Educating the Whole Engineer: Leveraging Communication Skills to Cultivate Ethical Leadership Character

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Dr. Olga Pierrakos is a rotating STEM Education Program Director in the Division of Undergraduate Education at the National Science Foundation (a second stint). Olga is also the Founding Chair (2017-2022) and a Professor of Wake Forest Engineering. With a unique vision to Educate the Whole Engineer and a commitment to Human Flourishing, Olga led Wake Forest Engineering to be ranked as one of the top (14th) ”Best Undergraduate Engineering Programs” by US News Report (2023). With this unique vision, Olga has also served as the principal investigator since 2019 on a multi-year Kern Family Foundation KEEN (Kern Entrepreneurial Engineering Network) award titled ”Educating the Whole Engineer” to integrate important competencies such as virtues, character, entrepreneurial mindset, and leadership across the Wake Forest Engineering curriculum. She has led Wake Forest Engineering with a focus on inclusive innovation and excellence, curricular and pedagogical innovation, and creative partnerships across the humanities, social sciences, industry, entrepreneurs, etc. in order to rethink and reimagine engineering education. All this has led to Wake Forest Engineering achieving unprecedented student diversity (42% women, 25% racial and ethnic minorities) and faculty diversity (50% women, 25% racial and ethnic diversity). Olga is an engineering education researcher, biomedical and mechanical engineer, and national leader in transforming undergraduate engineering education. She has served as founding faculty of two brand new engineering programs (the first at James Madison University) and served on several national roles across ASEE, ABET, AAAS, NSF, KEEN, etc.

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ABSTRACT - Effective communication skills are fundamental to the practice of engineering and thus essential to engineering education. In this paper, we highlight how effective communication skills can also become a vehicle to cultivate character and promote ethical development and professional conduct. Our analysis of communication seminars conducted by a former engineer and now leadership coach revealed important connections to ethics and character cultivation. Virtues that were visible in these communication seminars included empathy, honesty, integrity, humility, curiosity, courage, self-awareness, etc. Student feedback revealed important connections between communication skills and cultivation of character (grounded in virtue ethics). While this was a preliminary investigation to make visible the important integrative learning involved in both cultivating effective communication and character, there is much more work that remains in regard to integrative learning towards the Education of the Whole Engineer. Our group believes that leveraging professional skills, such as communication skills, to promote ethical conduct and character development is an important responsibility of engineering educators. We highlight important topics of communication skills that should be part of every engineering curriculum from the lens of ethics and character cultivation. This paper has the potential to transform how we teach communication skills to engineering students and how we can authentically integrate two often siloed topics - ethics and communication skills.

I. INTRODUCTION

Engineers are essential to solving the complex problems facing us in today's modern world, and many students enter the engineering profession with the motivation to make lasting positive impact. While our graduates may feel prepared to enter the workforce with strong technical fundamentals, analytical skills, software skills, and a solid work ethic, are they feeling prepared to handle the other complexities of professional practice? **Effective and ethical communication, decision making, professional conduct, leadership, social responsibility, and innovation are the core of what it means to be an engineer.** *Are we preparing our engineering graduates for the complexity of professionalism expected of them beyond the technical knowledge?* The complexity of organizations and the continuously evolving workplace requires us to better prepare engineering graduates for the professional challenges that they will inevitably face in the array of organizations they will be a part of, the diversity of teams they will be part of, and the diverse roles they will play in work environments. "Leadership, creativity, communication, management, professionalism, ethics, agility, resilience and flexibility are some examples of skills that go beyond the technical competence and which give professionals more ability to take ownership of their own career and deal with the current market's demands" (de Campos et al., 2020).

Educating the Whole Engineer implicates learning and competencies that go beyond the deep technical engineering knowledge that fill-up most engineering curricula. Whole engineer education involves competencies like communication skills, ethics, leadership, business knowledge, teamwork skills, an entrepreneurial mindset, lifelong-learning skills, sustainability,

cultural awareness, social responsibility, critical thinking skills, and so much more. While some might label such competencies as 'soft skills' or 'professional skills,' these competencies are essential to the success of every engineer. As pointed out previously, many of these competencies are already embedded within the student outcomes that all ABET-accredited engineering programs must show attainment of from graduates. And yet, while there are engineering programs that do integrate such competencies within engineering curricula, the majority do not because the assumption that is made is that such competencies are taught and learned outside of engineering classes - within the "broad education" component of the degree requirements or "on the job". When such essential competencies, though, are not integrated within engineering courses and engineering curricula - and thus not integrated with the technical aspects of engineering education - the costs are many. Integrative learning is absolutely essential to the education of engineers (Hitt, Banzaert, Pierrakos, 2023; Rover, 2007) because learning and development cannot be siloed to only technical knowledge. Further, experiential learning that is grounded in situated learning (Johri and Olds, 2011) authentically supports integrative learning. There are many advocating organizations that support the whole development of engineering graduates. First and foremost, the Engineering Accreditation Commission of ABET requires that all ABET-accredited programs demonstrate their graduates have attained seven Student Outcomes shown below (ABET, 2024). The four Student Outcomes in bold showcase the importance of personal and professional development (e.g. educating the whole engineer) beyond the three technical Student Outcomes (e.g. 1, 2, and 6). ABET's holistic approach to educating the next generation of graduates showcases the connectedness and intertwined necessity of bringing technical education and professional education together.

