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Engineer of 2025? Leadership Without Foundation: Gaps in Education, Consensus, and Character Formation

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Abstract

The National Academy of Engineering (NAE)'s *Engineer of 2020* call for educational reform emphasized the need for engineering schools to raise suitable leaders to respond to the rapid evolution of technology. Five years after the reforms were supposed to be implemented in 2020, we argue that leadership education is still not structurally scaffolded into engineering undergraduate curricula.

While the Accreditation Board for Engineering and Technology (ABET) Student Outcomes and many universities' program educational outcomes highlight the development of the next generation of leaders, we do not have clear evidence that these leaders are being trained using validated leadership frameworks or that such training is equitably distributed across students. Validation of such frameworks implies the existence of an internationally or nationally recognized definition of a leader in engineering. In response to the lack of an official source of the definition of leadership in engineering, we analyzed articles to identify a consensus definition of engineering leadership. Lacking a shared conceptual framework, one existing paper identifies commonly cited leadership attributes in literature and retrospectively maps them onto existing theories. This post hoc approach focuses heavily on motifs of leadership instead of intentional formation in engineering education. As a result, it underemphasizes pedagogically scaffolded learning experiences and overlooks the formative dimensions of leadership education, particularly the cultivation of character and ethical development. Through our literature review, we mapped definitions and attributes commonly found in engineering leadership development programs.

Additionally, we performed a scoping review following the PRISMA-Sc framework, related to the current methods of teaching leadership and leadership ethics in engineering undergraduate curricula. We evaluated 125+ articles from the Education Resources Information Center (ERIC) and the Journal of Engineering Education (JEE) for this review. In the assessment of the methods, we found that most engineering leadership education is being offered optionally, or with significant time gaps between students receiving such education. Generally, a large portion of leadership training in engineering undergraduate studies occurs during senior capstone design projects, occasionally supported by first-year design introductions. Aspiring engineers were found to have 2–3-year gaps between receiving said leadership education. This also suggests that many institutions do not view character development as a necessary basis for effective teaching strategies, making the leadership framework more fragmented and increasingly subjective when applied to engineering practice.

The scattered views on leadership have contributed to a significant educational gap, as evidenced by the rise of leadership development opportunities occurring outside of undergraduate engineering curricula. These include standalone courses,

scholarship programs, and industry-led initiatives. While these external programs attempt to fill the gaps left by formal education, they raise more questions: Are they supposed to fulfill the leadership development goals that ABET and university programs promise? And if industry-led initiatives begin to define what engineering leadership looks like, does this create a conflict of interest—where leadership is shaped more by corporate priorities?

We evaluated over 15 such programs based on their methodology, underlying leadership framework, accessibility, and intended target population. In our analysis, we identified additional concerns related to equity in leadership education. Some programs required payment, raising issues of economic accessibility, while others were specifically designed for underrepresented groups. This raises another question: Should leadership education adopt a variety of frameworks, or should it aim for a universal model that applies to engineers of all backgrounds?

We propose that leadership and leadership ethics should be taught within a broader character development framework—one that addresses the key traits essential to responsible innovation and effective engineering practice. Leadership and followership should be taught in tandem, viewed as part of the same spectrum rather than mutually exclusive abilities. This approach would better prepare engineers to contribute to adaptable, high-functioning teams immediately after graduation. To reduce reliance on external programs, the gaps between academic and industry expectations must be clearly identified and addressed within the undergraduate curriculum. Finally, to ensure equitable access to leadership education, we suggest developing a foundational definition of an engineering leader that is commonly applicable.

Introduction

Engineering is a profession that cannot exist without teamwork. From large-scale projects to product development, engineering work is rarely done entirely in isolation. Even when a project begins as an individual effort, successful outcomes inevitably introduce collaboration across disciplines, roles, and stakeholders. Within teams, engineers often assume both leadership and followership roles. They may lead development, manage projects, guide teams, whilst communicating across hierarchies in parallel. The ability to seamlessly transition back and forth between the roles requires more than demands a high level of engineering communication, and ethical judgement. Engineering leadership therefore is not limited to formal titles, but becomes an everyday necessity for every professional.

