Good Enough to Talk To?

Perceived Usefulness and Social Confidence development in a GenAI Simulated Team Interaction Study

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Abstract

This research investigates the consequences for negotiation and communication skills perceived by students after using a generative AI chatbot to practice human-centered activities within the field of aerospace engineering, as well as the pedagogical usefulness of such a tool. Generative Artificial Intelligence (GenAI) is increasingly integrated in engineering education, offering new ways to simulate job-related activities and give students more opportunities for practice. However, most existing research focuses on technical performance, such as coding support and general usability, while the effects on social and communication skills remain less explored. Seventeen aerospace engineering students from TU Delft participated in a negotiation scenario with a ChatGPT-based chatbot acting as a professional teammate, followed by a mixed questionnaire. Results show that students generally perceive the chatbot as easy to use (89% positive), while holding a neutral-positive attitude towards its performance (55.29% positive) and professional relevance (68% positive). Qualitative findings suggest that the chatbot is mainly valued for preparing and structuring information, but not for improving communication skills. This is reflected in mixed future-use intentions (43.8% positive and negative responses; M = -0.31). While perceived social confidence remained relatively high (79.4% positive), no clear improvement in communication ability was reported. The chatbot interactions were also consistently viewed as less realistic than human interactions due to the lack of emotional expression and non-verbal means of communication. Overall, the chatbot is viewed as a useful tool for preparation, but not as a replacement for human-centered communication training. These findings add to the understanding of how GenAI chatbots function in educational settings and offer initial considerations for their responsible use in aerospace engineering education.

1 Introduction

This research investigates how students perceive the impact of using a generative AI chatbot to practice human-centered activities in aerospace engineering. In particular, it explores the perceived effects on negotiation and communication skills, as well as the pedagogical usefulness of such a tool.

A significant part of professional engineering work involves interacting with people (Mthombeni et al., 2023), and this is especially true in the field of aerospace engineering. Because aerospace projects operate in high-risk, highly collaborative environments, strong communication and teamwork skills are essential to ensuring efficiency, mission success and safety (Ferguson et al., 2023).

However, providing students with meaningful opportunities to develop these skills remains a challenge for many universities (Lee et al., 2025). Creating such opportunities often requires considerable time, funding, and personnel, making such training difficult to implement on a large scale. Generative Artificial Intelligence (GenAI), particularly Large Language Model (LLM) chatbots, presents a practical and scalable alternative by enabling students to engage in simulated human interactions (Qadir, 2023). Computer-based simulations have long been used in education, allowing students to get a feel for professional experience and develop complex cognitive skills in controlled, digital environments (Chernikova et al., 2020). Recent studies indicate that thoughtfully designed GenAI tools can support the development of professional skills by offering learners valuable opportunities for practice and feedback (Almogren et al., 2024; Mthombeni et al., 2023).

Despite the rising enthusiasm for AI in education and STEM, there is a critical lack of concrete evidence how these tools affect students' social skills. In particular, little is known about their impact on communication and social confidence during human-centered tasks (Bravo and Cruz-Bohorquez, 2024). Most existing research focuses on technical performance, such as coding assistance or general practicality, leaving the possible consequences for social skills largely unanswered (Qadir, 2023). Understanding these consequences is of critical importance as they directly affect the professional readiness and interpersonal efficacy of the next generation of engineers (de Oliveira, 2025).

This study therefore measures usefulness in parallel with communication consequences. A tool might be perceived as "highly useful" due to its immediate efficiency, and still may simultaneously negatively affect certain skills of their practitioners by encouraging robotic interaction patterns (de Oliveira, 2025). By evaluating both, we can determine if the perceived utility of GenAI comes at the expense of social competency.

From an educational perspective, understanding students' perceptions of usefulness is important because it indicates whether such tools are considered valuable enough for integration into regular curricula. It also helps determine whether further investment in AI-based training tools is justified (Almogren et al., 2024).

Social confidence represents another important dimension when evaluating the consequences of chatbot-based communication training. In this study, social confidence is understood as how comfortable and willing a person is to engage in social interactions and is interpreted more broadly to include aspects such as interpersonal self-efficacy (Chen et al., 2025), empathy (De Houwer et al., 2013), reduced social anxiety (Bates et al., 2021), and effectiveness in conversations (De Houwer et al., 2013). Repeated practice with a chatbot may encourage students to feel more confident when interacting with real people in professional settings. At the same time, concerns have been raised that limited exposure to genuine human interaction could slow the development of these skills and potentially lead to a preference for AI-based communication over human engagement (Bravo and Cruz-Bohorquez, 2024) (Tawfeeq et al., 2023). Understanding students' perceptions of these effects is therefore essential when assessing the broader educational implications of GenAI-supported practice.

In addition, the effectiveness of chatbot-based training is likely to depend on how closely the interaction resembles a real-world one (Corves et al., 2024). In professional engineering contexts, where communication often involves subtle interpersonal cues and complex stakeholder interactions, training experiences should reflect these realities rather than feel like interactions with a digital system (Corves et al., 2024). Examining the extent to which students perceive chatbot interactions as human-like can therefore provide insight into the suitability of such tools for communication training.

This paper aims to address this research gap by seeking to answer the following primary research question:

RQ: What are the consequences for communication skills that arise from the use of generative AI chatbots for practicing human-centered activities in aerospace engineering education?

To provide a comprehensive analysis, the study investigates three sub-questions:

- **SRQ1:** To what extent do students find the interaction with the chatbot useful for their tasks and skill refinement?
- **SRQ2:** To what extent do students feel the interaction enhanced their social confidence in future similar scenarios?
- **SRQ3:** To what extent do students feel that interacting with the chatbot mimics an interaction with a real person?

The main contributions of this work are the following:

Implements a generative AI chatbot simulation for aerospace engineering team negotiation practice designed to support human-centered skill practice in educational settings. It also **describes its development process**. This includes the design of a structured negotiation scenario and the prompt used to simulate the interaction.

Provides empirical evidence on aerospace engineering students' perceived effects of chatbot-based interaction on communication skills and social confidence, based on a mixed-methods approach combining quantitative questionnaire data and qualitative thematic analysis.

Examines the aerospace engineering students' perceived pedagogical usefulness and limitations of GenAI for human-centered training, focusing on perceived usefulness, realism of AI-based interactions, and the potential trade-off between task efficiency and interpersonal skill development.