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. **an ability to communicate effectively with a range of audiences.**
4. **an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.**
5. **an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.**
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. **an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.**

Even beyond ABET accreditation, there are many other engineering and non-engineering professional and government organizations, including funding agencies, that have also advocated in their own ways for the whole education of engineering graduates. The calls for action to reform engineering education and to better prepare engineering graduates for the complexity of professional practice are many (Branhaver, Korte, Barley, Sheppard 2018; Jamieson and Lohmann 2009; National Academy of Engineering 2005; Shuman, Besterfield-Sacre, and McGourty 2005; National Academy of Engineering 2004; American Society of Civil Engineers 2008; McMasters and Matsch 1996; National Academy of Engineering 2004). The National Academy of Engineering (NAE) Bernard Gordon Prize is an annual award prize "to enhance U.S engineering leadership, to foster the development of engineering leaders through innovative educational programs developed by U.S. institutions of learning in the U.S." (NAE, Gordon Prize). Many professional engineering societies (e.g. NSPE, ASME, IEEE, etc.) offer continuing education opportunities specifically in areas of personal and professional development (along with technical knowledge) - ethics, leadership, conflict resolution, etc. The entire licensure process is built upon high ethical standards and "character" is explicitly part of such processes. Letters of support from "character" witnesses are even a part of the licensure process even beyond examinations engineers take.

Educating the Whole Engineer requires integrative learning and experiential learning, both of which research has shown to be essential to the education of engineers (and all professional degree-seeking learners). **In this paper, while there are many professional competencies that engineers need, we will focus our attention on integrative learning bridging communication skills (and interpersonal communication skills to be more specific) with ethics.** It should be of no surprise that a 2017 meta-analysis study (of 27 studies collectively representing over 14,000 respondents) found that communication and ethics were the 2nd and 4th most important skills needed for practicing engineers – behind problem-solving and teamwork (Passow & Passow, 2017). The top four competencies were professional skills and they ranked more highly than technical skills (Passow & Passow, 2017). **Thus, the <u>need</u> to target communication skills, specifically interpersonal communication competencies, and reasonably link such competencies to ethics, professional conduct, leadership, entrepreneurial mindset, and character is great, urgent, and novel.**

Even as Engineering Education has made strides to prepare engineers beyond purely technical skills, our research shows that we still fall short of what industry requires of young engineers in terms of sufficient workplace communication skills. There is agreement between engineering educators, engineering professionals, and employers that - **undergraduate engineering education should be doing more to prepare graduates in both communications and ethics** (de Souza Almeida et al 2019; Robles, 2012; Linvill et al 2023; Qadir et al, 2020). In regards to communication skills, several studies have found that engineering students (participating in internships) and engineering graduates (getting entry-level engineering positions) lack workplace-readiness communication abilities to be both successful in their jobs and to propel them for future career advancement (Wu, Xu, Philbin, 2023; Linvill et al 2023)

The guiding research questions (RQs) that drive our work in this paper include the following.

> **RQ1** - What connections exist in the instruction of communication and interpersonal competencies with ethics?
>
> **RQ2** - What have we learned from a pilot study of an 8-session communication and interpersonal competencies seminar series in promoting ethical professional conduct and cultivation of character?
>
> **RQ3** - What opportunities and implications exist in leveraging communication and interpersonal competencies to foster ethical professional conduct, leadership development, an entrepreneurial mindset, and cultivation of character?

II. COMMUNICATION SKILLS IN ENGINEERING EDUCATION

Because industry (and not academia) is the destination for the majority of undergraduate engineering graduates, the competency gap between engineering education and engineering practice remains wide. "While industry continues to be satisfied with the technical and scientific abilities of graduate engineers, they retain a 'marked lack of satisfaction' with their non-technical capabilities" (Nejad, 2017). Employers expect recent graduates and new hires to be able to communicate clearly and professionally and "to develop a productive working environment by participating in meetings, communicating through transparency, listening actively, and communicating with confidence, while simultaneously treating others with respect and being nice to others" (Ruff et al, 2015). To highlight even more the communication competencies expected of engineers, it is important to understand the complex professional environment.

Engineers interface daily with non-technical peers - clients, managers, directors, executives, stakeholders, government or policy makers, marketing, etc. - and thus an even greater need to demonstrate an excellent ability of communicating their ideas (Norback et al., 2009).

The changes made as a result of ABET EC2000 promoted greater curricular emphasis on oral and written communication skills within engineering education (National Academies, 2018). Although many engineering faculty cited a lack of incentives existing, more than two thirds were involved in teaching professional skills across diverse engineering coursework (National Academies, 2018). While great strides have been made in the last two decades of engineering education, in terms of teaching and learning, we still primarily see technical writing and technical presentations as the extent of communications skills taught across engineering curricula (Nicometo et al., 2010; Donnell et al., 2011; Mackay et al, 2022). Communication skills that target interpersonal communication, persuasion, conflict resolution, etc. are topics that are less common across engineering curricula.

What we do know is that the methodologies, skills, and ability of **communication in the workplace** are more desirable and relevant; they are essential to an engineer's success and yet they are "almost never explicitly taught as part of engineering education" (Burchfield & Kedrowicz, 2023). It has been said that "an engineer who is able to competently navigate

interpersonal communication concepts will have the capacity to think critically about the parameters of a given context and will be able to appropriately contextualize their verbal and written communication in a way that meets the needs of their specific audiences" (Burchfield & Kedrowicz, 2023). Engineering students passively expected to acquire interpersonal communication from classroom activities, group assignments, and lab work is simply not adequate. Engineering faculty expected to deliver effective communication courses and learning when they are not equipped with the appropriate knowledge and skills necessary is also not adequate (Beagon and Bowe, 2023).

Exemplar engineering programs that go beyond technical writing and technical presentation as the extent of teaching communication skills do exist, but such programs are not the norm. Colorado State University (CSU), as an example, targets development of engineering students' professional skills through an official program called the Professional Learning Institute (PLI). PLI provides students with "a broad array of workshops, presentations, and experiential opportunities addressing the areas of cross-cultural communication and teamwork, innovation, leadership, ethics, and public service" (Siller et al., 2009).

