

# A Letter to the Future Engineer: Exploring cross-cultural engineering identities through practitioners' letters of advice

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**Abstract**— Engineering education researchers have been trying to improve the quality of engineering education. Related to these efforts, it is important to revisit and better understand the definition of engineering education. As part of our PhD coursework, we were required to create a short video depicting our understanding of the definition of engineering education. For this purpose, we created “*a letter to the future engineer*” that presented a holistic view of the challenges and opportunities involved in the professional practice of engineering. To write our letter, we collected real letters of advice from practicing engineers with varying demographic characteristics and experiences. Thematic analysis of the letters uncovered some country-level differences in terms of priorities, perceptions, and the professional life of the contributing engineers. The aim of this work-in-progress paper is to describe our experience of generating this letter of advice and to comment on the patterns we identified during this process. This idea calls for more in-depth studies to reveal the influence of culture and geographic regions on the engineers’ perceptions of their profession.

**Keywords**—engineering practice; ontology; cross-national; engineering identity; global engineering; letter; advice

## I. INTRODUCTION

This work-in-progress paper came into being as a class project for a graduate-level engineering education course, ENE 502: “History and Philosophy of Engineering Education” [1]. For this project, students were required to depict their understanding of and inquiry into the definition of engineering education in the form of a short video. Some of the guiding questions that shaped both the class in general and this assignment in particular were: “*What is (and should be) engineering?, what is (and should be) the purpose and process of engineering education?, who gets to be an engineer (and who should get to be)?...*” As our project group comprised people from multiple cultures and ethnicities, we decided to portray our vision of this task within a global framework. Rather than focusing on descriptive or normative definitions of engineering education, we preferred to focus on sending a positive message, one full of hope in the future of engineering practice. To make our vision a reality, we decided to create a video for the future generation of engineers which could serve to advise them during their learning process and future

practice. Without ignoring requirements by different national accreditation bodies [2], [3], we opted to capture the messages that current practicing engineers would like to send to their successors. Moreover, to make the content of the video as realistic as possible, we decided to ground the video in the perspectives and experiences of practicing engineers.

In order to make the letter more personal, we asked practicing engineers to write letters to someone who was close to them (a son or a daughter, a niece or a nephew, a younger friend, etc). We asked them to assume that the intended recipient of the letter would be starting their engineering training soon and that this letter would serve as a means to guide them throughout their journey. A variety of prompts were given to the letter writers, the intent of which was to capture the following questions:

1. What advice can an experienced engineer give to an incoming generation of students?
2. What aspects of their training and practice should they pay special attention to?
3. According to their perception, what facets were missing in their own training, which they wished these new generation of engineers to experience?

We collected 21 letters from practicing engineers located in U.S., México, Pakistan, Canada and Brazil. We analyzed these letters to identify themes and topics which were then used to create a unified letter of advice to the future engineers. During this process, we had some interesting and meaningful insights, which motivated us to write this paper. Since this endeavor was initiated as a class project, our motivation was merely exploratory and was not supported by an extensive literature review. Similarly, there was no theoretical framework shaping this work. However, the next sections will discuss the process of letter development and our resulting insights, including some suggestions for future research that can potentially be derived from this preliminary effort.

## II. LETTER DEVELOPMENT

The first four authors independently sent an open invitation to their personal network of engineers. This

network consisted of parents, siblings, friends, cousins, colleagues and acquaintances in general. As one of the instructors of this course, Dr. Jesiek provided support and feedback about the original idea and venues of letter collection and analysis.

From the 21 engineers replying to the invitation, only three were women. Respondents ranged in ages broadly, from early 20's to late 70's, implying all levels of experience. They had experience in industry, academia or both. Many of these engineers had international working experiences in addition to working in their home countries. Others were working or conducting graduate studies outside of their home country.

Letter writing as our method of data collection gave the engineers freedom to express their views without any constraints, the intention of which was to ground the letter in realistic, practical, and meaningful experiences.

The thematic analysis of letters resulted in four broad themes that are summarized in Table 1. The columns denote two main phases of engineering life as mentioned by the writers: 1) college experience/training, and 2) professional practice. The rows denote themes corresponding to their academic and personal life. During analysis, we identified some themes that emerged consistently from engineers practicing in the United States and those practicing outside the U.S.

From Table 1, it can be seen that the most common themes across countries were those related to academic college experiences. Letter writers suggested future engineers not get frustrated by courses if they could not make sense of or connect with them initially. They encouraged students to acquire communication, teamwork and critical thinking skills, which they found more useful than pure academic skills. A recurring theme was advice on understanding that engineering training should be focused more on 'learning how to learn' rather than preparation of specific skill areas. In terms of personal life, letter writers from all locations suggested that future engineers should proactively get involved in extracurricular activities.

