

Developing Critical Thinking and Effective Communication Skills in the Future Aviation Workforce

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Developing Critical Thinking and Effective Communication Skills in the Future Aviation Workforce

Critical thinking and effective communication (hereafter CTEC) are among the top skills necessary for developing a resilient future workforce across professional areas. Recent world events have led to an increase in the demand for these skills in disaster and emergency management professions, especially those in and adjacent to the aviation industry. As such, the importance of higher education settings in teaching the skills needed to equip the workforce to face future challenges cannot be overstated.

However, there are gaps in how these skills are taught in higher education to meet the needs of aviation employers seeking disaster and emergency professionals. This paper introduces an interdisciplinary general education course in the ERAU-W COAS on critical thinking and communication in emergencies and disasters as a strategy to address these gaps. This direct approach involves teaching selected red teaming techniques, asking essential thinking questions, and applying effective communication tools in coordination with professional organizations. Improving these skills in higher education will support workforce development for aviation and other industries at the forefront of human innovation, security, and resilience.

Introduction

Critical thinking and effective communication are so important soft skills for the future professional workforce. These skills become more prominent in security and aviation fields since the lack of them can lead to loss of life, property, trust, prestige, and more. While authorities and professionals widely recognize the importance of these skills, agencies, organizations, and the public face challenges stemming from a lack of critical thinking and effective communication in the security environment. Higher education prioritizes the acquisition of these skills, and award-winning programs seek to acquire these skills as learning outcomes. However, academics and professionals face challenges in providing these skills in higher education and practicing them in professional roles (Aydiner, 2022, p.2). First, the study discusses the importance and gaps of higher education settings in teaching these skills to future aviation workforce. Then, the project introduces the interdisciplinary general education course in the ERAU-W COAS on critical thinking and communication in emergencies and disasters as a strategy to address these gaps and provides examples of innovative strategies (i.e., red teaming, asking essential communication, aviation safety-related tabletop exercises) in coursework. Finally, it concludes with the recommendations and practical implications of building critical thinking and effective communication to prepare future aviation workforce.

The Importance of CTEC in Education and the Workforce

Critical thinking is “the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, or evaluating information gathered from or generated by observation, experience, reflection, reasoning or communication, as a guide to belief and action” (National Council for Excellence in Critical Thinking 2021, p. 1, Aydiner, 2022).

Critical thinking helps develop thinking and communicate effectively by building confidence in your conversations (Saltzman 2021, LinkedIn Learning). Effective communication is an important learning skill

related to critical thinking. Clarity of thought in the necessary thought processes is demonstrated through clear language and effective communication. Griffin (2016, p. 364) defines effective communication as "the process of sending messages in such a way that the received message is as close as possible to the intended message." Sending an accurate message about the thinker's problem is, therefore, as important as the critical thinking process itself. Learning critical thinking and effective communication skills nurtures each other. These skills are very important to learn and apply in the aviation and security field (Aydiner, 2022).

The Gaps in Higher Education for CTEC Teaching

University administrators and faculty recognize the importance of critical thinking and effective communication skills. Most college programs include these skills in their program goals and student learning outcomes. However, as Bailin et al. discussed in their study, faculty members help develop critical thinking in students as a curriculum goal. However, they often do not formulate terminology or teach how to think critically (1999). Most academic programs lack a structured approach to support the development of critical thinking (Patry 1996). Equally, while effective communication is part of a student's learning goals in many disciplines, integrating it with other courses and teaching its conceptualization and development are not shared by all disciplines. Therefore, the trainer should know how to teach and apply these skills in the course. Without a trainer or instructor's formal training, it can be difficult for an instructor to find the proper way to teach these skills to a student (Aydiner, 2022).

CTEC Importance in Aviation Education and Careers

Critical thinking skills are essential in the aviation field, where safety and lives are at stake. Human error remains the primary cause of aviation accidents, with hazardous attitudes being an important factor behind the errors. Hazardous attitudes (e.g. invulnerability, impulsivity, etc.) require educational intervention to overcome, but consciously designed pedagogy is essential, or these attitudes may

increase (Wetmore et.al. 2007). Likewise, in aviation security, prior research has identified several essential skills needed for successful careers, including critical thinking (Loffi et. al.). The aviation industry increasingly values education alongside experience (Earnhardt, et. al. 2014), with education being the primary avenue for students to learn critical thinking skills. Despite the established importance of critical thinking skills, there is limited attention to a systematic integration of critical thinking skills into the curriculum. We offer strategies to address this gap, with an example from our recent development of a general education course designed to teach critical thinking skills using reality-based scenario methods detailed in this work.