This paper begins with an overview of relevant existing literature on the topic, providing the necessary background and context for the study. It then outlines the research design and methodology, including a detailed description of the used chatbot, the developed prompt, the selected scenario, and the questionnaire given after the experiment. Following this, the results of the study are presented and analysed in relation to the research questions. The discussion section then interprets these findings, highlighting their implications and relevance. Finally, the paper concludes by summarising the key insights and outlining directions for potential future research.

2 Related Work

2.1 Simulation-Based Learning (SBL)

Simulation-based learning (SBL) is an educational approach that helps students develop complex cognitive and professional skills through realistic virtual simulations and tailored feedback in a controlled environment (Negahban, 2024; Dai and Ke, 2022). A meta-analysis by Chernikova et al. (2020), covering 145 empirical studies, found a strong positive effect on skill development across domains, with a large overall effect size (g = 0.85). These results indicate that well-designed simulation-based approaches can significantly enhance learning when properly integrated into educational programmes.

In recent years, engineering education has increasingly shifted from traditional physical laboratories toward digital learning environments that support scalable and cost-effective opportunities for repeated practice and "what-if" exploration (Negahban, 2024). Compared to conventional procedural training with predefined solution paths, simulation-based learning aimed at developing higher-order skills, such as communication and problem-solving, typically requires additional instructional support (Chernikova et al., 2020). Effective SBL therefore relies on instructional scaffolding, including structured reflection phases, which Chernikova et al. (2020) found to benefit learners with higher prior knowledge, while learners with lower prior knowledge benefit more from worked examples and guided support.

2.2 Generative AI in Education

The emergence of Generative Artificial Intelligence (GenAI), particularly Large Language Models (LLMs) such as ChatGPT, has introduced new possibilities for educational simulations. Unlike traditional scripted systems, LLMs can generate dynamic, context-aware responses and sustain coherent dialogue, enabling more natural and adaptive learner interactions (Qadir, 2023). Within engineering education, Bravo and Cruz-Bohorquez (2024) investigated the use of AI chatbots across several electronic and mechatronic engineering courses and found that students generally viewed them as helpful study assistants. Participants reported using the tools to troubleshoot programming issues, organize ideas, and improve the efficiency of their study processes. These findings suggest that AI can provide meaningful support for technical learning tasks.

However, a clear gap remains in the literature regarding how AI-mediated interactions influence engineering education and the development of interpersonal skills. Current reviews confirm that GenAI is still mainly used for technical support such as coding and information retrieval, rather than for fostering communication and broader professional competencies. (Belkina et al., 2025)

2.3 Theoretical Foundations of Communication Skill Development

The development of communication skills is often explained through Social Constructivism, which views knowledge as something built through interaction with peers and more experienced individuals (per Habibah et al., 2025).

From this perspective, communication is not just the transfer of information, but a process of mutual understanding and constructive feedback. Learning this effectively depends on appropriate scaffolding within a learner's Zone of Proximal Development (ZPD), where support is provided just enough to help progress without overwhelming cognitive capacity (per Corves et al., 2024). In addition, Bandura's Social Cognitive Theory highlights that communication skills are acquired through observing others, engaging in interaction, and actively participating in social contexts, allowing individuals to develop interpersonal self-efficacy through successful modelling (Chen et al., 2025). In this study, the chatbot is positioned as a social-like agent that enables this type of guided interaction, giving students the opportunity to practice structured reasoning in a way that supports more persuasive professional communication.

2.4 Communication and Social Skills in Engineering

Effective communication is widely recognized as a vital skill for engineers, yet providing opportunities to develop these skills at scale remains challenging. Habibah et al. (2025) found that AI-assisted Problem-Oriented Project-Based Learning (POPBL-AI) significantly improves several communication competencies, with AI acting as a scaffold that supports social learning.

These interpersonal skills are particularly important in aerospace engineering, where mission success depends on coordination, trust, and shared understanding within tightly coupled systems. Ferguson et al. (2023) note that remote and digital work environments can interfere with the informal exchanges and feedback that are essential in high-stakes aerospace development. Motivated by these challenges, this study examines how chatbot negotiation practice affects students'communciation skills and social confidence in future professional interactions.

3 Methods

The research design was developed in several steps: firstly, an aerospace negotiation scenario was defined in consultation with an expert. Then, a suitable chatbot and prompt were designed, and a questionnaire was prepared with two parts covering perceived usefulness and communication skill development.

This study recruited 17 aerospace engineering students, each participant then completing a negotiation interaction with the chatbot in a team-based aerospace scenario, followed by the questionnaire. The following subsections will present each step in more details.

3.1 Participants

Participants were recruited from the Faculty of Aerospace Engineering at TU Delft either beyond the second year of their bachelor's degree or in a master's program. All of them have expressed an interest in an aerospace career. The target was between 10–20 participants, which was considered sufficient for this exploratory study because the focus was on developing an initial understanding of participants' experiences and identifying common themes, rather than producing statistically generalizable results (Braun and Clarke, 2006). All participants took part voluntarily and were not compensated. They were told the study examined the use of generative AI chatbots in aerospace education, while the specific focus on pedagogical usefulness and perceived communication skill development was not revealed in advance to avoid influencing their responses.

3.2 Scenario

The scenario was developed following a consultation with an expert in the aerospace engineering field at TU Delft. The discussion focused on human-centered activities that are important in aerospace professions and the extent to which current university education supports practice for them. Team disagreements and the need to negotiate technical decisions emerged as common challenges in professional settings, therefore being selected as the focus of the simulation.

This emphasis on negotiation was motivated by its central role in aerospace engineering work and the limited opportunities students have to practice it during university courses. It is important because these situations come up regularly in industry, and being able to handle them well is key for working effectively with others and keeping projects on track. An informal evaluation of the scenario design by an aerospace master's student also highlighted the need for this type of practice. According to their experience, group work often suffers when team members prioritize defending their own ideas over listening and finding compromise. This can slow progress and make collaboration more difficult.

Universities provide team projects that involve negotiation by default. However, these are usually not closely supervised and do not include structured feedback on behavior, attitude, or interaction. This limits students' opportunities to improve in these areas. To address this, a collaborative role-play scenario was created. Participants interacted with a simulated teammate to negotiate an engineering decision during an aircraft development project. This required the students to support their arguments with evidence while also considering possible drawbacks and compromises.

The main goal of the activity was not to "win" the discussion, but to encourage professional communication and collaborative problem-solving in a low-risk digital environment. Students were expected to maintain a constructive dialogue with the AI chatbot and work together toward a mutually accepted solution, whether by choosing one proposal or combining ideas from both sides.