What we have also learned from past literature is that engineering students do not value interpersonal communication skills and do not explicitly see the value of such skills to effective engineering practice (Carrion and LeDoux, 2019). For students to value these important skills, clear career aspirations must be established (Itani and Srour, 2016).
When we think about the **communication skills** that are essential to professional engineering practice, we find many important contexts that spotlight the diversity of interactions that engineers have to be successful in their roles:

- Advocate for new ideas, projects, initiatives, policies, etc. Lead presentations for different stakeholder groups Persuade outside-the-box thinking
- Influence decisions and directions on high-stake projects Seek and secure resources and funding
- Effectively navigate disagreements and conflict Promote high ethical standards and core values
- Effectively describe tasks and ideas to non-technical audiences Interact successfully with high-level management
- Prepare and deliver effective presentations Prepare and deliver high-quality written materials
- Select the most effective medium to communicate the message Effective dyadic face-to-face communication
- Communicate with individuals from different cultural backgrounds Relate and connect with upper management and customers
- Exude leadership and confidence in meetings Counter ideas with tacts, diplomacy and poise
- Exercise Emotional Intelligence during conflict and disagreements
- Interact with people in marketing, sales, field support (Nicometo et al., 2010)
- Interact with engineers from different disciplines (Nicometo et al., 2010)

Engineers lacking these essential communications skills will over a period of time, begin to feel distant from their non-technical counterparts and misunderstood by upper management and executives. This can lead to self-isolation, loss of innovative drive, and a decline in active participation, idea sharing, and motivation. Not only does an engineer's career suffer in these instances, the loss of talent, impact, and contribution affects all. Novice engineers recognize the costs of ineffective communication and the negative impacts on job security, hindrance to meeting organizational goals and project goals, etc. (Akakepoto et al., 2022) It is the hard skills and the soft skills that are absolutely essential for "growth of an engineer in the organization" and "determines the level of success as a professional" (Mannan, 2014)

What constitutes effective communication skills then? While there is no single approved or agreed-upon 'list' of such competencies in industry or academic literature, we offer a representative one below. This list is not a complete list. It is also believed that communication skills are highly transferable across contexts, positions, and organizations because they are non-technical and non-industry specific skills (Hirudayaraj et al., 2021). Here is our list with the criteria above in mind:

Self-awareness
Adaptability
Self-regulation
Agreeableness
Conscientiousness
Confidence
Resilience
Analytical ability
Ethical Decision-making
Active Listening
Empathy
Conflict Resolution
Giving and Receiving Feedback
Culture Setting
Building Trust
Stress Management
Communication Styles Emotional
Intelligence Negotiation Skills
Persuasion and influence

III. ETHICS AND CHARACTER ASSOCIATED WITH COMMUNICATION SKILLS

Although one may not traditionally associate communication skills with ethics, we believe that this association is powerful to authentically Educate the Whole Engineer. We are certainly not the first group to make this explicit connection between ethics and communication skills. Others have demonstrated the importance of bridging ethics and communication skills and used tools such as debates, role playing (to model interactions between co-workers and/or supervisors), and scenario analyses to both teach effective communication and make visible ethical dilemmas that may arise in workplace environments (Takahara and Kajiwara, 2013). Communication ethics supports interpersonal communication development as well as supporting strong professional relationships in workplace settings (Laksana and Nurhaliza, 2023).

The importance of virtue ethics as a missing link to engineering ethics has been made because virtue ethics supports a more holistic development of human flourishing (for the self and of others) towards character cultivation (Pierrakos et al., 2019). Bridging ethics and character cultivation with teamwork and collaboration skills has been made in recent publications (Pappas and Pierrakos, 2023; Gross et al., 2021) and an investigation of student perceptions of

embedding ethics and character into the engineering classroom has also made (Koehler, Pierrakos, Yeaman, 2023). Engineering students have in fact valued ethics and character being integrally connected to technical engineering knowledge via course projects, teamwork, and engineering faculty modeling strong ethical behaviors (Koehler, Pierrakos, Yeaman, 2023).

The pedagogies we use to integrate ethics and character into engineering education are not trivial. Intentionality is needed to ensure that ethics and character are authentically connected to engineering situations and engineering contexts (Yeaman et al., 2022). Without pedagogies that support these connections, learning is hindered. Although there are some examples of approaches to bridge communications and ethics within engineering education, there is much more work needed. The fact that graduates are still falling short in both ethical reasoning and communication skills indicates the need for continued improvement - teaching, pedagogies, learning assessment - in undergraduate engineering education.

IV. PROFESSIONAL COMMUNICATION SEMINAR SERIES AT WAKE FOREST ENGINEERING

In this section, we describe the 8-session Communication Seminar Series that was deployed at Wake Forest Engineering during the 2022-2023 academic year. The trainer and facilitator for these seminar series Farnoosh Brock is a lead author of this paper. She is an electrical engineer with 12 years of experience in industry as an engineer and 13 years as a leadership coach across academic and corporate settings. The following highlights the eight sessions delivered to the Wake Forest Engineering students. Most in attendance were seniors. The 8 sessions covered the following 10 topics:

Topic 1: Cultivate Expansive Mindset

The Expansive vs. Fixed Mindset is an important starting point for workplace readiness. In this module, students were guided to understand our thinking and our identity as we enter a new ecosystem and transition from academia to the corporate/business world. Fixed vs growth mindsets (aka fixed vs expansive mindsets) were discussed to demonstrate the pitfalls that one might face as they navigate new contexts. The benefits and success that comes from having an expansive mindset (aka growth mindset) were discussed. A sample scenario used in this training session is below. This scenario enables students to learn how to apply an expansive mindset in a relevant and tangible workplace scenario and to put some experience into this ‘elusive’ concept of mindset.