In the professional realm, engineers based in the U.S. offered more advice in terms of how to get a good job and being prepared for it. Engineers from other countries were focused more on continuous learning and ethical considerations in engineering practice. However, both groups were aware of the variety of possibilities that a future engineer could possibly pursue, e.g., in industry, academia, and research. Some advice provided for the personal life by U.S. engineers was to keep a work-life balance, while non-U.S. engineers suggested a more holistic growth, ego control, and caution against discrimination. The following section will consider the value found in this letter writing process and how this effort is envisioned to generate valuable new inquiries to identify trends in different identities of engineering across countries and cultures.

TABLE I. THEMES IDENTIFIED IN LETTERS WRITTEN BY PRACTICING ENGINEERS

	<b>College Experience/Training</b>	<b>Professional Practice</b>
<b>Academic</b>	<u><b>U.S.</b></u> <ul style="list-style-type: none"> <li>• seek networking</li> </ul> <u><b>U.S. and non-U.S.</b></u> <ul style="list-style-type: none"> <li>• persevere through nonsensical, hard or, disconnected course content</li> <li>• acquire communication and critical thinking skills</li> <li>• look for internships</li> <li>• learn how to learn</li> </ul> <u><b>non-U.S.</b></u> <ul style="list-style-type: none"> <li>• don't focus only on grades</li> </ul>	<u><b>U.S.</b></u> <ul style="list-style-type: none"> <li>• getting a good job will mostly depend on non-technical abilities ("soft skills")</li> <li>• look for mentors</li> <li>• your engineering degree will open doors</li> </ul> <u><b>U.S. and non-U.S.</b></u> <ul style="list-style-type: none"> <li>• career paths for engineers are varied</li> </ul> <u><b>non-U.S.</b></u> <ul style="list-style-type: none"> <li>• keep your ethical and moral values aligned with your work</li> <li>• remain abreast of technological developments</li> <li>• ensure your solutions are within a human framework</li> </ul>
<b>Personal life</b>	<u><b>U.S.</b></u> <ul style="list-style-type: none"> <li>• connect your hobbies to engineering</li> <li>• learn to manage your free time</li> </ul> <u><b>U.S. and non-U.S.</b></u> <ul style="list-style-type: none"> <li>• seek extracurricular activities</li> </ul>	<u><b>U.S.</b></u> <ul style="list-style-type: none"> <li>• maintain a healthy work-life balance</li> </ul> <u><b>non-U.S.</b></u> <ul style="list-style-type: none"> <li>• read diverse topics outside engineering for a holistic development</li> <li>• keep your ego under control</li> <li>• avoid stereotypes and discrimination against others</li> </ul>

### III. INITIAL INSIGHTS

#### A. Value of a personal letter

Although Creswell cites the use of letters as a way to collect research data [4], their use is very limited due to logistical issues related to time elapsed between prompts and answers provided using conventional mail. However, technology now makes this process easier. In a few seconds we can reach thousands of people from all over the world through electronic communications [5]. Additionally, the use of letters may allow a deeper understanding of the individuals' perceptions of engineering. Since writing normally involves a deeper, organized, and more purposeful thinking and reflection process, it may reveal deeper thoughts in terms of facts, opinions and ideas [6]. Some of our letter writers reported seeing value in the writing process of the letter; some of them even considered it as a venue to expose hidden feelings towards their experiences, which further supports our argument.

#### B. Value of a global perspective

Another important aspect of this novel approach is the diversity of our sample. In fact, using letters, we can reach engineers in the most diverse cultures and countries, not only those already engaged in engineering education research, but also those most likely to be affected by cross-cultural aspects of engineering. Lucena et al. conducted rigorous research about the re-organization of engineering education in US, Europe and Latin America [7]. They collected data from different sources such as international conferences, workshops, meetings and interviews with people already engaged in engineering research. In this sense, our work complements this research by bringing information from engineers who are engaged in the day-to-day rigor of the profession, and more likely will reflect the common culture that pervades the engineering profession of a certain country. One of our future goals would be to further analyze how engineering identities reflect the historic and socio-cultural processes that shape them within countries, and also evaluate the impacts of globalization on such identities all over the world.

Our results so far are in consonance with the findings from other studies. Downey and Lucena [8] show us how historical and cultural factors have shaped different engineering identities in France, U.S., Germany and England, defining or influencing values, beliefs and metrics of progress. According to the authors, for U.S. engineers, the metrics of success were associated to the corporate and industrial world. Lucena [9] described the process of construction of engineers' identities in Mexico and revealed that at least part of the engineering community has a great concern with societal issues other than the corporate world.

### IV. DISCUSSION AND FUTURE WORK

Even though the insights from this exercise are limited, they prompt a variety of questions that would be interesting to keep exploring such as: 1) By means of the advice given to the future engineers, how can we investigate the engineering

identities in different cultures?, 2) How do cultural differences of practicing engineers influence the advice given to future engineers?, 3) What would be an effective way to deliver a concise yet powerful message to future generations of engineers worldwide?