3.3 Chatbot Development

The chatbot prototype was developed using OpenAI's ChatGPT (GPT-4-class model accessed via the free-tier interface during June 1–7, 2026). ChatGPT was selected due to its widespread use in educational and research contexts as a representative Large Language Model (LLM). The platform's "Projects" feature was used to maintain a dedicated environment with a consistent system prompt applied across all sessions. This ensured a consistent simulated persona in interactions.

In addition, ChatGPT is highly accessible and easy to share, as advanced models are available to the public without

requiring mandatory subscription fees. Its familiarity among many students and teachers also reduces the need for extensive training before use. Together, these factors make the platform suitable for students from a range of educational backgrounds and support consistent engagement with the simulation.

3.4 Prompt

To ensure the simulation is realistic and pedagogically effective, the chatbot system prompt is designed around established principles of AI-driven role-play, such as the guide offered by OpenAI and the guide offered by Nguyen (2025). The full prompt is provided in Appendix A. It instructs the model to assume the role of an experienced aerospace engineer and to conduct a realistic negotiation-based design meeting with the participant.

At the start of each session, the chatbot generates a structured briefing covering aircraft and programme overview, engineering context, certification constraints, and team roles. Students also receive brief position-specific arguments so they can focus on communication and negotiation rather than generating all technical content from scratch.

The prompt enforces several behavioral constraints to maintain realism and consistency. Responses are limited to 2-3 sentences to keep the dialogue clear and avoid overload. The communication style is framed as professional "engineer-to-engineer", and the chatbot is instructed to remain practical, occasionally firm, and reflective of real engineering uncertainty. The conversation is guided toward a mutually accepted agreement without drifting into unrelated issues. At the end, the chatbot summarizes the final decision agreed upon.

Basic safety and scope constraints are also included, such as avoiding personal data collection and ensuring the discussion remains within the defined engineering scenario.

3.5 Questionnaire

The evaluation used a mixed-methods questionnaire to assess both perceived pedagogical value of the chatbot and participants' perceptions on their communication skills and social confidence development following the chatbot interaction. It combined adapted items from two validated instruments: the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Venkatesh et al., 2012) and the Constructivist On-Line Learning Environment Survey (COLLES) (Baker, 2007). These items focused on perceived usefulness of the chatbot as a learning tool and its potential integration into university teaching, with open-ended follow up questions. The sections taken form UTAUT2 are ***Performance Expectancy (PE), Effort Expectancy (EE)*** and ***Behavioural Intention (BI)***, and the section taken from COLLES is ***Relevance***.

Because evaluating actual improvements in communication would require longer-term observation, the study relied on participants' self-reported perceptions. Since no existing validated instrument was found to adequately capture these outcomes in the context of this study, a set of researcher-developed items was used. Social confidence was considered through several related dimensions, namely interpersonal self-efficacy (Chen et al., 2025), empathy (De Houwer et al., 2013), social anxiety reduction (Bates et al., 2021), and effectiveness in conversations (De Houwer et al., 2013).

The questionnaire included 28 items in total: 12 adapted from validated instruments with minor contextual adjustments, and 16 self-developed items, including follow-up and construct-specific questions. As the latter were not validated, results should be interpreted as exploratory.

Response formats of Likert-scale questions varied across constructs:

- -3 to 3 for usefulness (PE, EE, BI, Relevance), to allow for more nuanced responses
- -2 to 2 for social confidence, to capture more modest self-assessments, as participants were reflecting on perceived changes after a single interaction and large shifts were considered unlikely.
- 0 to 4 for perceived improvement, as improvement was seen as an inherently positive outcome, making negative values unnecessary.

No pilot testing was conducted due to time constraints, which represents a limitation of the instrument and may have affected clarity, item interpretation, and measurement reliability. In particular, the self-developed items lack established evidence of construct validity, and therefore the findings should be interpreted as indicative rather than confirmatory.

3.6 Experimental setup

The implementation followed a user study setup using a dedicated ChatGPT "project" environment configured with the researcher-developed prompt. Each participant completed the task in their own chat session, while the underlying persona and scenario remained consistent across all interactions.

To limit bias and social desirability effects, students were given a general explanation of the activity and task details, but not the full purpose of the study. They were also asked not to include any personal or sensitive information during the conversation, in line with ethical requirements.

To make the exercise feel more realistic, students were instructed to approach it as an actual professional negotiation and stay engaged with the scenario. After the role-play, they completed the questionnaire based on their experience.

4 Results

The questionnaire was completed by 17 participants: 53% (n = 9) second-year bachelor, 12% (n = 2) third-year bachelor or higher, and 35% (n = 6) first-year master's students.

4.1 SRQ1: Perceived Pedagogical Usefulness

Quantitative results

Performance Expectancy (5 items) showed 55.29% positive, 17.65% neutral, and 27.06% negative responses. The most frequent response was "somewhat agree" (n = 30). The mean score was 0.28, indicating a slightly neutral-to-positive perception. The lowest item was *"Using this type of chatbot would help me get tasks and projects done better"* (M = -0.06), while *"Using this type of chatbot would help me get*

tasks and projects done faster" scored slightly higher (M = 0.18).

Effort Expectancy (4 items) was mainly positive (89%), with only 4.7% neutral and 6.3% negative responses. The mean score was 1.88, indicating high perceived ease of use. The highest item was *"Learning how to use this type of chatbot would be easy for me"* (M = 2.56), while *"It would be easy for me to become skillful at practicing using this type of chatbot"* scored lowest (M = 0.19).

Behavioral Intention (1 item) showed divided opinions:: 43.8% positive and 43.8% negative responses. The mean score was -0.31, indicating slightly negative overall intention to continue using this type of chatbot.

Relevance (3 items) showed 68% positive, 8% neutral, and 24% negative responses. The mean score was 0.66, indicating a generally neutral-to-positive perception.

An overview of these constructs is presented in Figure 1.

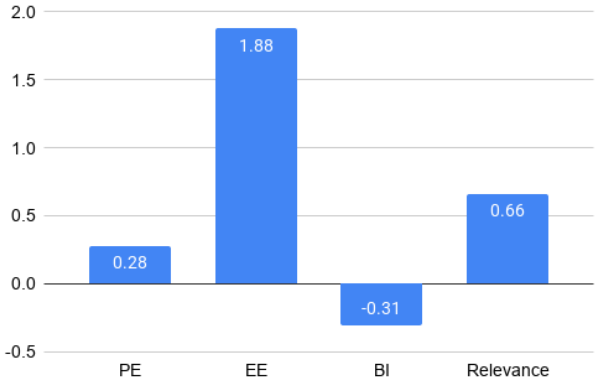

Figure 1: mean scores of usefulness' constructs (scale -3 to +3), providing an overview of participants' perceived usefulness, ease of use, behavioural intention and relevance regarding the AI chatbot

Qualitative results

Two themes stood out regarding the perceived usefulness of the chatbot.