Strategy Example to Address the Gaps (CTEC Course for Aviation Workforce)

Critical thinking and effective communication are interdependent. Instructors and trainers advocate for the development of a student's CTEC, and staff may find it difficult to facilitate his CTEC without systematic guidance and resources in the safety field. Studying examples in educational and professional settings can support educators and professionals in their development and application efforts to prepare the workforce of the future.

Asking Essential Questions

Common strategies for improving CTEC, such as guided discussions, case studies, and presentations, involve asking well-chosen questions (Browne and Keeley 2018; Kiltz 2009; Paul and Elder 2000). Browne and Keeley (2018) individually examined relevant questions in their guide to developing critical thinking (see Table 1). These questions can be used to prepare discussion and case study questions. Leading critical thinking scholars Paul and Elder (2005) prepared questions in the source of the mini-guide with reference to intellectual standards of thought. Table 2 shows the criteria established by Paul and Elder (2005) and possible questions for reasoning. These questions are well suited to foster intellectual

discussion and support the development of his CTEC in educational and professional security settings (Aydiner, 2022).

Table 1 Question checklist for critical thinking

1. What are the issues and the conclusion?
2. What are the reasons?
3. Which words or phrases are ambiguous?
4. What are the value conflicts and assumptions?
5. What are the descriptive assumptions?
6. Are there any fallacies in the reasoning?
7. How good is the evidence?
8. Are there rival causes?
9. Are the statistics deceptive?
10. What significant information is omitted?
11. What reasonable conclusions are possible?

Table 2 Intellectual standards and questions

Intellectual standards	Possible questions
Clarity	Could you elaborate further? Could you give me an example? Could you illustrate what you mean?
Accuracy	How could we check on that? How could we find out if that is true? How could we verify or test that?
Precision	Could you be more specific? Could you give me more details? Could you be more exact?
Relevance	How does that relate to the problem? How does that bear on the question? How does that help us with the issue?
Depth	What factors make this a difficult problem? What are some of the complexities of this question? What are some of the difficulties we need to deal with?
Breadth	Do we need to look at this from another perspective? Do we need to consider another point of view? Do we need to look at this in other ways?

Logic	Does all this make sense together? Does your first paragraph fit in with your last? Does what you say follow from the evidence?
Significance	Is this the most important problem to consider? Is this the central idea to focus on? Which of these facts are most important?
Fairness	Do I have any vested interest in this issue? Am I sympathetically representing the viewpoints of others?

Course Activity Examples

Discussion (Be a Critical Thinker)

In this module's resources, you should have watched a LinkedIn Learning video on "Using Questions to Foster Critical Thinking and Curiosity" and read about the "Three Kinds of Questions" in Paul and Elder's guidebook. Now, respond to the following questions regarding what you learned from these sources.

- Why is learning the types of questions important?
- Evaluate a typical workday for you. Which types of questions do you use, and how do they help you do your work? Be specific!
- How are the types of questions related to the right questions in critical thinking?
- "The questions you ask shape your life." Do you agree with this statement? Why or why not?
- What is your dream/target job in the aviation field? What kind of questions you're asking to reach that target? Do you think your questions are good enough to accomplish your goals? Why or why not?

Podcast

In this activity, you will apply critical thinking questions while analyzing the security crises and strategies/policies/systems to prevent them in aviation security following 9/11.

You will watch a documentary about TSA events and operations. You may or may not agree with the solutions and systems. The important thing is to ask the right questions to foster your critical thinking and listen to experts from different perspectives to construct your answers. Finally, share your critiques about the events and strategies in the history of TSA in a podcast.

- What are the issues and the conclusion of the speaker?
- Should you accept the conclusion based on what is supporting it in the documentary? Why?
- What are the reasons (explanations or rationales for why we should believe a particular conclusion) and the researcher's evidence (facts that demonstrate the truth of the reasons)?
- Scrutinize the documentary and find ambiguous words/phrases, if any.
- The speaker has a position about the policies and strategies to cope with security crises and trying to convince you, but how did he do it? Does he have any assumptions (hidden, deceptive, taken for granted, influential in determining the conclusion) or fallacies? What are they?
- How good is the evidence?
- Do you have a white, black, or grey side on the issues? Which one/s and why?

