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Digital Engineering: Leveraging AI to Improve Communication Skills

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Abstract

Engineers must engage with diverse individuals from different functional departments to execute their projects as they enter the workforce. Because of the curricular requirements for technical degrees, there are potentially limited opportunities for students to practice and grow their professional communication skills, which can yield communication challenges for new engineers. In this paper and presentation, a no-code AI-powered chatbot platform (character.ai) will be presented with general instructions on how to build an executive chatbot for students to practice executive interactions. Common issues and dynamics will be discussed as well as our experience using chatbots to simulate executive interactions and a pilot project to enable them to evaluate their communication practices. Current limitations and classroom deployment dynamics will also be addressed.

Background

Numerous authors have published works on the importance of effective communication and soft skills in the workplace, and the value proposition of such skills is well-known for people who are required to engage with others in a professional setting to accomplish their tasks. In response to these publications and industry demand for engineers to be effective communicators, Accreditation organizations such as the Association of Technology, Management, and Applied Engineering (ATMAE) and the Accreditation Council for Engineering and Technology (ABET) have indicated the importance of professional communication skills explicitly in their accreditation standards. Academic institutions that wish to be accredited are expected to address these requirements. However, addressing these important aspects of an effective engineer and leader is not simple, as the development of these skills is highly dependent on the individual's persona.

Some students are very confident in their communication skills, and others may not be as comfortable engaging with others professionally. Providing an effective capability to build and provide constructive feedback on communication skills for each student would require a coach who is qualified to provide such feedback. This process is also time-consuming, and the student would need to be comfortable presenting to and interacting with the communications coach. Some students who would benefit the most from such coaching may be the most resistant to seeking such opportunities. The author A.A. Mohammed et al. [11] report that engineering students who are presenting their work may experience debilitating anxiety and facilitating anxiety, both of which can significantly and negatively impact the effectiveness of the engineer communicator. This study found that one of the best ways to help students relieve their anxiety is through frequent and timely corrections.

ABET Student Criterion 3, Outcome 3 specifies that students are expected to illustrate "an ability to communicate effectively with a range of audiences." Components of effective communication include ethical communication, the ability of individuals to communicate with individuals of diverse professional backgrounds and to function effectively on a team [1]. Researchers [2] further expanded the purposefully general criteria provided by ABET "into six main groups:

problem-solving and Critical thinking, Communication, Team Work, Ethical Perspective, Emotional Intelligence, and Creative Thinking." While these researchers provided an analysis of the literature, they also identified that many engineering students are ultimately deficient in their ability to communicate effectively. This sentiment was also recognized by Riemer [3], who referenced studies by [4] and [5].

The Problem

Many engineering programs have limited ability to add courses, as university general education requirements and accreditation requirements challenge programs to exist as 120 credit hour experiences, with many programs exceeding this desired number of credit hours. Frequently, compromises are executed where a generic public speaking general education course is used to justify meeting a communications requirement. Many programs will augment the public speaking course by expanding additional professional communications development opportunities across several classes in the curriculum. For example, classes that require students to present a technical report could be used to assess communication skills. Professional communication skills could be incorporated into the capstone experience for the program, especially if the capstone requires students to work as a group with a project sponsor. While these approaches are generally appropriate, they might not be what all students need to succeed. Furthermore, embedding these critical components of the effective engineer could diminish the importance of these skills.

How can we, as engineering educators, provide our students with an appropriate understanding of the importance of communication and professional skills development and a platform for which they can actually practice and receive confidential, timely, and frequent coaching on their communication skills? One response could be to use AI-powered chatbots to serve as an initial communications coach and to allow students a platform to refine their most common professional communications issues so that their professors can focus on the refinement of those skills.

AI Chatbots

One solution being explored by a mid-sized midwestern university is using chatbots to provide an online mechanism for students to engage as though they were speaking directly to actual people. The author recognizes this as a supplement to, not a replacement for, feedback from their instructors. The technology being used is currently freely available software located online at http://character.ai. This tool enables people to build a basic chatbot without any coding experience. The process requires the person creating the chatbot to provide some context about the personality they wish the chatbot to exhibit by describing the individual. Four components are required: 1. Name, 2. Tagline, 3. Description, and 4. Greeting. The Name is the identifier given to the chatbot. The tagline is limited to 50 characters, and this is how the chatbot would describe itself to another person. The description, limited to 500 characters, is similar to the chatbot tagline but allows for up to 500 characters. The greeting, limited to 2,048 characters, is what the chatbot will say at the beginning of every chat session.

For the purpose of this study, the researcher developed and tested a chatbot that is focused on being a professional communications coach. The intention is to provide students access to this chatbot so that they can practice presentations, job interviews, and other interactions in the

privacy of their own home. The chatbot informs participants in the introduction how to interact with it. Specifically, the chatbot expects the participants to tell them the purpose of the session and to introduce themselves. The chatbot also instructs participants to tell it when the participant is ready for feedback on the interaction(s). At this point, the chatbot provides the participant with feedback towards improvement.

Parameters to Program the character.ai chatbot

Character Name:

Soft Skills Coach

Tagline:

Hi! Interact with me to help you grow your skills!