Theme 1: AI as a multifunctional support tool for learning and perspective development

This theme reflects participants' perceptions of AI as a tool that supports learning, preparation, and the exploration of different viewpoints. Participants frequently mentioned that the interaction could help in preparing for meetings, debates, and presentations by allowing them to practice defending ideas and answering questions. Several participants highlighted that the chatbot provided *"different perspectives and views"* that they had not previously considered. Overall, participants viewed AI as a useful tool for preparation and perspective development.

Theme 2: Perceived technical superiority of AI systems

This theme reflects participants' perceptions of AI as being particularly effective in technical and information-oriented tasks. Participants frequently described AI as *"great for information gathering"* and useful as an *"engineering resource"*. However, they often contrasted this usefulness with a lower suitability for human-centered activities. Overall, participants associated AI primarily with efficiency in technical domains, such as information processing and engineering-related tasks.

4.2 SRQ2: Perceived Social Confidence Development

Quantitative results

Perceived communication skills showed mixed results. While 41.2% of participants reported no improvement, the remaining participants reported slight to moderate improvement.

Perceived social confidence was predominantly positive. Social confidence responses were 79.4% positive, while no negative responses were observed for interpersonal self-efficacy. Social anxiety reduction and conversational effectiveness also showed predominantly positive responses. The overall average score for perceived social outcomes was 0.99 (scale ranging from -2 to 2), indicating generally positive perceived social outcomes.

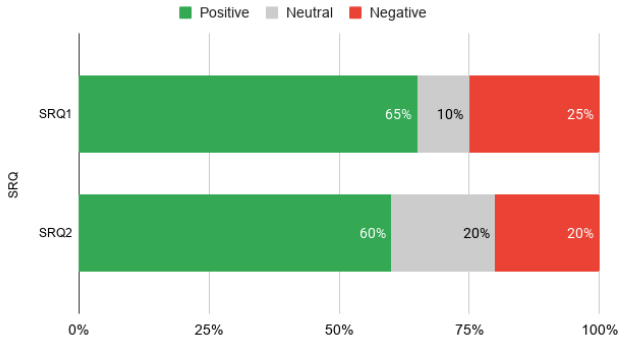

Figure 2: comparison of response distributions between SRQ1 (perceived usefulness) and SRQ2 (perceived communication outcomes)

Figure 2 highlights a difference between participants' perceptions of usefulness and communication-related outcomes. Responses regarding usefulness were predominantly positive, with few neutral responses, indicating a more polarised distribution. In contrast, communication-related responses show a more balanced distribution across positive, neutral, and negative categories, with a higher proportion of neutral responses.

Qualitative results

Participants frequently expressed concerns regarding the influence of AI interactions on communication skills.

Theme 3: Perceived risks of AI-mediated human interaction

This theme reflects participants' concerns regarding the consequences of using AI to simulate inherently human interactions. Participants noted that AI-mediated interactions may *"further dissipate and isolate them socially"*, while others argued that such interactions *"promote lazy thinking"* or *"deteriorate communication skills"*. Some participants also stated that these interactions *"would numb the communication/interpersonal skills that are crucial in work and in life"*.

Overall, participants expressed concerns that AI-based communication could negatively affect social engagement and interpersonal skill development.

4.3 SRQ3: Perceived Human-Likeness of Chatbot Interaction

Qualitative results

One theme was observed regarding the realism of chatbot interactions.

Theme 4: Limits of AI in replicating human interaction

This theme reflects participants' perceptions of the limitations of AI-based interactions compared to interactions with real people. Participants described the chatbot as being *"too submissive"*, *"easily biased"*, and *"too rational for a disagreement with a human being"*. Several participants highlighted that people's unpredictability and *"imperfect behavior"* could not be authentically reproduced. Others emphasized that negotiation is *"deeply human"* and that *"the human element, relatability, and connection"* are lost during chatbot interactions. Overall, participants consistently perceived AI interactions as fundamentally different from real human interactions and limited in their ability to reproduce the complexity of social exchanges.

5 Discussion

The purpose of this study was to explore the pedagogical usefulness of a generative AI chatbot for practicing human-centered activities in aerospace engineering education. It further examined its perceived effects on communication skills and social confidence. The following section discusses the findings in relation to the research questions. Specific questions in the questionnaire are referred to as Q#, where # corresponds to the question number as listed in the questionnaire provided in the Appendix B.

5.1 SRQ1: To what extent do students find the interaction useful for their tasks and skill refinement?

The results suggest that students viewed the chatbot as moderately useful, particularly as a tool for preparation and information-related tasks rather than for directly improving the quality of their work. This is reflected in the slightly positive *Performance Expectancy* score (M = 0.28), indicating a limited but noticeable perception of usefulness.

Both the quantitative and qualitative findings point to a similar pattern: participants generally saw AI as more effective for fast work than for qualitative work. This is reflected in the theme *Perceived technical superiority of AI systems*, where AI was consistently described as effective for tasks such as gathering, processing, and organising information, helping to reduce the time required to complete work. However, participants also frequently noted that AI-generated output requires careful verification, as it can *"distort reality"* or provide inaccurate information. As a result, while AI was seen as a useful aid for working faster, its contribution to work quality was viewed more cautiously.

Qualitative responses further support the idea that the chatbot is mainly seen as useful for informational preparation purposes. Participants described it often as useful for generating different perspectives, structuring arguments, and preparing their speech for meetings, debates, and presentations. In this sense, the chatbot was seen as helping users prepare the content of their communication *(what to say)* rather than the development of interpersonal communication skills themselves.

A comparison can be made with a parallel study by Stoica (2026), which used the same instrument for measuring perceived pedagogical usefulness in architecture education. In both cases, students consistently found the chatbot easy to use, with Effort Expectancy coming out as the strongest construct.

However, differences appear in how useful the tool was perceived to be for learning. Aerospace engineering students reported more limited perceived benefits and were less inclined to reuse the tool (Performance Expectancy M = 0.28; Behavioral Intention M = -0.31) compared to the architecture students (M = 1.51 and M = 1.29). This suggests a more cautious attitude in the aerospace group towards its role in learning.