Red teaming

Red teaming has been defined differently according to the context and field of activity of different scholars, practitioners, and organizations. The most common definitions relate to the red teaming's role in critical thinking, decision support, openness to innovation, and anticipation of opposing decisions. Red teaming techniques help improve critical thinking. Red teaming offers “thinking outside the box” and is

widely used, especially in the military and large corporations, to avoid the dire consequences of groupthink and challenge assumptions.

Table 3 presents a selection of red team techniques that can be used to develop critical thinking in the security domain. Over 100 red teaming techniques in the literature were reviewed. The 12 most common techniques can be applied to develop selected critical thinking in the security domain. These red team techniques can provide a more structured and methodical approach to developing learners' critical thinking skills in the educational and professional settings of security-related programs (Aydiner, 2022).

Table 3 Red Teaming Techniques

	Red Teaming Techniques	Main Goal	When to Use for CT Development in Security Domain	Resources (Includes the US, UK, and Australian Contexts)
1	Devil's Advocacy	Challenging the dominant view by proposing the best alternative.	To create contrary arguments for security issues and support decision-making. To avoid focusing on one idea with incomplete/ false assumptions, reasoning, or overconfidence	US Government, 2016; Kardos and Dexter, 2017; Landry, 2017; Matherly, 2013; UFMCS, 2018; UK MOD, 2021; Zenco, 2015
2	Key Assumptions Check or Assumptions Check	Testing assumptions	To synthesize the implicit and explicit assumptions at the beginning of a security project	
3	Outside-In-Thinking and/or Outside-In Analysis	Disclosing counterintuitive variables by including an external view	To critique insider security professionals' perspectives. To compose imaginative and critical perspective	
4	Premortem Analysis	Finding key vulnerabilities or potential issues of a plan before being so late.	To evaluate possible susceptibilities of a security/defense plan	
5	What If Analysis	Understanding the risks better by considering on what happens if expectations do not happen	To evaluate unexpected security risks. To avoid reaching a decision based on limited information and expectation about a security situation	US Government, 2016; Kardos and Dexter, 2017; Matherly, 2013; UFMCS, 2018; UK MOD, 2021; Zenco, 2015
6	Analysis of Competing Hypotheses	Examining hypothesis that explain circumstances	To examine proposed explanations systematically.	
7	High Impact / Low Probability Analysis	Considering on less likely events if happens may cause a lot	To create an analysis for situations that may less likely realize by encouraging out of box thinking	
8	Alternative Future Analysis	Predicting complex and uncertain situations may develop in a plan or situation	To estimate possible outcomes for the future of the security plan/event	US Government, 2016; Matherly, 2013; UFMCS, 2018; UK MOD, 2021; Zenco, 2015
9	Brainstorming	Providing diverse perspectives about the situation	To examine security issues by taking the contributions of all parties and stakeholders	Kardos and Dexter, 2017; Matherly, 2013; UFMCS, 2018; UK MOD, 2021; Zenco, 2015
10	Stakeholder Mapping	Highlighting the perspectives of stakeholders	To evaluate how stakeholders will have an influence or be affected by the security plan	US Government, 2016; Matherly, 2013; UFMCS, 2018;
11	Argument Deconstruction or Argument Mapping	Assessing the high standards and coherence of logic lies behind the plan	To critique the reasoning used to create a security plan	Kardos and Dexter, 2017; Matherly, 2013; UFMCS, 2018; UK MOD, 2021
12	S-W-O-T Analysis	Viewing the case by using Strengths, Weaknesses, Opportunities and Threats	To appraise different perspectives for the evaluation of a security situation or plan	Kardos and Dexter, 2017; Matherly, 2013; UFMCS, 2018

Course Activity Examples

Discussion (Be a Critical Thinker)

In this activity, you'll respond to questions about the module's resources and apply your understanding of the assigned resources to daily challenges.