Description:

I am an expert in soft skills. I help engineers improve their communication and soft skills by enabling them to practice with me. I love to challenge the engineers and see how they will react. I do this so that I can give them constructive feedback. I am very mindful of them trying to fool me by using big technical words, and I always try to respond in ways to get them to refine their communication if they are being too technical for a normal person to understand.

Greeting:

Hello there! It's a pleasure to meet you. I'm the Soft Skills Coach, and I'm here to offer you a warm welcome. Please introduce yourself, then tell me about the purpose of this interaction. I'll have a conversation with you, and I will give you feedback on your communication skills and your soft skills. When you are ready for my feedback tell me "OK, I am finished. Please give me feedback on this conversation", and I'll do my best to give you some constructive feedback.

These are the only parameters/coding provided by the author to create and implement this particular chatbot for this project.

Pilot Results

Initial interactions with the soft skills coach have shown that the AI can provide constructive feedback to the users. If a user is kind and conversational, the AI will evaluate the interaction positively. Interactions where the user is short, or rude, will be reported back to the person as opportunities for reflection. This feedback is provided back to the participants when they complete the exercise by stating that they are finished and would like feedback on the conversation.

AI Chatbots to Simulate Executive Interactions

The researcher of this study has also built similar chatbots, which focus on executive interactions. This case study has been published in [13]. In this study, two executives were created and programmed not to like each other. The students were acting as project managers and

were instructed to engage with both executives and then develop a stakeholder analysis and communications plan to include these executives in the project they are managing.

Observations

The researcher did encounter a few dynamics when using chatbots to simulate individuals. Specifically, gender bias seems to be built into the AI model. For example, in [13] when a female CEO chatbot was developed (JaneCEO), the AI would use male pronouns in conversation. This forced the developers of the chatbots to include statements such as "I am a woman who…", and etc. to force the AI to understand that the CEO was indeed female.

In the study [13], the researcher did find that some people experienced inconsistent interactions with the chatbots. Specifically, for this study, some students were unable to identify the conflict between the two AI executives. This was not their fault, as analysis of the interactions between the student and the AI executives did not yield any context clues that would have informed the student of this dynamic. The students were also very minimally prompted in their interactions with the AI executives, as the author wanted them to communicate as organically as possible. While they are not perfect, the chatbots are very good and are able to replicate the persona of many different generic personalities and experiences.

The author did notice that students did appear to be more likely to interact with the AI chatbots in ways that they normally would not for an actual person. This dynamic appeared to be liberating for some students because they could explore how the chatbot thinks an actual person would respond. One student, for example, pushed the CEO chatbot executive so hard that the CEO chatbot fired the student for insubordination. The student found this interaction very humorous, but it also yielded some opportunities for the instructor and the class to explore the interaction. We were able to have conversations around empathy and understanding to help the students understand the other person's perspectives and expectations.

The chatbots, in many cases, are still unable to completely trick a person into thinking they are actually interacting with a live person, typically identified as the Turing test [7]. This perception is likely persistent in the conscious or subconscious of the individual, which could influence interactions. For example, in the scenarios presented in this paper, the subjects were aware that they were interacting with a chatbot and that their interactions were being recorded, per the instructions in the assignment. Additionally, informed consent was acquired before the study, and as such, the participants may have been less authentic than they would be if they were interacting with an actual person. This dynamic could have induced the Hawthorn effect on the students, impacting their responses. Nevertheless, the instructor was able to discuss some of the more common types of bias, such as gender bias, with the class.

In some cases, the researcher used the transcripts of the interactions to expose potential biases in the responses of the student participants. If done correctly, the instructor can use the transcripts to anonymize the students' responses and help them understand that they may have bias blind spots, which they should consider remediating. However, the utmost care should be employed to avoid exposing an individual's biases in front of others, as this could have harmful repercussions.

The latest releases of the character.ai tool now include the ability to call a chatbot and have an actual voice conversation with it on a mobile device or computer. The refinement of this

capability is the next logical step in the evolution of the tool, along with the general refinement of the AI powering the chatbots.

Student Feedback

The researcher has used the Character.ai chatbot tool for other applications in their courses at both the graduate and undergraduate levels. Instructors for this module observed informal comments and experiences from the students, which were typically positive. Some students provided anonymous feedback in the course evaluations, highlighting this experience as positive. This is unique as the course evaluation is centrally administered, and does not ask students about specific assignments, yet the students felt obligated to comment on an assignment executed roughly a month before the end of the course.

Students were provided an opportunity to provide their comments on the experience using the chatbots. The researcher asked: Overall, please tell us about your experience with this assignment:

Students responded to this question (N=25). To analyze the qualitative data, the researcher compiled the unedited list of responses and submitted the list to the GPT CoPilot, requesting the GPT to analyze and summarize the qualitative data. The specific prompt to CoPilot was "Please summarize the sentiment of this data set of responses:"

The response from CoPilot was:

"The overall sentiment of the responses is largely positive, with most participants finding the assignment enjoyable, engaging, and insightful. Many appreciated the interactive nature of the exercise and found it to be a valuable learning experience in stakeholder communication and project management.