It is important to emphasize that throughout this article, there is a distinction between leadership and engineering leadership and engineering leadership ethics, and that when leadership is mentioned in this paper it refers to the character trait specific to the field.

Moreover, engineers are the frontiers of innovation and play a significant role in shaping societal change. As a result, engineers bear the responsibility not only for technical outcomes, but also for ethical conduct and effective communication with the broader public affected by these innovations. Fulfilling these responsibilities requires a set of leadership skills that extend beyond technical expertise. So where does one gain this set of skills?

Before educational reforms, engineers were often expected to develop leadership skills informally through team experiences and ultimately - trial and error. As the pace and impact of technological innovation increased, reliance on a "gamble" became no longer an option.

In response to rapid innovation and growing societal impact of engineering work, the National Academy of Engineering (NAE) released the *Engineer of 2020* report [1], calling for an educational reform in the engineering curriculum of higher education. The report emphasized the need for future engineers with the ability to lead, communicate and make ethical decisions.

Leadership shifted from being implicitly treated as an innate or assumed ability to a competency that must be intentionally taught and developed within engineering education. Currently, the Accreditation Board for Engineering and Technology (ABET) Student Outcomes and many universities' program educational outcomes highlight the development of the next generation of leaders as one of the desired results from their graduates.

From the perspective of an undergraduate engineering student, a paradox often emerges regarding teamwork in engineering curricula. While there is a consensus that engineering practice is team-based, the introduction of team-based assignments within academic courses does not consistently elicit positive responses from students. To understand the cause of such a disconnect, it is necessary to examine the foundations of current curriculum development and conceptual frameworks. Early in our research, we ran into a wall - what even is the definition of engineering leadership? How are engineering curriculums being built without a common framework? In this paper we investigate published curricular articles to find a consensus definition of leadership in the engineering education context.

Despite the emphasis on leadership development within accredited engineering curricula, the growing presence of leadership programs external to undergraduate engineering education, specifically industry leadership programs, that we encountered during our initial research raised additional concerns pertaining to the potential disconnect between academia and industry. These programs range from standalone courses, scholarship programs, industry-led initiatives, as well as

minority-oriented programs. This trend raises a question central to this study: whether the current structure of undergraduate engineering curricula adequately supports leadership development.

Methods

Protocol and registration

This study was conducted as a scoping review following Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMA-SCR) [2]. A scoping review method was selected to map how leadership is defined within undergraduate engineering education and related fields as well as to characterize the range of available instructional interventions through published literature.

Eligibility Criteria

For articles to be included in our literature review, we maintained the following criteria:

1) Published in English
2) Occurs at an Undergraduate Higher Education (e.g., college or university context)
3) Addressed leadership within an engineering context and/or education methodology for engineering leadership
4) Were empirical studies, reviews, or conceptual papers published in peer-reviewed venues.

Different textbooks and other commentary or opinion articles exist to define engineering leadership, but our approach is focused on the practical implementation of leadership education in the engineering classroom or as part of a standalone program.

Information Sources

A structured literature search was conducted using Education Resources Information Center (ERIC), Journal of Engineering Education (JEE) and ASEE PEER. Search terms consisted of keywords: “successful leadership in engineering”, “definition of a successful engineering leader”, “methods to teach engineering leadership”, “engineering leadership ethics courses”.

Search Parameters and Outputs

A keyword search was applied to the ERIC database; a file was generated with at least 100 resulting papers. The file was then initially screened based on abstracts, in order to remove highly irrelevant articles. The approved papers were organized in a spreadsheet where they would be screened for content and relevancy. The articles in the spreadsheet were screened in two phases corresponding to two research questions discussed in this study. The first screening phase focused on identifying relevant papers to mapping the definition of engineering leadership, while the second screening phase focused on identifying studies that examined or presented undergraduate engineering leadership coursework. The two-stage screening process was used to ensure that articles relevant to one research objective were not excluded based on criteria applied to the other objective.

This search strategy may have limitations due to the reliance on the ERIC search mechanism, which yielded a limited range of relevant articles per individual query. Although multiple databases were used to compensate, it is possible that some relevant studies were not captured.