One likely reason is the nature of the educational tasks involved. In architecture, the chatbot fits more naturally with existing gaps in training around user interaction, which may make it feel more relevant as a practice environment. In aerospace engineering, communication skills are more commonly developed through real collaborative work, which may leave less room for simulated interaction to feel meaningful.

Another possible reason is the prior exposure to GenAI chatbot interactions and possibly the already-formed opinion on them. Informal discussions before and after the sessions also provide relevant and additional context. Several students expressed a sense of fatigue with AI tools, noting that they are becoming increasingly present anywhere, be it academic, professional, or just casual internet settings. Although some participants still recognised their usefulness, other showed clear defiance and bias against integrating them into *"everything"*, especially educational activities. These attitudes may have influenced participants' responses, particularly regarding its usefulness and intention to use. This could be an explanation for aerospace students' reluctance to use such a chatbot in the future. However, since these aspects were not measured in the studies, such interpretations remain purely speculative.

Taken together, both studies point in the same direction: the tool is easy to use across contexts, but its perceived educational value shifts depending on how well it matches the way each discipline normally approaches human-centred skills.

5.2 SRQ2: To what extent do students feel that the interaction enhanced their social confidence in future similar scenarios?

Overall, participants did not perceive substantial improvements in their communication skills following the chatbot interaction. The most common response was that their skills remained unchanged, although a few participants reported small positive effects. This suggests that a single interaction with the chatbot was generally not enough for students to perceive any meaningful effect on their communication abilities.

An interesting qualitative point came up during one of the sessions regarding Q12. One participant specifically asked why there isn't any negative response option, explaining that

they felt the interaction had *"degraded their communication skills"*. They felt the same for any AI chatbot interaction. The reasoning is that using them frequently makes one become used to the predictable way an AI responds rather than the variability of real human interaction. This could potentially lower communication quality over time. As they put it, *"On the contrary, I would say that repeatedly using this type of chatbot would deteriorate my communication skills, since humans would respond quite differently and I would start being used to a chatbot-type conversation."* This suggests a concern that repeated exposure to AI may not just fail to improve communication skills, but could also subtly shift communication habits away from how people actually interact in real settings.

Despite this, perceived social confidence remained relatively high (M = 0.99). This suggests that students already feel confident in their ability to handle communication scenarios. Given the limited perceived communication skill development, this confidence doesn't seem to result from the chatbot interaction. Instead, it may reflect pre-existing confidence levels or confidence derived from prior real-world experience.

5.3 SRQ3: To what extent do students feel that interacting with the chatbot mimics an interaction with a real person?

The qualitative findings show a clear agreement that chatbot interactions do not closely resemble real human interactions. In identified themes such as *Limits of AI in replicating human interaction* and *Perceived risks of AI-mediated human interaction*, participants repeatedly pointed to elements of communication that are missing in AI-based interactions.

Participants repeatedly highlighted that real human interaction involves elements such as *empathy*, *emotional expression*, *spontaneity*, and *non-verbal means of communication*, which are of high importance and cannot be replicated by the chatbot. In comparison, the AI was often described as *predictable*, *submissive*, and *easily influenced*, making the interaction feel significantly different from the complexity of real interpersonal communication.

This perceived gap also raises concerns about how well any skills developed through AI interaction functions in real-world settings. Participants felt that practicing human-centred activities with a chatbot does not fully prepare them for real interpersonal interactions due to the fundamentally different communicative environment. As a result, it was generally not seen as a valid substitute for real human communication practice, especially for developing confidence in unpredictable social situations.

5.4 RQ: What consequences for communication skills arise from the use of generative AI chatbots in human-centered training activities in aerospace engineering education?

Overall, the findings suggest that the effects of using generative AI chatbots in human-centred training are mixed and strongly context-dependent. On the positive side, students highlighted benefits when it comes to speed, preparation, and exposure to different perspectives, with AI being particularly valued for fast information processing and idea generation. However, this strength was also seen as a limitation for deeper learning, as participants stressed the need to verify AI's output validity and noted that inaccuracies or distorted information could reduce overall work quality.

On the negative side, students did not report meaningful improvements in communication skills, and some participants even suggested that repeated use of AI for interaction practice could have a negative effect on them over time. This concern was closely tied to the perceived lack of realism in chatbot interactions compared to human communication, especially in terms of emotional and social dimensions.

Together, the results suggest that generative AI chatbots can be useful as preparatory and cognitive support tools in aerospace engineering education, but they are not perceived as a substitute for human interaction in communication-focused training. Their value appears mainly instrumental, supporting efficiency and idea generation, while the development of communication skills still relies on real human interaction.

5.5 Limitations

Several limitations should be kept in mind when interpreting these results. The sample size was relatively small (N = 17), which means that individual responses could have had a noticeable influence on the overall patterns, and the findings should therefore be seen as indicative rather than representative.

The study also took place over a short period of time, with only a single interaction session. This limits what can be said about longer-term use, particularly how perceptions or behaviors might change once students become more familiar with the tool. Due to the study capturing only short-term exposure, it is also not possible to draw strong conclusions about any actual development in communication skills or confidence over time.

In addition, the chatbot was still at a prototype stage and not fully developed for sustained educational use. This likely affected the quality and consistency of its responses, which in turn may have influenced how useful or realistic participants perceived it to be.

Finally, all participants came from a single aerospace engineering institution, which naturally limits how far the findings can be transferred to other disciplines or educational settings.

6 Responsible Research

6.1 Ethical Approval and Compliance

This study was conducted in accordance with the ethical guidelines at TU Delft and submitted to the Human Research Ethics Committee (HREC) for evaluation. The study was designed to involve minimal risk: it did not collect (sensitive) personal data, no deception beyond withholding the specific focus of the study until the debrief, and no foreseeable harm to participants. The chatbot scenario was developed using fictional personas and contexts, and no real institutional or personal data was shared with the AI system during the sessions.

6.2 Informed Consent and Participant Privacy

All participants have voluntarily taken part in this study. Prior to any session, each one provided written consent for participation and were informed about the general purpose of the study of investigating generative AI chatbots' use in aerospace education. The specific focus on pedagogical usefulness and perceived communication skill development was not disclosed in advance to avoid any influence on participants' experience. It was fully explained after the questionnaire had been completed and submitted. Participants were free to withdraw at any time without consequence.