Sample Scenario: One of your peers achieves a high milestone on the team project. Your emotional response to this teaches you a lot about your current mindset: are you in more of a fixed versus expansive thinking? We explored our inner monologue in this scenario and learned how to expand our language using the re-framing below:

1. Write your I WANT TO BE statements.
2. Follow with a BUT on obstacles to achieving your goal.
3. Now, scratch it out.
4. Create your AND statements.

Topic 2: Sharpen Self-Awareness

In this module, we focus on cultivating a sharp self-awareness as one navigates their new environment and builds an intentional and deliberate reputation. An essential element of the self-awareness work is around blind spots, the areas that we are not even aware of and yet do hurt our progress and upward mobility, and how to avoid this. Part of the blind spots focus on common issues such as unconscious bias, self-defense mechanisms, and habits/patterns that no longer serve us in a professional environment. A sample scenario used in this session is below. This scenario enables students to feel the power of both (1) self-awareness and (2) blind spots and how ignoring a blind spot can become a barrier to deeper relationships with their ecosystem.

Sample Scenario: We explored conversations with superiors - executives, upper management - and their body language / facial expressions in response to our request and reflection on what may have been a blind spot on our part. This is a way to sharpen your self-awareness by understanding the impression you make on your ecosystem and how to elicit the desired outcome by improving on your blind spots. A strategy to learn about your blind spots is asking for feedback from a trusted person in your inner circle with this framing: *"I am in growth mode and working on my leadership / communications skills. You are someone I trust. Could you tell me of any areas in which I could improve?"*

Topic 3: Uncover the Power of your Voice and Elevate Confidence

Confidence is a skill that can be developed like any other, and it is accessible to everyone. In this module, we dive deep into the major components of confidence, where to start working on one's confidence, and then we do a deep dive around the power of one's voice. With culture gaps, personality stigmas, and language barriers, there is no short of excuses to remain quiet at meetings, and this is precisely how STEM professionals lag growth. We turn this around here. A sample scenario used in this training session is below. This scenario enables students to tune in to their voice and realize they can train that voice on many levels to communicate better, to reach more of their desired goals in a conversation and to exude confidence simply by adjusting tone and volume and pace of their voice.

Sample Scenario: We explored two scenarios to indicate two ways for maximizing the power of your voice, in particular, the tone and pace and volume. The first scenario is to set up your project update to your manager and highlight your role while also recognizing overall team work. The second scenario is to apologize and set things right with a colleague over a miscommunication that you may have caused. Each requires you to adapt your voice to the situation in order to build trust, connect and relate with the person and have the intended result in that communication.

Topic 4: Improve Communication with 4-C Framework

Effective communication skills can help a professional navigate every scenario and situation that he/she is bound to face. This skill especially benefits highly technical individuals who think analytically and often lack the ability to 'translate' their thoughts into leadership and management language. The 4-C communication framework is a step-by-step approach with

demonstrated examples on how to connect and relate to non-technical peers and with decision makers and stakeholders in one's team/organization. A sample scenario used in this training session is below. This scenario enables students to organize their ideas, to increase clarity and compassion of their messaging for better impact and have a simple framework with which to share these ideas with clients, colleagues, peers, executives as well as with non-technical audiences.

Sample Scenario: One of the most difficult communications is when our engineer is ethically torn between challenging/standing up to or agreeing with upper management. In this scenario, we explored the ethical choice of challenging a NO from the boss in a diplomatic and effective way, outlining the step-by-step phrases as we advocate for our idea, position it for the mutual benefit of the larger team/project and make our ask.

Topic 5: Elevate Conversation Skills

Most STEM professionals avoid difficult yet necessary conversations, but this is a huge disservice to their career growth. In this module we build on the effective and proven strategies to having difficult, awkward, but crucial conversations within the ecosystem, whether that is to advocate for an idea, to ask for resources or support, to clear up a misunderstanding, to build trust with peers or management or other similar scenarios. A sample scenario used in this training session is below. This scenario enables students to personalize their conversations, to build rapport and connect deeper with others rather than just mechanically go through the motions of conversation.

Sample Scenario: We explored a sticky/awkward scenario where the engineer is the technical lead and the boss wants to know why a team member is not meeting deliverables and the plan of action on the part of the technical lead. This is sticky/awkward because tech leads want to encourage their teams and they only have a dotted line reporting structure to their teams - the boss has the hardline reporting and thus more authority - so this kind of feedback needs to be done just right. We used the 5 conversation strategies to help the engineer have a powerful conversation with the boss, see below:

1. Say A Person's NAME
2. Start with CONTEXT
3. Ask PERMISSION first
4. End on mutual AGREEMENTS
5. Set and honor BOUNDARIES

Topic 6: Influence with the Leadership Language

The influence one can exert with the right language in the business/corporate world cannot be overestimated. When you speak the leadership language in a business meeting, with your upper management, or with your executive sponsors, you influence the response and the direction of that conversation. You earn a higher level of respect, visibility, trust and are better equipped to navigate the politics as well as the delicate situations. This crucial topic is covered in this module. A sample scenario used in this training session is below. This scenario enables students

to become aware of their phraseology and to realize that the words and phrases used among top executives can very well be a part of their vocabulary, and when used well, it can make a lasting impression and enable further opportunities for all.

