical leadership at work questionnaire (ELW): Development and validation of a multidimensional measure. *Leadership Quarterly*, 22(1), 51–69.
- Khuntia, R., & Suar, D. (2004). A scale to assess ethical leadership of Indian private and public sector managers. *Journal of business ethics*, 49(1), 13-26.
- Langlois, L., Lapointe, C., Valois, P., & de Leeuw, A. (2014). Development and validity of the Ethical Leadership Questionnaire. *Journal of Educational Administration*, 52(3), 310–331.
- Martinson, B. C., Anderson, M. S., & de Vries, R. (2005). Scientists behaving badly. *Nature*, 435(7043), 737–8.
- McCall, R. B. (2001). *Fundamentals of statistics for behavioral sciences* (eighth edition). Belmont, CA: Wadsworth.
- Meyers, C. (2004). Institutional culture and individual behavior: Creating an ethical environment. *Science and Engineering Ethics*, 10(2), 269–276.
- Pfatteicher, S. K. (2003). Depending on character: ASCE shapes its first code of ethics. *Journal of Professional Issues in Engineering Education and Practice*, 129(1), 21-31.
- Phillips, T., Nestor, F., Beach, G., & Heitman, E. (2018). America COMPETES at 5 years: An analysis of research-intensive universities' RCR training plans. *Science and engineering ethics*, 24(1), 227-249.
- Riley, D. R., Horman, M. J., & Messner, J. I. (2008). Embedding leadership development in construction engineering and management education. *Journal of Professional Issues in Engineering Education and Practice*, 134(2), 143-151.

- Schuhmann, R. J. (2010). Engineering Leadership Education--The Search for Definition and a Curricular Approach. *Journal of STEM Education: Innovations & Research*, 11.
- Treviño, L. K., Brown, M., & Hartman, L. P. (2003). A qualitative investigation of perceived executive ethical leadership: Perceptions from inside and outside the executive suite. *Human relations*, 56(1), 5-37.
- Tuana, N. (2014). An Ethical Leadership Developmental Framework. In C. Branson & S. J. Gross (Eds.), *Handbook of Ethical Educational Leadership* (pp. 151–175). New York, NY: Routledge.
- Tuana, N., and Vasko, S. E. (n.d.) “12-step approach: From moral literacy to ethics spotting” in *Rise-up moral literacy*. Retrieved from <http://stem-researchethics.org/ru001/node/102>.
- Wiggins, Grant, and Jay McTighe. 2005. *Understanding by Design. Understanding By Design*. 2nd ed. Alexandria, VA: Assn. for Supervision & Curriculum Development. doi:10.1207/s15326985ep2403.
- Yukl, G., Mahsud, R., Hassan, S., & Prussia, G. E. (2013). An improved measure of ethical leadership. *Journal of Leadership and Organizational Studies*, 20(1), 38–48.