Data Acquisition

To quantify the data collected for the engineering leadership definition, the relevant articles were sorted into categories based on the definition provided in the body of the article. The categories were displayed as bar graphs.

1) Definition as a set of competencies
2) Power/influence over others
3) None provided/Vague
4) Searches for a definition/admits lack of definition

The data for engineering leadership education coursework was categorized by the time at which the education was administered. The following stages of engineering leadership education were identified as:

1) First-Year Course
2) Sophomore/Junior
3) Elective/Separate courses (non-major requirement)
4) Senior Capstone
5) First-Year + Senior Capstone
6) Integration throughout curriculum

Data Analysis and Presentation

All data are organized and summarized using Python and Matplotlib.

Results and Discussion

The Definition of Engineering Leadership

The first component of this review examined how engineering leadership is defined within the engineering education literature. In order to assess the efficiency of the current methods of engineering leadership education, it was important to understand the frameworks that were used to develop the curricula. The relevant articles were categorized into patterns developed during the preliminary research as is found in **Table 1.**

Table 1: Categories of Engineering Leadership Summarized from Scoping Review

Category	Description	Example
Set of Competencies	Leadership is defined as a list or collection of soft skills	When engineering companies include "leadership" in their entry-level job descriptions, this term encompasses strong communication, teamwork, and interpersonal skills [3]
Power/Influence over others	Leadership is defined as the ability to influence, direct and guide individuals	Leadership involves a power based on influence [4]
None provided/Vague Identification	Leadership is referenced as a	

	requirement without an explicit definition or conceptual framing	
Searches for definition/Admits lack of definition	The authors acknowledge the absence of a general consensus and/or attempt to compensate by conducting surveys or literature reviews to base a definition	This work is based on two survey questions that ask engineers 1) to identify exemplary engineering leaders in their lives, and 2) to describe what makes an exemplary engineering leader [5]

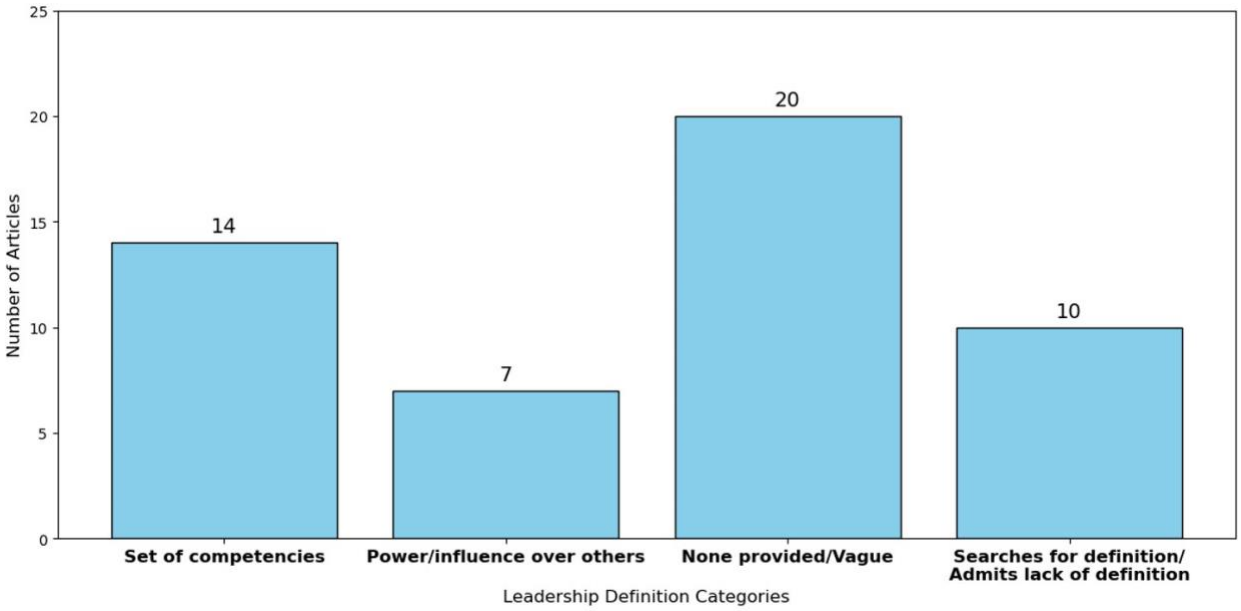

Figure 1: Number of Articles within Engineering Leadership Definition Categories based on Scoping Review.