Sample Scenario: For the engineer to relate and connect well with their management/executive teams, we explored the power of influencing using leadership phrases. Then we explored the common scenario of making mistakes on the job and the steps to own and grow from mistakes. These are listed below:

1. Figure out who is impacted
2. Explain to direct boss in a private 1:1
3. Reassure oversight won't recur
4. Propose a solution moving forward
5. Offer to circle back with completed actions

Topic 7: Master Work Settings, Advocate for Ideas and Build Trusted Relationships

As a technical person, you must learn how to organize your thoughts in a logical and structured manner and how to facilitate and lead meetings and how to effectively articulate your ideas and get buy-in and arrive at mutual agreements. All of this is part of the top-down communication roadmap that we cover and practice in this module. A sample scenario used in this training session is below. This scenario enables students to appreciate the variety of work settings they will encounter, and gives them tools to navigate each setting most effectively, and in particular, the setting where they are asked to showcase their expertise, and how to do that effectively and powerfully to get the support needed for those ideas.

Sample Scenario: Even though engineers are often best equipped to propose new ideas in the direction of a project, their poor confidence or communication skills get in the way and most prefer staying quiet. This is one key skill to turn around for the Whole Engineer so we explored how to advocate for your ideas, especially if the idea is new/innovative. We broke it down step by step and practiced this conversation.

Topic 8: Craft your Unique Serving Proposition and Negotiate with Authenticity

Even if you are an employee in an organization, you must have your own unique brand and be able to speak to your unique value and contribution. This is beyond one's title and work responsibilities. It is the combination of three essential pillars referred to as one's Unique Serving Proposition, how you are truly serving your environment and why you are unique in how you do it. A sample scenario used in this training session is below. This scenario enables students to realize that even if they have similar expertise and experience as their peers, when they consider the element of their character and values, that combination makes them unique. Then they learn how to 'package' that unique value and speak to it.

Sample Scenario: The engineer usually does not think about their value proposition or 'branding statement' after the job interview days so in this session, we learn the power of understanding and articulating your USP - Unique Serving Proposition - and how to use the USP

in scenarios such as idea advocacy to an internal group, making requests on funding/resources for projects, and internal moves to other organizations for new opportunities. The USP helps the engineer have an easier and more impactful conversation focused on their value, and this helps them separate their worth/'deserving' from the project and speak the 'corporate currency' that leaders can understand and often respond well to.

Topic 9: Working Effectively in a Team and Giving Constructive Feedback

In almost all workplaces, you belong to a team, whether small or large, and whether you work closely together on a project or operate with a high level of interdependence and autonomy, working in teams is crucial to adapting successfully to corporate work life. A large component of that is the ability to receive feedback to grow oneself and to give effective feedback that builds our peers up. We cover all these topics and more related ones in this module. A sample scenario used in this training session is below. This scenario enables students to learn the power of people before projects - which includes being a dream team player as well as giving feedback - and this skill not only increases overall project success, it creates healthier workplace cultures for all.

Sample Scenario: Strong teamwork is no strange concept to engineers, and neither is giving constructive feedback. Yet it proves to be a difficult and uncomfortable task for most. We provided a framework that makes effective feedback part of a collaborative effort. We then practiced a scenario where their peer made a mistake, and it is up to them to provide effective feedback. The 5-step method is outlined below:

Build them up with 2 specific positive actions taken.

1. Share 1 key area of improvement for more success.
2. Validate clear understanding of feedback.
3. Agree on the next steps everyone will take.
4. Offer your support and help, then listen.

Topic 10: Identify and Resolve Conflict with Empathy, Leadership and Authenticity

Building relationships is a lifelong process in a successful career, and yet it does not come naturally to many. Regardless of one's personality tendencies, or cultural or language barriers, everyone can learn how to network effectively at an event and how to build relationships. We go over helpful dialogue openers, and follow-up messages to nurture relationships over periods of time, and the best tools at our disposal. A sample scenario used in this training session is below. This scenario enables students to understand that some conflict is inevitable, and their goal is not to avoid conflict but rather to do their great work, bring ideas and concerns to the proverbial table and if/when they encounter conflict (disagreements + tensions), to have the tools to manage and resolve that conflict.

Sample Scenario: Conflict is inevitable if our engineer is of high character, and needs to speak up, address concerns, share innovative ideas, and disagree with colleagues/clients from time to time, and conflict is one of the most crucial skills with which to equip our future engineers. The emotional toll that unresolved conflict takes is damaging to morale, culture, and final work results. We explored a highly emotional type of conflict whereby a teammate blamed the

engineer for a client mishap and reported them to the boss. We navigated this situation step by step focused first on curiously exploring the reasons with our teammate and then doing damage control from there.

The essential part in delivering the sessions described above is the application of the concepts using experiential learning. That was accomplished through hands-on exercises (solo or pair or small groups), role-play of conversations followed with specific coaching followed with the student demonstrating what they would do when faced with that inevitable scenario at their future jobs. Workshops that are highly engaging, practical, actionable and relatable to the students will inevitably enable learning. The learning environment also needs to be a safe space where openness to learning is promoted without judgment. Communication skills take practice and development as do engineering knowledge and skills. The use of authentic real-world scenarios supports the learning.

V. CONNECTING COMMUNICATION AND ETHICS

The delivery of Communication Seminar Series sessions offered by [REDACTED] students revealed important connections to the cultivation of ethics and character. A character scholar on our team and co-author Jessica Koehler reviewed the recordings delivered by Farnoosh Brock and found important connections between virtues and seminar topics. Virtue definitions can be found in previous publications [REDACTED]. Table 1 below and the excerpts that follow illustrate some of these connections. The most common virtues relevant to developing communication skills were curiosity, empathy, kindness, courage, and intellectual humility and to a lesser degree, honesty, resilience/perseverance, self-regulation.