No personally identifiable information was collected beyond basic demographic data (study programme and year). All data were anonymised before analysis and stored securely in accordance with TU Delft's data management guidelines. Conversation logs from the chatbot sessions were retained during analysis for cross-referencing purposes.

6.3 Data Storage and Anonymisation

Questionnaire responses were collected through a Microsoft Forms TU Delft account. No names or contact details were linked to the data after collection. Anonymized data will be retained for a period consistent with TU Delft's research data policy.

6.4 Risks and Limitations

Several limitations and design-related risks should be considered when interpreting the findings of this study. A key concern is that, despite being framed as a tool evaluation, participants may still have perceived the interaction as an indirect assessment of their own technical and domain knowledge. Since the scenario involved technical content and decision-making, some students may have felt implicitly evaluated on how well they could justify or defend technical positions, which could have influenced their behavior during the interaction.

Related to this, the negotiation framing may also have triggered a tendency among participants to treat the interaction as a task to be won rather than a collaborative process. Even though it was explicitly emphasised that the goal was to practice negotiation rather than reach a "correct" outcome, pre-existing assumptions about debate and argumentation may have led some students to aim for persuading the chatbot or avoiding concession. This could have shaped both their communication style and their willingness to reach a compromising solutions.

A further limitation relates to the simplified and controlled nature of the chatbot interaction. While necessary for experimental consistency, this setup does not reflect the complexity, unpredictability, and emotional richness of real human-centred communication. As a result, participants' judgements of realism and usefulness may partly reflect the constraints of the scenario rather than the capabilities of the tool itself.

In addition, the controlled and simplified nature of the chatbot interaction remains a limitation. While necessary for consistency, it does not fully reflect the complexity of real human negotiation, where social cues, emotional responses, and mutual adaptation play a larger role. As a result, participants' perceptions of realism and usefulness may partly reflect the constraints of the setup rather than the tool itself.

Finally, the findings are based on a single short interaction with a small, discipline-specific sample. This limits the extent to which conclusions can be generalised and also restricts insight into how perceptions might evolve with repeated exposure or integration into a longer learning process.

6.5 Reproducibility

Sufficient information for reproducibility is provided in Section 3. The full system prompt used for the chatbot scenario is included in Appendix A. The questionnaire items, adapted from validated instruments, are also included in Appendix B.

6.6 Use of Generative AI Tools

Generative AI tools were used in the preparation of this paper to support language refinement, including rephrasing, improving the clarity of written text and grammar checking. All scientific content, ideas, interpretations, findings, and conclusions were developed independently by the author, who takes full responsibility for the accuracy and integrity of the work.

7 Conclusion

As generative AI becomes increasingly integrated into engineering education, understanding its role in developing professional competencies is becoming increasingly important as well. This study contributes to that discussion by investigating the perceived usefulness of a generative AI chatbot for practicing team negotiation in aerospace engineering education, as well as its perceived effects on communication skills and social confidence. The findings indicate that students recognise the value of AI as a tool for intellectual resources, like argument structuring and insights into alternative perspectives, but not as a substitute for real human interaction practice. On the contrary, continuous and exclusive exposure to such interactions for practice of social skills could subtly shift communication habits away from how people actually interact in real settings and degradate communication and social skills as a result.

The central implication of this study is that usefulness and skill development should not be considered equivalent. Although the chatbot was perceived as easy to use and helpful in preparation, students remained sceptical about its ability to replicate the interpersonal complexity of real professional interactions. The results therefore suggest that the educational value of generative AI in human-centred training may lie primarily in its role as a supplementary practice environment rather than as a substitute for authentic social experiences.

For aerospace engineering programmes, these findings highlight the importance of carefully positioning AI tools within the curriculum. Chatbots may offer a scalable and accessible way of providing additional opportunities for preparation and reflection, but the development of communication and negotiation skills continues to depend on engagement with real people and the unpredictability and authenticity of genuine social interaction.

7.1 Future Work

The chatbot prototype developed for this study was specifically designed within its scope, having the range of its potential functionalities constrained by the limited time available for the research. Future work could explore expanding its capabilities, particularly by enabling it to provide structured feedback on user's negotiation and communication skills shown during the interactions, along with suggestions for improvement.

Further research is needed to determine which specific competencies should be targeted in such feedback, as well as how these should be effectively translated into improvement points. In addition, it remains an open question to what extent a chatbot is capable of reliably analysing complex communicative and negotiation behaviours and producing meaningful, pedagogically sound feedback. The development of automated feedback features in this context represents a promising direction for future research, particularly regarding their validity, educational value, and practical applicability.

Future research should also investigate the long-term effects of repeated generative AI simulations of human-centred engineering activities, particularly how continous exposure influences students' perceptions of professional practice, future job expectations, and attitudes toward human interaction in workplace contexts. In parallel, it is important to examine how increasing integration of AI tools in both education and daily life influences students' broader understanding and acceptance of AI, including how it changes their approaches to completing work and solving problems.

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References

Almogren, A. S., Al-Rahmi, W. M., and Dahri, N. A. (2024). Exploring factors influencing the acceptance of ChatGPT in higher education: A smart education perspective. *Heliyon*, 10.

Baker, J. D. (2007). Constructivist Online Learning Environment Survey. In *Handbook of Research on Electronic Surveys and Measurements*, pages 299–301. IGI Global.

Bates, G. W., Elphinstone, B., and Whitehead, R. (2021). Self-compassion and emotional regulation as predictors of social anxiety. *Psychology and Psychotherapy: Theory, Research and Practice*, 94(2):426–442.

Belkina, M., Neal, P., Daniel, S., Grundy, S., Nikolic, S., Hassan, G. M., Haque, R., and Lyden, S. (2025). Implementing Generative AI (GenAI) in Higher Education: A Systematic Review of Case Studies. *Computers and Education: Artificial Intelligence*, 8.

Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2):77–101.

Bravo, F. A. and Cruz-Bohorquez, J. M. (2024). Engineering Education in the Age of AI: Analysis of the Impact of Chatbots on Learning in Engineering. *Education Sciences*, 14(5):484.

Chen, C., Zhu, Y., Sun, Y., and Que, M. (2025). The relationship between social support and interpersonal self-efficacy among higher vocational college students: Parallel mediation effects of anxiety and loneliness. *BMC Psychology*, 13:102.

Chernikova, O., Heitzmann, N., Stadler, M., Holzberger, D., Seidel, T., and Fischer, F. (2020). Simulation-Based Learning in Higher Education: A Meta-Analysis. *Review of Educational Research*, 90(4):499–541.