The scoping review revealed substantial variation in whether and how leadership is defined. Across the reviewed articles, a major portion of the writing referenced engineering leadership without providing an explicit definition, relying on an implicit definition or an assumption. **Figure 1** presents the quantitative categorization of the 51 articles as part of our scoping review process, indicating that the largest fraction of articles (~40%) fell within a "None provided/Vague" characterization of engineering leadership. While this may be a subjective categorization, when compared to other articles in our scoping review process, we identify this inconsistency of definition to be apparent within this subset of articles.

Another substantial portion of the literature (27%) described engineering leadership as a set of competencies, or a list of skills that is supposed to represent leadership. It is important to note that while within this category, the lists of skills varied. While one paper described engineering leadership as strong communication, teamwork, and interpersonal skills [3], another presents an engineering leader as maintaining the highest level of integrity and ethics in every situation, envisioning engineering solutions to the issues facing society, developing the breadth and depth of

engineering knowledge to understand constraints and possibilities when developing an engineering innovation; understanding and assessing the potential markets and listening to potential users for additional innovation opportunities; effectively communicating a vision to various stakeholders; preparing novel product proposals and accepted business plans; initiating strategic risk-taking for developing projects on time, within budget, and to the client's specifications; recruiting, motivating, educating and engendering loyalty from team members; demonstrating a passion and intellectual drive for life-long learning [6]. In other words, the variation in the literature is not limited to the differences between definitional categories, but also exists within the categories themselves. Even when leadership is described as a set of competencies, the range of expectations differs across studies. This is also observed within the "Searches for definition/Admits lack of definition" category as a multitude of approaches is utilized to search for the definition across the literature.

The Power/Influence category (~20%) may be a slight exception to this since the articles generally agree that engineering leadership is an ability to inspire and motivate others. For instance, an article wrote that engineering leaders are individuals who inspire others and promote a vision that represents a grand challenge [7]. It is not always apparent from the data what is meant by the ability to influence or inspire, the professional or individual attributes are rarely described. In other words, in attempting to define an already ill- defined construct, the literature substitutes one vague concept for another. What this means is that we once again run into the "innate" stereotype surrounding soft skills, a problem highlighted in the introduction. The articles assume that we, the public, already know what an ability to inspire consists of, or that the definition of it is part of common sense. Since these concepts were historically viewed as lacking theoretical foundation, a shared consensus around the meaning was never established, resulting in a chain of definitions resembling a Russian doll.

Overall, the findings from the scoping review poses a concern over the consistency of leadership outcomes within undergraduate engineering education. Engineering leadership has become a required outcome in most accredited institutions, positioning itself on the same level as technical expertise. Despite this, while the expectations for technical education are relatively standardized across institutions, leadership education has yet to take a formal shape. The lack of a shared definition of engineering leadership carries direct implications for how leadership education is built and implemented. The following scoping review examines the structure of current engineering leadership coursework within undergraduate curricula.

Engineering Leadership Coursework

The second component of the scoping review examined when engineering leadership is being administered. The articles selected covered a range of engineering leadership course interventions

Time was chosen as the emphasis for this review. Specifically, we were interested in whether engineering leadership education is being implemented gradually throughout the 4-year curriculum, which we argue is the best approach to developing leadership skills. **Figure 2** presents the articles from our scoping review that were explicit with their implementation strategy.