Table 1: Summary of character virtues mapped to seminars by the research team*

Topic	Themes	Character Mapping to Virtues
Topic 1: Cultivate Expansive Mindset	Identify fixed versus expansive mindset and practice expansive mindset	Curiosity Resilience/Perseverance
	Do something scary to cultivate an expansive mindset	Courage
Topic 2: Sharpen Self-Awareness	Reflect on communication to improve self-awareness and communication with others	Empathy, Perspective, Humility
Topic 4: Improve Communication with the 4-C Framework	Introduce the 4-C Framework (Compassionate Tone, Correct Information, Clear Language, Calm Demeanor)	Kindness, Honesty, Self-regulation
	Challenge a "No" from your boss with a serving mindset	Kindness Courage
	Connect with others - personalizing communication	Perspective
Topic 5: Elevate Conversation Skills	Set boundaries and honor others' boundaries with kindness and active listening	Kindness, Empathy, Curiosity
	How to own up to workplace mistakes and even influence workplace culture around handling mistakes	Intellectual humility, Courage, Honesty
Topic 7: Master Work Settings, Advocate for Ideas and Build Trusted Relationships	Specific strategies for how to think and act like an entrepreneur, no matter the role	Courage, Creativity
Topic 9: Work Effectively in a Team and Giving Constructive Feedback	People before projects - caring about teammates is key to successful teamwork	Empathy, Teamwork, Curiosity
	Actively address when teamwork is faltering without unprofessional behaviors such as avoidance, defensiveness, etc.	Courage, Self-regulation Intellectual humility
Topic 10: Identify and Resolve Conflict with Empathy, Leadership and Authenticity	How to keep your temper	Self-regulation
	Assess and accept others' emotional states	Empathy, Curiosity, Perspective
	Listen deeply and reflect back	Empathy, Curiosity

***Note that Topics 3,6, and 8 are not represented due to lack of clear connection between the topical content and character virtues**

The following excerpts are a few examples of how Farnoosh Brock integrated character virtues either explicitly or implicitly. This is not comprehensive of all topics or instances of character within them, but is intended to provide a brief overview.

From Topic 1: “Cultivate Expansive Mindset," Ms. Brock addresses the role of **curiosity** in fostering an expansive mindset as preparation for how to handle conflict at work:

> *“if you have more of an expansive mindset, you're like, Oh, the situation happened and I don't love it. I'm not happy about it. I'm actually frustrated. However, I wonder what results I can create this time. What I might do differently this time. You stay open and* ***curious****. That is more of an expansive mindset.”*

From Topic 4 “Improve Communication with 4-C Framework” Ms. Brock] addressed the role of **perspective** taking, by observing and adapting to the style of another, in order to personalize communication to better connect with others. This leads to more trust and better collaboration.

> *“Everybody can communicate. Sometimes they communicate really well, but there are very few that connect…Now, if we are really good, our communication, we stay connected, especially if the stakes are high. So to do that, we need to learn to adapt our style of communication if we choose to the style of the other person* ***(perspective)****, if it's different from us.”*

From Topic 5 “Elevate Conversation Skills” seminar. Ms. Brock addresses the importance of **intellectual humility, honesty,** and **courage** to recover and grow from inevitable workplace mistakes.

> *“whatever line of work you're in, you're going to make mistakes and you're going to feel bad about it…So we're going to talk about how to own and grow from our mistakes* ***(intellectual humility)****...first of all, we never hide the mistake, we never cover it up* ***(honesty)****. That's the number one temptation…And then 99% of the time we go to our direct boss, request a meeting and explain…That's going to take* ***courage****.”*

This preliminary analysis bolstered confidence in how the seminar series was able to simultaneously support the development of the communication skills and character virtues relevant to ethical decision- making and led to the empirical study of student data presented in the following sections.

VI. METHODS

Five sessions of the Communications Seminar Series were offered as part of a 1-credit engineering elective available to all undergraduate students in the Fall of 2022. Student data was collected from two primary sources: (1) a series of three surveys designed, administered, and with responses synthesized by Ms. Brock and (2) a weekly online written discussion forum. Sixteen students (5 first-year, 3 second-year, 2 third-year, and 6 fourth-year students) formally enrolled in the course, but an additional 37 students completed the initial pre-survey. All sixteen enrolled students completed the second survey, though this data is not included due to its peripheral nature. Fifteen of the sixteen enrolled students completed the third survey. The course discussion forum was available for all five communication seminars, though not all students participated each time: Seminar 1, Topics 1 and 2 ("Cultivate Expansive Mindset and Sharpen

Self-Awareness") (15 student respondents), Seminar 2, Topic 3 ("Uncover the Power of Your Voice and Elevate Your Confidence") (12 student respondents), Seminar 3, Topic 4 ("Improve Communications with 4-C Framework " (6 student respondents), Seminar 4, Topics 5 and 6 ("Elevate Conversation Skills" and "Influence with Leadership Language") (12 student respondents), and Seminar 5, Topic 7 ("Master Work Settings, Advocate for Ideas and Build Trusted Relationships") (9 student respondents).

The surveys consisted of a combination of multiple choice and open-ended questions designed to elicit students' interests and needs that the seminars could address. For this study, relevant data was selected by the co-authors from the reports synthesized by [REDACTED] in order to provide context for student self-reported communications skills gaps, but no further analysis was conducted.

In the discussion forum, students were prompted to share their top 1-2 takeaways from the communications seminar they had attended the week prior. Responses were qualitatively mined by a single researcher using an inductive coding approach to identify evidence of character development in conjunction with communications skill development. Given the exploratory nature of this study, student prompts were open-ended and responses were not explicitly targeted to character and therefore did not warrant systematic analysis, findings are considered preliminary indicators to determine whether further more targeted data collection and rigorous and systematic analysis would be warranted in the future.