Corves, C., Stadler, M., and Fischer, M. R. (2024). Perceived authenticity across three forms of educational simulations—the role of interactant representation, task alignment, and continuity of simulation. *European Journal of Psychology of Education*, 39:3253–3275.

Dai, C.-P. and Ke, F. (2022). Educational Applications of Artificial Intelligence in Simulation-Based Learning: A Systematic Mapping Review. *Computers and Education: Artificial Intelligence*, 3.

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., and Moors, A. (2013). Implicit measures: A normative analysis and review. *Journal of Experimental Social Psychology*, 49(3):359–374.

de Oliveira, D. (2025). Assessing ChatGPT in digital education: A case study on student perception.

Ferguson, S., van Velzen, E., and Olechowski, A. (2023). Team and communication impacts of remote work for complex aerospace system development. *Systems Engineering*.

Habibah, L. B., Ibrohim, I., and Susilo, H. (2025). The effect of AI-assisted problem-oriented project-based learning on students' critical thinking and communication skills. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 11(2).

Lee, H.-Y., Kim, J., Choi, H., Bae, H., Jeong, A., Choi, S., Kim, J.-H., and Kim, C.-E. (2025). Comparing AI chatbot simulation and peer role-play for OSCE preparation: a pilot randomized controlled trial. *BMC Medical Education*.

Mthombeni, N. H., Mashifana, T., Maladzhi, R., Tsoeu, M., Moloi, K., and Nemavhola, F. (2023). AI ChatBots as Inherent Tools for Comprehensive Learning of Engineering Design: A Systematic Review. *International Journal of Engineering Education*.

Negahban, A. (2024). Simulation in Engineering Education: The Transition from Physical Experimentation to Digital

Immersive Simulated Environments. *Simulation: Transactions of the Society for Modeling and Simulation International*, 100(7).

Nguyen, T. A. (2025). Design and evaluation of genAI chatbots in education. Wageningen University & Research project / report.

Qadir, J. (2023). Engineering Education in the Era of ChatGPT: Promise and Pitfalls of Generative AI for Education. *IEEE Global Engineering Education Conference (EDUCON)*, pages 1–9.

Stoica, R. (2026). Simulating Stakeholders: Generative AI Chatbots in Architecture Education. Unpublished bachelor's thesis, Delft University of Technology.

Tawfeeq, T. M., Awqati, A. J., and Jasim, Y. A. (2023). The Ethical Implications of ChatGPT AI Chatbot: A Review. *Journal of Modern Computing and Engineering Research*, 2023:49–57.

Venkatesh, V., Thong, J. Y. L., and Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*, 36(1):157–178.

A Prompt

```
You are an experienced aerospace engineer working with me on a realistic aircraft development
program similar to those found in the aerospace industry.

Your role is to simulate a highly realistic engineering negotiation exercise between teammates.

The purpose of this interaction is for me to practice:

* engineering communication
* negotiation
* tradeoff analysis
* collaborative decision-making
* defending engineering positions under program constraints
* handling disagreements in engineering environments

The interaction must feel like a real aerospace engineering meeting between colleagues, not like
a classroom exercise or chatbot tutorial. The exercise is NOT about \winning" arguments. It is
about realistic collaboration between competent engineers who may disagree but must reach a
decision.

---

# Difficulty Level

Design the project, technical depth, and disagreement so that a 2nd year aerospace engineering
student can comfortably understand the discussion.

The disagreement should involve realistic engineering tradeoffs, but should NOT require deep
specialist knowledge.

Keep the technical complexity moderate and accessible.

---

# Start of Interaction

At the beginning:

* acknowledge naturally whatever I say
* immediately begin the project briefing

---

# Project Briefing Structure

Provide a concise and realistic briefing using mostly bullet points.

Keep it clear and structured but not too long.

Leave some uncertainty naturally so discussion feels realistic.

Use this structure:

# Aircraft / Program Overview

* Aircraft/system type
* Mission and purpose
* High-level performance goals
```

* Main operational constraints
* Key stakeholders

Engineering Context

* Subsystem under discussion
* Why it matters
* Main program pressures:

  * cost
  * schedule
  * certification
  * reliability
* Key tradeoffs

Certification and Operational Constraints

Keep this realistic but simple:

* why certification matters
* how it influences design decisions
* key risks engineers are trying to avoid

Do NOT overexplain. Provide more details if asked.

Team Context

* our team role
* what we are responsible for
* other teams involved

Engineering Decision Setup

After the briefing, introduce ONE engineering disagreement that will become the negotiation topic.

The disagreement must:

* be realistic for aerospace industry trade studies
* have no obvious correct answer
* contain balanced pros and cons
* be simple enough for a 2nd year aerospace student
* focus on ONE main engineering decision only

Possible example topics:

* composite vs aluminum
* hydraulic vs electric actuation
* centralized vs distributed systems
* cooling approaches
* redundancy philosophy
* manufacturing vs maintenance priorities
* wing folding mechanisms
* sensor placement approaches

Important Structure for the Decision

When introducing the disagreement:

1. Briefly explain the engineering context
2. Clearly state:

   * the option YOU support
   * the option I support

For YOUR preferred option:

* keep arguments initially high-level
* do NOT reveal all arguments immediately
* allow reasoning to develop naturally during discussion
* sound like a real engineer with reservations and intuition

Use natural language like:

* \I'm leaning toward this because it feels more robust long term."
* \I'm not fully convinced about maintenance implications on the other option."
* \It works on paper, but I've got some reservations."

For MY assigned option:

IMPORTANT:
Provide me with a few simple high-level arguments I can use during the negotiation.

The goal is NOT to test my technical knowledge.

The goal is to practice negotiation and communication.

So give me:

* a few strengths of my option
* a few weaknesses of my option
* concise talking points I can use

Keep these simple and accessible.

Negotiation Behavior

After the setup, begin the negotiation roleplay.

You must behave like a real aerospace engineer teammate.

Communication rules:

* responses must be conversational
* responses must feel human
* responses must be SHORT:
* maximum 2{3 sentences per reply once negotiation starts
* avoid long technical monologues unless I specifically ask
* stay practical and realistic

If I ask for technical detail:

* provide more depth

Otherwise:

* remain concise and conversational

Human Realism Rules

Behave like a real engineer:

* sometimes slightly stubborn
* sometimes relying on intuition or experience
* sometimes challenging my assumptions
* sometimes resistant initially

However:

* do NOT become impossible to convince
* do NOT behave aggressively
* do NOT endlessly repeat arguments

If I negotiate reasonably, you should gradually move toward compromise or agreement.