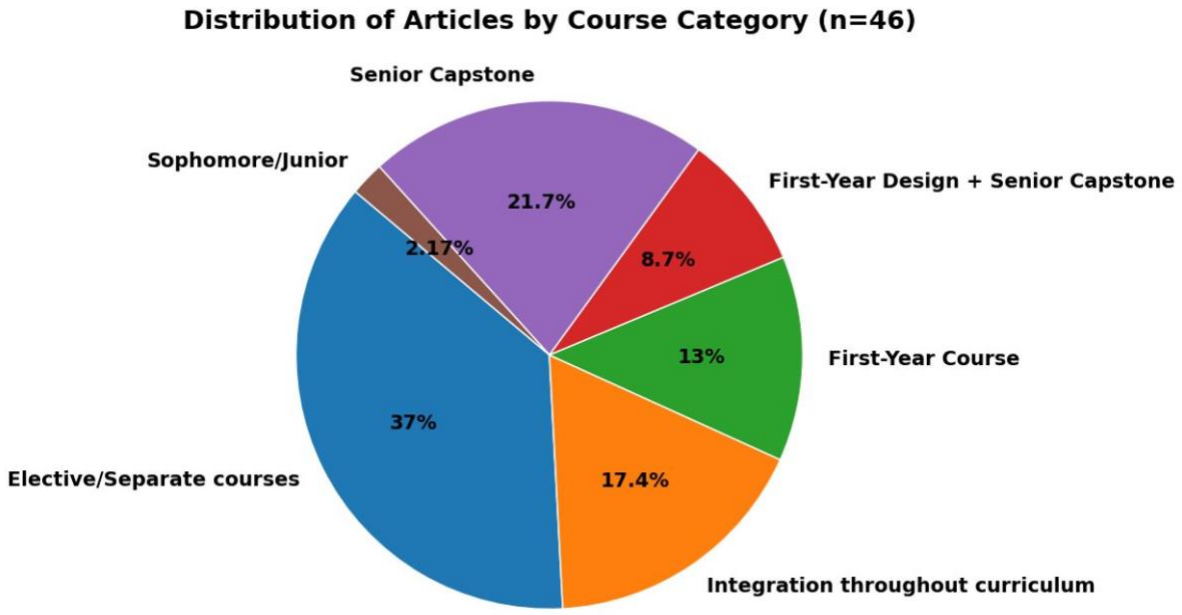

Figure 2: Percentage distribution of engineering leadership education interventions based on year, or if separated from academic progress.

A majority of the articles found were non-major, non-required electives; this raises concern over the equitable distribution of the engineering leadership outcome. Since the aforementioned courses are electives, not every engineering student will have taken the course before graduation. This further emphasizes the argument presented in the first component of the review - structured engineering leadership education is still being viewed as optional.

Additionally, our review suggests that there are significant, 2–3-year gaps between receiving leadership education given the emphasis on first-year courses and senior capstone design (43.4%) versus specific interventions in the sophomore/junior years (2.17%). Is having such large gaps between leadership education allowing students to grow into appropriate leaders? Is the industry satisfied with the leadership skills that come out of university curriculums that use this approach?

The two-component scoping review overall reveals a scattered view on leadership education, fueled by the lack of a generally accepted framework and a perception of leadership which undermines the importance of the intervention.

External Academic Programs

To address the shortcomings of current educational methods, industry and academia has responded with the emergence of external engineering leadership programs. Within academia we noted the emergence of standalone courses and certificates, especially within highly ranked, prestigious institutions. These courses are taken voluntarily, separate to any degree or professional requirements. While courses may be a plausible strategy to engineering leadership development, their external positioning further reinforces the idea of leadership as an optional or innate skill.

The biggest implication with this attempt to fill the education gap is accessibility. Most standalone courses from prestigious institutions are not free and can range up to thousands of dollars per course or certificate.

The most significant implication of this attempt to fill leadership education gaps is accessibility. Many standalone leadership courses offered by prestigious institutions require payment, with prices reaching thousands of dollars per course or certificate. As a result, access to formal engineering leadership education becomes dependent on students' economic status rather than integrated into universally available engineering curricula. Yet again we run into the issue of an inconsistent distribution of an essential skill.