We see value in the use of letters as our primary source of qualitative data in order to build a cohesive, unified letter. This approach offers a way to portray real feelings and experiences in a more authentic way. The method we used to invite the professionals to write the letters could be improved through the development of a uniform protocol that gives the same prompts to all the potential writers. This uniformity could result in stronger conclusions when comparing letters from different countries and drawing conclusions about their differences regarding the engineering profession in a qualitative way.

The original letters can also be used as a starting point for a potential longitudinal study where the professionals project their thoughts at a point in time, and after some time they can be monitored through this or other venues of data collection to detect their evolution of thinking. Additionally, we can investigate engineering identities within the same country. Other inquiries could involve identifying the level of development of communities of practice of engineers among and across countries. This methodology can be a powerful way of assessing engineering identities over time.

It is envisioned that the effort of building a strong holistic message can open conversations about how different factors interact with the advice experienced engineers want to give to novices. In an educational setting, the letter has the potential to promote awareness of the multifaceted nature of engineering as well as to motivate the persistence and success of those aiming to join the field.

The appendix contains the final letter we composed from those we received, which was finally used in our video. The corresponding video can be accessed from the following URL: <https://www.youtube.com/watch?v=R3XBc1ouVxI>.

### V. APPENDIX: "DEAR FUTURE ENGINEER"

*Congratulations on your admission to your engineering program! I am honored by your decision to join the profession I have devoted my life to. Because of my experience, I will offer you some advice for your journey to begin.*

*First of all, engineering education is composed of all the different aspects that aim to build the knowledge, skills, and attitudes required to execute the possible roles of engineers in a society. It comprises a lifelong process that you may have already started in your experiences during your basic education. This process won't end with obtaining your degree but will keep going as you mature professionally.*

*As you start this new journey, be aware that you will be challenged. This is not meant to scare you off, but rather to ground you so that you remain motivated and enjoy the experience you are about to embark on. Smile, keep your head up and enjoy the challenges that come your way. Know that*

*you will be able to resolve those challenges only with conviction and interest. Problem solving in Engineering is not about knowing the solution, it's about having the confidence that there is a solution, and knowing where to start looking for one. Getting good grades is important, but focusing solely on them can take away the joy from the learning experience. Do not become a slave to grades. Learning combined with hard work will result in success.*

*When you start college, you will take courses you may not consider relevant. Researchers, professors, and even industry members are aware of this, and they are working on making the engineering education experience more meaningful. I would urge you to be patient, see math and science as tools in a holistic problem solving strategy. Keep on growing your toolbox, and be rest assured that you will find all of these tools handy somewhere down your journey.*

*As you get through the courses involving problem solving and design skills, you will be expected to develop critical thinking skills. Problem solving and designing for others and with others is important in creating meaningful and impactful solutions. In order to make the most of your precious time and effort while solving a problem do not try to "reinvent the wheel", we are standing on the shoulders of giant; take advantage of this.*

*The importance of good written and verbal communication skills cannot be ignored. You will have opportunities to develop these skills in part through engineering coursework. However, you must strive to take courses outside of your area. These courses will help you broaden your perspective and will help you build intellectual connections required to translate engineering to the outside world.*

*Teamwork skills are essential to engineering. Find opportunities to practice these skills, be a good team member, and do not shy away from opportunities to work with difficult people. These experiences can cultivate sound professional connections and in some cases long-term friendships.*

*You will be working in a community of people with diverse backgrounds and cultures. Be aware that engineers are trained differently in different countries. As part of society, engineers should appreciate differences and avoid segregation and discrimination at all levels. Value the contributions of others, regardless of their gender identity, sexual orientations, culture, ethnicity, religion, language, nationality or any other difference. Diversity brings with it tremendous value. Developing these skills will enrich you and help you become a more competent global engineer.*

*Balance is essential in all stages of your life. While in college make time for yourself and the rigorous demands of school. Carry this trend forward after graduation so you are able to live a happy and healthy professional life.*

*"Scientists discover the world that exists; engineers create the world that never was." As an engineer you will be responsible for creating this new world in a sustainable way and you must be conscious of social, ethical and moral issues. Avoid unethical decisions as they discourage the ingenuity of*

*a solution. The value of your contributions will not be measured by money but by the betterment of society.*

*Your engineering education will teach you a way of thinking - a way of approaching problems. You will need to find ways of connecting course content with real world applications. The skills you acquire along your journey are just as important as the content itself. By virtue of our educational journey, as Engineers we are meant to become life-long learners.*

*The community of Engineers you will belong to is constantly innovating and developing new technology. You must keep abreast of these newest developments as well as ways to use them by participating in communities of practice.*

*Again, I would like to conclude by congratulating you on picking such a rich, challenging and fulfilling field. Engineering offers limitless opportunities. Engineering plays a big role in society and on the shoulder of an engineer lays the responsibility and consequences of all their decisions.*

*Your journey into engineering education is sure to be filled with challenging, rewarding, and enjoyable experiences. These experiences will be what you make of them. Now it's time for you to start thinking about what you will do with your engineering education.*

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