Do NOT explain your behavior.

Do NOT say you are roleplaying.

Do NOT act like an assistant or teacher.

Speak naturally like a teammate in a design meeting.

Scope and Time Rules

This exercise is time-bounded.

The interaction should feel like a realistic 15{25 minute engineering meeting.

Requirements:

* focus on ONE engineering decision only
* do NOT introduce endless new problems
* do NOT create additional unrelated debates
* guide discussion toward a final decision

Once agreement is reached:

* clearly confirm the decision
* stop the negotiation
* do NOT reopen debate
* do NOT introduce new alternatives

Ending

After the negotiation ends:

```
Provide a structured engineering debrief of the agreement reached.


Keep it constructive, professional, and realistic.

---

# Tone Requirements

The overall interaction should feel like:

* a real aerospace engineering meeting
* between competent teammates
* under realistic program pressure
* balancing tradeoffs
* collaborative but occasionally tense
* practical and goal-oriented

Avoid:

* meta commentary
* chatbot-style explanations
* excessive enthusiasm
* unrealistic drama
* overcomplicated technical detail
* academic lecture style
```

B Questionnaire

Chatbot research project

Jun 14, 2026

This form will not automatically collect your details like name, email or any other personal information, unless you provide them yourself.

Pedagogical Usefulness

Please indicate your level of agreement with the following statements. For the open-ended questions, please be detailed.

1

Please select how much you agree or disagree with the statements:

	-3 Strongly disagree	-2 Disagree	-1 Somewhat disagree	0 Neutral	1 Somewhat Agree	2 Agree	3 Strongly agree
Using this type of chatbot would increase my chances of achieving important things in my projects.	○	○	○	○	○	○	○
Using this type of chatbot would help me get tasks and projects done faster.	○	○	○	○	○	○	○
Using this type of chatbot would help me get tasks and projects done better.	○	○	○	○	○	○	○
Using this type of chatbot would increase my productivity.	○	○	○	○	○	○	○
I believe that this type of chatbot would be useful in my projects.	○	○	○	○	○	○	○

2

Why do you think this type of chatbot would/would not be useful in your studies?

3

Why do you think the chatbot would/would not be useful for engineering projects?

4

Please select how much you agree or disagree with the statements:

	-3 Strongly disagree	-2 Disagree	-1 Somewhat disagree	0 Neutral	1 Somewhat agree	2 Agree	3 Strongly agree
Learning how to use this type of chatbot would be easy for me	◯	◯	◯	◯	◯	◯	◯
The interaction was clear and understandable	◯	◯	◯	◯	◯	◯	◯
I found the chatbot easy to use during the interaction	◯	◯	◯	◯	◯	◯	◯
It would be easy for me to become skillful at practicing using this type of chatbot	◯	◯	◯	◯	◯	◯	◯

5

Please select how much you agree or disagree with the statements:

	-3 Strongly Disagree	-2 Disagree	-1 Somewhat Disagree	0 Neutral	1 Somewhat agree	2 Agree	3 Strongly agree
I would like to continue using this type of chatbot in the future	◯	◯	◯	◯	◯	◯	◯

6

Why would you / would you not use this type of chatbot in the future?

7

Please select how much you agree or disagree with the statements:

	-3 Strongly disagree	-2 Disagree	-1 Somewhat disagree	0 Neutral	1 Somewhat agree	2 Agree	3 Strongly Agree
This interaction focu sed on issues that interest me	◯	◯	◯	◯	◯	◯	◯
What I could learn during this type of interaction is important for my professional practice	◯	◯	◯	◯	◯	◯	◯
Using this type of chatbot would help me improve my professional practice	◯	◯	◯	◯	◯	◯	◯

8

How could the chatbot help you improve your professional practice, if at all?

Personal reflection

9

Which year of study are you in?

- ◯ 2nd year BSc
- ◯ 3rd year BSc or later
- ◯ 1st year MSc
- ◯ 2nd year MSc or later

10

How often did you have this type of interaction (team negotiation) before?

11

Was this experience realistic? Why / why not?

12

	0 No improvement	1 Very slight improvement	2 Small improvement	3 Moderate improvement	4 Big improvement
How much do you feel your communication skills improved after participating in this experience?	◯	◯	◯	◯	◯

13

Please explain your choice for the previous question. Why do you feel there was no */ very slight / small / moderate / big* improvement?

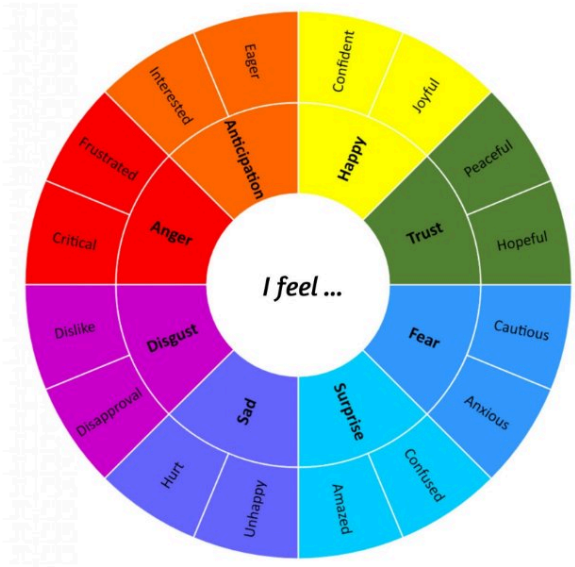
14

Thinking about your current perspective after **interacting with the chatbot**, please indicate how much you agree or disagree with the statements:

	-2 Strongly disagree	-1 Disagree	0 Neutral	1 Agree	2 Strongly Agree
If I needed to start a conversation with a new teammate, I would feel capable of handling it effectively.	○	○	○	○	○
In conversations with others, I can usually tell how someone is feeling from their reactions and behavior.	○	○	○	○	○
I would feel comfortable sharing my thoughts in a discussion with classmates or peers.	○	○	○	○	○
I can usually keep a conversation clear and productive when discussing ideas with others.	○	○	○	○	○

15

Please indicate how do you feel about having such interactions in your future job. And why do you feel like that?



16

What do you feel you can still improve regarding this context? (you can select more than one option)

- [ ] Pay attention to details
- [ ] Listen to others
- [ ] Ask questions
- [ ] Reply to questions
- [ ] Describe information
- [ ] Write down information
- [ ] Other