Industry Programs

The growth of industry-led leadership programs signals a gap between academic preparation and professional expectations. Many companies now implement internal leadership training to equip engineers with leadership skills not developed during undergraduate education. Generally, these programs are internship or rotational programs that aim to teach leadership through professional experience and mentorship opportunities. For example, the Techtronic Industries' Engineering Leadership Development Program (ELDP) claims to provide structured leadership training alongside hands-on professional development opportunities. Siemens Healthineers R&D Leadership Development Program is a two-year rotational program that aims to build leadership skills through interdisciplinary assignments and projects. As a result, industry programs are another example where leadership is taken as a skill learned solely through experience rather than formally taught. These programs often conflate terms such as leadership, management and higher-up roles, which points to the current ambiguity of the term in the industry.

Minority-Focused Programs

This scoping review has established that the current engineering leadership education is being distributed inconsistently, posing the question of equity. In response to these gaps, a range of minority-focused leadership programs have emerged with the explicit goal of supporting students from historically underrepresented backgrounds in engineering. An example of such is the Society of Women Engineers leadership programs, which provide professional help and networking opportunities for women in engineering careers. While such programs are important to address historical inequities and systematic barriers to progress in engineering leadership, the approach of society-based or minority-focused programs is still reserved for a selective population and can address the challenges of engineering leadership education at the formative years of undergraduate learning.

Conclusion

This review argues for the establishment of a foundational definition of engineering leadership, the development of a working educational framework that is theoretically grounded and the deconstruction of myths surrounding the instructional potential of leadership. The minority-based programs should initiate discussions of whether leadership development should be guided by a single, universal framework applicable to all engineers, or whether multiple frameworks are necessary to reflect diverse identities. We argue that leadership and leadership ethics should be integrated within a larger framework of character development, which should be introduced gradually throughout the 4-year curriculum without significant time gaps. Leadership should be taught in conjunction with followership in order to raise adaptable, well-rounded engineers.

References

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[6] E. P. M. Williams, "Case Study #5: University of California San Diego – Gordon Engineering Leadership Center," *New Directions for Student Leadership*, vol. 2022, no. 173, pp. 109–111, Mar. 2022, doi: https://doi.org/10.1002/yd.20491.

[7] D. W. Hess, "Leadership Skills Awareness and Development Via Interactive Engineering Courses or Workshops," *Chemical Engineering Education*, vol. 53, no. 1, 2019, doi: https://doi.org/10.18260/2-1-370.660-107757.

Appendix A: Scoping Literature Articles Included in Scoping Review

Title	Categorization	Link/DOI
Predictors of Effective Leadership in Industry--Should Engineering Education Focus on Traditional Intelligence, Personality, or Emotional Intelligence?	Successful leadership in engineering	http://dx.doi.org/10.1080/03043797.2014.944102
Team Leadership in Engineering Education	Successful leadership in engineering	http://dx.doi.org/10.1002/yd.20479
Students' Learning of Management and Leadership in Engineering Education -- A Literature Review	Successful leadership in engineering	http://dx.doi.org/10.1080/03043797.2023.2299279
Walking and Talking Sensors: Conceptualising Restorative Leadership to Enhance People Management Education in Engineering	Successful leadership in engineering	http://dx.doi.org/10.1080/03043797.2019.1646211
Contextualizing Engineering Leadership Development in Science, Technology, Engineering and Mathematics	Successful leadership in engineering	http://dx.doi.org/10.1002/yd.20485
Early Career Engineers' Perspectives on Leadership Competency Development in Undergraduate Education	Successful leadership in engineering	https://gateway.proquest.com/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqm&rft_dat=xri:pqdiss:30994836
Engineering Leadership Development: Contribution of Professional Skills to Engineering Undergraduate Students' Leadership Self-Efficacy	Successful leadership in engineering	http://eric.ed.gov/?id=EJ1332292
The Multiple, Unique Perspectives of Mechanical Engineering Undergraduates about Their Program of Study and Their Persistence	Successful leadership in engineering	http://dx.doi.org/10.1080/03043797.2024.2406436
Developing an Engineering Leadership Identity	Successful leadership in engineering	http://dx.doi.org/10.1002/yd.20484
Leadership Skills Development among Engineering Students in Higher Education -- An Analysis of the Russell Group Universities in the UK	Successful leadership in engineering	http://dx.doi.org/10.1080/03043797.2020.1832049
Leadership Growth Over Multiple Semesters in Project-Based Student Teams Embedded in Faculty Research (Vertically Integrated Projects)	Successful leadership in engineering	http://dx.doi.org/10.1109/TE.2023.3344314
Engineering Leadership in a Chinese Industrial Context: An Exploration Using the Four Capabilities Model	Successful leadership in engineering	http://dx.doi.org/10.1002/jee.20404
In Search of a Definition and Frameworks for Engineering Leadership Development	Successful leadership in engineering	http://dx.doi.org/10.1002/yd.20477
Characterizations of Successful Leaders: A Comparison of Leadership and Non-Leadership Students	Successful leadership in engineering	https://journalofleadershiped.org/wp-