VII. RESULTS - STUDENT FEEDBACK AND INSIGHTS

In this study, students' self-reported skills gaps prior to participating in the seminar series align with industry and employers call for improved communication skills of engineering graduates. These skills focus primarily on navigating, even initiating, difficult conversations at work, which have ethical implications. From the seminars, students indicated learning four key interpersonal communication skills to this end that either implicitly or explicitly involve several virtues: (1) Positive self-talk (courage, intellectual humility, resilience), (2) Receiving/asking for feedback (intellectual humility, courage), (3) Greater self-awareness around verbal and non-verbal communication to others (curiosity, empathy/compassion, and (4) Active Listening.

Student Self-Reported Skills Gap

Prior to the seminar series, students completed a pre-survey gauging their interests, needs, and concerns regarding their engineering careers. Results revealed that 20.8% worried most about how to have conversations with managers and bosses. In a subsequent survey, students were given a prompt about how to handle a conflict with a boss, only 13.3% felt confident they could handle it well. The student quotes below further illustrate this overarching theme of needing to be more equipped to effectively participate in or initiate difficult conversations.

> *"I'm nervous about my introvert personality preventing me from communicating my ideas, questions, concerns, and opinions."*

> *"While I am good at speaking up, I often struggle with disagreeing respectfully whether that*

be with a teammate or an authority figure."

"I would love to learn how to properly go at potentially uncomfortable situations."

"I think I most struggle with asking for help or things I need, like time off, and extension, and other accommodations for situations."

"I worry about coming off too harsh or by being too partial to my own work…I do not take too well to criticism so this is something I need to work on."

"I struggle with bringing bad news to a team of people and worry about having to do this as a team leader."

Student Character and Communication Skills Development from the Seminar Series

Student takeaways from the seminars revealed four main areas of skill development that will better enable them - directly or indirectly - to have difficult conversations. Each of these require and/or cultivate one or more character virtues.

1. ***Positive self-talk supports courage, intellectual humility, and resilience in the face of limitations, conflict, or other obstacles.***

   "Sometimes when things are hard, I tend to ignore that I am struggling in an attempt to overpower challenges without admitting to the struggle. This seminar helped me realize that I need to change my mindset. Instead of "let me ignore my struggles and power through" I need to be saying "yes this is an area I am struggling with, and I know I have the skills and resources to succeed." - student takeaway from the "Cultivating an Expansive Mindset and Self-Awareness" seminar

2. ***Receiving/asking for feedback requires and cultivates intellectual humility and courage.***

   "One good takeaway from Farnoosh Brock's workshop was the importance of asking for feedback, it might be something intimidating at first, but if it is asked in an appropriate and smart way it can be of great benefit." – student takeaway from the "Expansive Mindset and Self-Awareness" seminar

   "My biggest takeaway from Farnoosh Brock's workshop was the idea that you should be open to improvement and be fearless of asking your peers to provide constructive criticism on things that you can improve upon. I especially liked how she emphasized that this could be asking a close peer or coworker as well as someone who ranks above or below you." – student takeaway from the "Expansive Mindset and Self-Awareness" seminar

3. ***Self-awareness of own verbal and nonverbal communication to others cultivates empathy and perspective.***

   "I like how Ms. Brock talked about how our body language and communication skills can affect how we are perceived in the eyes of other people. I want to become more aware of how

I communicate." – student takeaway from the "Improve Communication with the 4-C Framework" seminar

"It was beneficial to be made aware of the phrases that negatively impact the delivery of what I am trying to say as well as have phrases to say instead. I tend to be very straightforward and direct when responding to others which is sometimes too harsh. Learning ways to understand what others are saying and being able to make sure I am understanding what they are saying will help me to be not only a more effective team member but also a better leader." – student takeaway from the "Empower Your Conversation Skills and Leadership Language" seminar

4. ***Active Listening requires curiosity and empathy***

"I liked how Ms. Brock emphasized the importance of listening to others and making sure they are heard. It is important to acknowledge what the other person is saying and encourage them to expand on their idea with phrases like "Hmmm. Tell me more. I'm listening" to let the other person know you are interested in their concept." - student takeaway from the "Empower Your Conversation Skills and Leadership Language" seminar

These findings serve to illustrate the nuanced set of communication skills that students learn in the seminar series that also better prepares them to handle the delicate and complex nature of interpersonal relationships, which are a key variable in ethical decision-making and action-taking.

VII. DISCUSSION

In this paper we have shared our analyses of the Communication Seminar Series at Wake Forest and the connection between communication and ethics/character. We also have learned a broader perspective from doing a similar seminar series at 6 other universities across a total of 8 engineering programs and these highlights inform our discussion. We invite all engineering educators to reflect on how this might align or support your own university's approach to Educating the Whole Engineer. **Bridging communication and ethics within engineering education offers promise and embodies the need for more integrative and experiential learning to prepare our engineering graduates for professional practice.**

Although this paper serves as a preliminary investigation of integrating communication skills with ethics and character cultivation, we believe more work and more research is needed. Future work should bridge engineering education practice (e.g. teaching, pedagogies, assessment) with engineering education research (e.g. theoretically grounded studies to investigate integrative learning). The implications for engineering educators are many and we hope that this paper inspires more educators to integrate what might appear (and is most often delivered) as distinct and siloed learning (e.g. communications, ethics, teamwork) as a more integrated, holistic, and authentic approach to bringing real-world engineering practice into the classroom. Connecting communications and ethics in engineering classrooms is just one way. Educating the Whole Engineer requires a holistic approach, an authentic approach, a human

flourishing approach, and an experiential approach to cultivating the next generation of engineers.

Here are some other **observations** about bridging communication skills and engineering ethics skills in the engineering classroom.

1. **The value is loud and clear for engineering educators.** Engineering faculty, educators, chairs and program heads have accepted communication skills and ethics reasoning as a key essential to workplace success in engineering/STEM, and are integrating the content in their curricula. This effort varies greatly across institutions and even programs within the same institution.