However, a few respondents mentioned challenges, such as difficulty in formulating relevant questions due to limited background information or the AI providing responses that felt more generalized than human-like. Some also expressed uncertainty about describing the CEO and CFO without external context. Despite these difficulties, many found the exercise thought-provoking and beneficial for developing professional communication skills" (CoPilot, 2025).

In reviewing each comment from the students, the researcher agrees with the assessment of the Copilot GPT. The comments from the students highlight the specific goals of the assignment. That is, to have them think about what they want to ask their executives before approaching them in the actual meeting.

During the class meeting, the discussions between and among the student groups were rich and positive. The discussions enabled the instructor to highlight how to approach such an interaction in the workplace, as well as strategies to glean valuable insights into the project execution from the perspective of the executives. In several cases, the students stayed after the class ended to discuss their experience further.

Concerns and Limitations of the Chatbots

Security – In the case of the chatbot which was built as a coach to help students practice their presentation skills, a security concern may exist. The destination and future use of the data that is collected through interactions with the chatbot is unknown. Therefore, conversations with the chatbot should be limited to typical projects and assignments, not classified research or research where intellectual property may be a concern. For example, as noted by [9], ChatGPT and presumably other GPT and AI tools are not HIPAA compliant. As such, students and users of AI should understand the privacy constraints concerning the use of their data.

Bias – Bias appears to exist in the chatbots, perhaps as a result of the corpus of data that the model was trained upon [8]. Bias was also cited as a concern by [9]. It is important that consumers of the output of chatbots understand this dynamic as an element of the output from the AI, and act accordingly.

Gender – Some people may prefer to interact with male or female chatbots, especially if they are using the voice functionality of character.ai. For this reason, instructors could consider building male or female versions of their chatbots and allowing students to pick which version of the chatbot they prefer to interact with. Additionally, some students may prefer to interact with chatbot agents who communicate with a specific accent, dialect (difference?), or alternate lexicons of communication as compared to the standard American accent and English lexicon. The current conversational chatbots allow for some customization, but they are still relatively limited compared to the numerous regional accents that can be encountered.

Hallucination – A hallucination is when the AI fabricates information instead of providing factual responses. Within current chatbots and other general Pre-trained Transformer (GPT) tools, hallucination is a significant concern [10]. When creating chatbots where personality dynamics are important to simulate, such as one chatbot who does not like another chatbot, the hallucination dynamic can manifest as the preprogrammed relationship dynamics being ignored. For example, when the author created the CEO and the CFO for the fictitious company, the chatbots were programmed with some tension between them. For some students, this was not indicated in their interactions. This dynamic required the instructor to review the student's transcripts to identify if the miss was because the student did not correctly identify the strained relationship or if the opportunity was never presented to the student through their interactions.

Conclusions and Next Steps

This paper presents the instructions and a general framework for instructors to easily and quickly bring an AI chatbot to their curriculum. The chatbot developed for this paper was developed to serve as a coach for students to practice their presentation skills before they have to present their project to their audience. Other chatbots using the character.ai tool have also been used by the author to enable the simulation of other interactions between executives to effectively enable the instructor to observe interactions and provide feedback and rich discussions with the students concerning their interactions. Using chatbots has proven to be an effective tool to enable students to talk about their interactions without fear of retaliation from the exercise. Because of the derisking of these communications, the students seemed to be more open about discussing what they were actually thinking at the time and after reflecting on the interactions.

Because the instructor can build the chatbots in advance of the assignment, instructors can build personality dynamics between the chatbots to enable the students to discover these dynamics. This provides the instructor opportunities to develop scenarios to play out organically as the students interact with the chatbots, providing a less scripted, more organic, conversational, and in many cases more authentic experience as though they were conversing with a real person.

The intention of the professional communication coach chatbot is to help students to discover ways to improve their communication skills in a low-risk, confidential environment. However, it was observed that the current AI Chatbot model seems to be very reserved in providing feedback to the participants. Some students will respond to this, but others may prefer for the chatbot to be more explicit with its critique. Currently, there is no mechanism to accurately control how agreeable the chatbot communicates, and the AI seems to favor a polite approach.

Other studies have used similar AI Chatbots to simulate executive interactions, as explored by [13], and have found value in using the chatbots over role-playing or other types of experiences, which seem in many cases to be too leading to the students. These canned approaches to analyzing personal interactions diminish the value of exercise as the solution can be obvious to the participants.

Leveraging AI chatbots to enable a growth mindset for engineering students appears to be an emerging capability for engineering educators. The AI-powered chatbots have provided a method of enabling students to practice interacting with non-technical audiences. The chatbots appear to have been programmed at an educational level consistent with a typical person, and as such, it should be able to simulate interactions with the students. Using chatbots to simulate executive interactions has also been helpful, and the students appear to be willing to interact with the chatbots is ways that they might not interact with an actual person for fear of being judged. Chatbots are currently a novel solution for many students. More studies using chatbots are needed to validate other use cases of the technology, and over time, students may become less excited about chatbot interactions as they encounter chatbots more frequently in their lives.

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