		content/uploads/2021/03/20_2_Clapham.pdf
Inclusive Leadership Development for Engineers	Successful leadership in engineering	http://dx.doi.org/10.1002/yd.20483
The Unseen Work of Establishing Engineering Leadership Development Initiatives	Successful leadership in engineering	http://dx.doi.org/10.1002/yd.20481
A Scoping Review of Professional Skills Development in Engineering Education from 1980-2020	Successful leadership in engineering	http://dx.doi.org/10.1080/2331186X.2024.2309738
Equity-Focused Leadership: The Leadership Practices and Beliefs of Principals in Academically Successful Schools Serving Students from Marginalized Communities	Successful leadership in engineering	https://gateway.proquest.com/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqm&rft_dat=xri:pqdiss:31356362
Assessing NASA's University Leadership Initiative. A Consensus Study Report	Successful leadership in engineering	https://doi.org/10.17226/25996
Undergraduate Students' Perceptions of the Development of Generic Competences and Their Relevance to the Engineering Profession	Successful leadership in engineering	http://dx.doi.org/10.1080/03043797.2022.2113763
Understanding Professional Skills in Engineering Education: A Phenomenographic Study of Faculty Conceptions	Successful leadership in engineering	http://dx.doi.org/10.1002/jee.20556
The Influence of Engineering Competition Team Participation on Students' Leadership Identity Development	Successful leadership in engineering	http://dx.doi.org/10.1002/jee.20418
Engineering: Moving Leadership from the Periphery to the Core of an Intensely Technical Curriculum	Successful leadership in engineering	http://dx.doi.org/10.1002/yd.20373
The Six C's of Successful Higher Education-Industry Collaboration in Engineering Education: A Systematic Literature Review	Definition of a successful leader	http://dx.doi.org/10.1080/03043797.2024.2432440
Characterizations of Successful Leaders: A Comparison of Leadership and Non-Leadership Students	Definition of a successful leader	https://journalofleadershiped.org/wp-content/uploads/2021/03/20_2_Clapham.pdf
The Multiple, Unique Perspectives of Mechanical Engineering Undergraduates about Their Program of Study and Their Persistence	Definition of a successful leader	http://dx.doi.org/10.1080/03043797.2024.2406436
Shared Ownership of an Engineering Success Centre to Support Students and Develop Leaders	Definition of a successful leader	http://eric.ed.gov/?id=EJ1384397
Re (Engineering) Student Success: Constructing Knowledge on Students' Experiences in Engineering Education Programs to Encourage Holistic Student Success	Definition of a successful leader	http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqm&rft_dat=xri:pqdiss:30571057