2. **The value is not consistently loud and clear for the undergrad engineering students.** This group may have had an internship in addition to their academic experience. With exceptions of 5%-10%, the majority of this group is mildly aware that professional skills development (e.g. communications, ethics, etc.) work is essential to their success. While they are not resistant to learning, they do not see the urgency of exposure and skill transfer at this stage. This could be improved with the help of faculty mentoring along the way. Based on communications seminars at other universities, it appears that graduate engineering students, who have more experience in professional settings, value this work better than the undergraduate engineering students.

3. **The current level of communication skill coverage for undergraduate engineering students is low and inadequate.** Even though the students rate their own skills higher in the pre-workshop surveys, they are still unskilled in using their voice, confidently speaking in a conversation (negotiation, performance, conflict resolution, other similar scenarios) with their colleagues or managers. They understand the ideas in theory, but still largely appear self-conscious and timid in their actual communication skills.

Based on the experience of the authors, the following list offers some **guiding principles** in regard to delivering successful communications workshops for maximum impact:

1. **In-Person Format**: The workshops are always delivered in-person. The only component that is done virtually is the pre-workshop and post-workshop surveys sent anonymously to students to collect initial data. Experience has shown that material presented in an experiential format with 20-30% lecture and the rest consisting of engaging conversations, discussions, or exercises is most effective.

2. **Unified Vision**: Preceding the workshops, strong vision setting has to take place between program directors and/or whoever is hosting the workshop and workshop facilitator/trainers. The workshop hosts that emphasize the importance of communication skills in the engineering field, highly encourage attendance and participation, and thus show unity of vision with the trainer on their efforts. This unified vision for the Whole Engineer is essential to the success of this partnership.

3. **Priming**: Students are made aware of the workshop through flyers, and a personalized video and notifications two to three weeks in advance. This helps them connect with the workshop trainer's style, approach, background and primes them to show up.

4. **Space Set-up**: The rooms are ideally set up in such a way that encourages collaboration, discussion, and participation. Auditorium style is the least desirable type of space and small classrooms which are level with the trainer as well as large tables to accommodate 3-5 to a table are best for all the exercises as well as a sense of community versus individual competition for attention.

5. **Experiential Learning**: First, the foundation is established with the overall concepts and methodologies. Next, the students put those concepts and methods into practice through role play of conversations, voicing out the phrases, going through actual scenarios and predicting as well as playing out their exact response. The trainer demonstrates as needed. In this way, the students embody the principles in their voice and body and become more comfortable. They fail and laugh and have fun in a safe space. They come to appreciate the challenge in this deep and powerful skill of communicating well and walk away more prepared for when they inevitably face those situations in the workforce.

It is needless to mention that a vast topic such as communication and ethics can be taught in many ways, based on many proven useful methodologies available in the field. It can also be taught by those who have theoretical knowledge of the material as well as by those who have actual experience in the engineering workplace. Our experience speaks to the latter group as it brings actual experience from the 'cubicles to the classrooms', if you will, and then it shapes that knowledge from an interesting 'lessons learned' format into a teachable trainable transfer of skill for the student. The workshops are not merely based on actual experience; they are methodologies that build on those lessons into transferring these essential skills to the students. The idea is not to just inspire the students to avoid pitfalls but also to teach them precisely how to avoid such pitfalls.

The value of this specific type of experiential workshop is that it combines several key factors: (1) first-hand experience in the corporate setting of the trainer herself (2) as well as the second-hand experience of all her clients and (3) the methodologies and principles of The Serving Mindset (Pub: 2018 by Skyhorse Publishing) which is an approach to leadership that always puts people before projects, people before profits, to cultivate thriving workplaces and healthy cultures and (4) actual demonstration of each and every method described, such as tone of voice in a particular conversation, presenting oneself professionally in a meeting, making eye contact, exuding executive presence, interrupting without alienating, and so on, and (5) last but not least, application of those methods into actual scenarios that are played out in the classroom with the students.

As a result, the students immediately formed trust with the trainer who has significant industry experience. When the student made the connection between the trainer/instructor's experience and their own future experience, they were attentive and curious enough to ask "what should I do if that happens to me?". The students were able to answer that question with the precise 1-2-3 step by step instructions that they received during the workshop. And last but not least, they were

made slightly uncomfortable to put their learning into practice through the various exercises and role plays of relevant scenarios.

Some of the most relevant scenarios of our workshop from what an engineer will inevitably face in the workplace are below:

1. Conversations with one's immediate boss or manager
2. Resolving conflict in peer-to-peer, client or management relations
3. Asking for help, resources, or advancement opportunities

VIII. CONCLUSION

A major goal in this paper is to demonstrate the innate connections between ethics, character, and communication skills. With engineering education's desire to Educate the Whole Engineer, we showcase examples of how ethics, character, and communication skills can come together to prepare graduates for professional work environments and professional practice. While delivering communication skill sessions to the engineering students, we have seen that there is always a connection between our character and our communication. The challenge is that this connection is often neither obvious nor displayed with intention in the traditional engineering classroom environment. Our goal in making this connection deliberate and intentional for the engineer and for engineering education leads to our hope that future work in this integrated learning space (connecting communication skills to character and ethics) can take place. There are opportunities to rethink how to: (1) integrate learning content, (2) rethink pedagogy, (3) assess the learning, and (4) continue research-grounded investigations.

ACKNOWLEDGMENTS

The authors would like to thank the Kern Family Foundation for supporting this research as part of a KEEN (Kern Entrepreneurial Engineering Network) award titled "Educating the Whole Engineer" granted to Wake Forest Engineering under the leadership of co-author Pierrakos and the remarkable work of wonderful colleagues and affiliates of Wake Forest Engineering. The perspectives in this paper do not represent the views of the Kern Family Foundation or KEEN.

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