A Scoping Literature Review of Sociotechnical Thinking in Engineering Education	Definition of a successful leader	http://dx.doi.org/10.1080/03043797.2024.2346344
Students and Academicians Views on the Engineering Curriculum and Industrial Skills Requirement for a Successful Job Career	Definition of a successful leader	http://dx.doi.org/10.1515/edu-2022-0011
What Engineering Employers Want: An Analysis of Technical and Professional Skills in Engineering Job Advertisements	Definition of a successful leader	http://dx.doi.org/10.1002/jee.20581
Understanding Professional Skills in Engineering Education: A Phenomenographic Study of Faculty Conceptions	Definition of a successful leader	http://dx.doi.org/10.1002/jee.20556
Design of a Simple Rubric to Peer-Evaluate the Teamwork Skills of Engineering Students	Definition of a successful leader	http://dx.doi.org/10.1080/03043797.2024.2338239
A Scoping Review of Professional Skills Development in Engineering Education from 1980-2020	Definition of a successful leader	http://dx.doi.org/10.1080/2331186X.2024.2309738
The Impact of Different Methods of Increasing the Intensity of Compassion in Engineering Ethics Cases	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1080/03043797.2024.2341758
How to Teach Engineering Ethics? A Retrospective and Prospective Sketch of TU Delft's Approach to Engineering Ethics Education	Methods to teach engineering leadership ethics	http://eric.ed.gov/?id=EJ1316203
A Scoping Review of Professional Skills Development in Engineering Education from 1980-2020	Methods to teach engineering leadership ethics	https://eric.ed.gov/?q=time+AND+management+AND+skills&ff1=pubInformation+Analyses&id=EJ1453452
Infusing Ethics across the Curriculum in Biological Engineering: Background, Process, and Initial Results	Methods to teach engineering leadership ethics	http://eric.ed.gov/?id=EJ1279777
Experiential Learning: Exploring Nuances When Making Ethical Decisions in a Capstone Design Course	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1007/s43683-023-00126-2
"The Good Place" in Your Classroom: Recommendations for Teaching Management Ethics	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1177/23792981211041696
Moral Sensitivity among Engineering Students in a Natural Disaster Context	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1061/JCEECD.EIENG-2096
Pedagogical Innovation to Captivate Students to Ethics Education in Engineering	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1108/JARHE-02-2023-0056
Leveraging Faculty Knowledge, Experience, and Training for Leadership Education in Engineering Undergraduate Curricula	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1080/03043797.2022.2043243
Factors Contributing to Black Engineering and Computing Faculty's Pathways toward University Administration and Leadership	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1037/dhe0000407

Exploring the Discursive Construction of Ethics in an Introductory Engineering Course	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1002/jee.20367
Validating the Civic-Minded Graduate Scale with First-Year Engineering Students Using Mixed Methods	Methods to teach engineering leadership ethics	http://eric.ed.gov/?id=EJ1418651
Attitude towards Engineering Ethical Issues: A Comparative Study between Malaysian and Indonesian Engineering Undergraduates	Methods to teach engineering leadership ethics	http://eric.ed.gov/?id=EJ1240532
Integrating Ethics in Engineering Education through Multidisciplinary Synthesis, Collaboration, and Reflective Portfolios	Methods to teach engineering leadership ethics	http://eric.ed.gov/?id=EJ1279776
Compassion and Engineering Students' Moral Reasoning: The Emotional Experience of Engineering Ethics Cases	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1002/jee.20538
"We've Always Been Engineers:" Indigenous Student Voices on Engineering and Leadership Identities	Methods to teach engineering leadership ethics	http://eric.ed.gov/?id=EJ1320931
Analysis of Macroethics Teaching Practices and Perceptions in Engineering: A Cultural Comparison	Methods to teach engineering leadership ethics	http://eric.ed.gov/?id=EJ1233320
Engineering Teamwork: Low Stakes Teambuilding Activities for High-Impact Undergraduate Experiences	Methods to teach engineering leadership ethics	http://eric.ed.gov/?id=EJ1400126
What Engineering Employers Want: An Analysis of Technical and Professional Skills in Engineering Job Advertisements	Methods to teach engineering leadership ethics	http://dx.doi.org/10.1002/jee.20581
Big Data Ethics and Its Role in the¬†Innovation and Technology	Engineering leadership ethics courses	http://dx.doi.org/10.1108/JRIT-12-2022-0088
Infusing Ethics across the Curriculum in Biological Engineering: Background, Process, and Initial Results	Engineering leadership ethics courses	http://eric.ed.gov/?id=EJ1279777
Exploring the Discursive Construction of Ethics in an Introductory Engineering Course	Engineering leadership ethics courses	http://dx.doi.org/10.1002/jee.20367
The Role of Disasters and Infrastructure Failures in Engineering Education with Analysis through Machine Learning	Engineering leadership ethics courses	http://dx.doi.org/10.1061/JCEECD.EIENG-2021
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