- What is the biggest challenge you have encountered during your education at Embry-Riddle Aeronautical University? How did/would you solve this problem? (Check Table 3 in "Critical Thinking and Effective Communication in Security Domains" and find when to use these 12 red teaming techniques in "The Red Team Handbook")
- In the video from this module's resources, the speaker talks about the Millennium Challenge 2002 (MC '02) exercise run by the U.S. Joint Forces Command (JFCOM) and the success of General Van Riper as the leader of the red forces. Riper stated, "A culture not willing to think hard and test itself does not augur well for the future." Do you agree or disagree with his statement? Why?
- Whether you lose your job, an opportunity, or a relationship, loss is an inevitable part of life. Have you experienced any loss in your life? How did you deal with your loss? What were your lessons learned? How can your story of loss teach others?

Scenario (Be a Critical Thinker)

Read the "Navigating in the Dark" scenario (CHDS) and then respond to the following questions.

- How has the COVID-19 pandemic differed from other pandemics, such as AIDS, SARS, and Ebola?
- Think about the experts (Fauci, etc.) and leaders mentioned in the case study. How was their response to the pandemic?

- If you were in the shoes of the North Carolina governor, how would your perspective be different?
- Why did previous responses to pandemics like Ebola and AIDS fail with COVID-19?
- Which red teaming techniques could fit well to predict, respond to, and manage COVID-19 crises? Why?

Applying Effective Communication Skills

Effective communication is essential for the development of critical thinking, as analyzing, evaluating, developing, and applying plans requires active listening, verbal, non-verbal, written, and visual communication. One good example of effective communication teaching materials was produced by the Federal Emergency Management Agency (2021), a federal organization that prepares professionals for all hazards. Table 4 shows some excerpts from his FEMA continuing education course on effective communication. Also listed are some ways to use these effective communication tips based on his five forms of communication in the security domain (Aydiner, 2022).

Table 4 Effective Communication

Communication Types	FEMA Tips	How to use the tips in EC Development in Security Domains
Active Listening	<p>'Really' listen and focus on the speaker. Put yourself in speaker's shoes. Notice speaker's verbal and non—verbal expressions. Allow speaker to speak continuously. Note critical points of the speech. Be sure to receive intended meaning of the speech by clarifying it. Explore speaker's psychological situation.</p>	<p>Real world events (listen to the survivors of security crisis/threats actively by using the tips). Case studies/scenarios (create a scenario to apply all tips for a security situation). Role play (divide students/practitioners into groups, assign them to different roles of victims, first responders, officials in a security event as well as evaluaters for the activity).</p>
Verbal	<p>Speak clearly and concisely. Speak louder to be heard effectively. Vary the pace of your speech at critical moments. Speak with enthusiasm. Know your audience. Speak with respect. Follow a coherent sequence while sending message.</p>	<p>Examine verbal communication of responders', officials', and surviving victims' of a real security issue before, during, and in recovery process from video/audio recordings and identify how they communicated verbally. Record yourself, students, or practitioners in a case study/scenario and evaluate/develop the verbal communication with more practice.</p>
Non-Verbal	<p>Be aware of your emotions. Set your body language consistent with your intended message. Rise and fall your voice appropriately.</p>	<p>Examining non-verbal language of security crisis' survivors by turning on and off the sound. Recording activities in scenario/case study and make a self evaluation, peers' evaluation, and expert's evaluation.</p>
Written	<p>Provide a clear and comprehensible message. Adapt your message to purpose and audience. Find out other ways of communication. Transmit information respectfully.</p>	<p>Evaluate previous written messages of officials in times of security crisis from beginning to end. Prepare a well-written for a specific case study/scenario in related security issue and evaluate with peers and experts.</p>
Visual	<p>Choose appropriate visual form based on needs and audience. Use visual forms effectively and consistent with intended message.</p>	<p>Examine previous visual communication examples of officials/security responders in your field. Choose appropriate form for intended message and prepare your message individually and with a group.</p>

Course Activity

Scenario (Be a Critical Thinker)

In this activity, you will examine security/emergency crises in aviation and apply your effective communication knowledge to reflect your critical thinking on your selected topic by preparing an audio/visual presentation.

Include the following:

- Incident context and background information
- The official response to emergency/security crises
- What information do they provide to the public?

- Examine the effectiveness of communications plans with related stakeholders (e.g., for school shootings: community partners, school staff, students, parents and guardians, and the public.) Then, share your reflections. What was good/bad? Why?
- As a head of security/emergency responders, create and deliver your own announcement to the public about the event and what officials did so far in an ideal way. (Check the tips about "Preparing for Briefings and Public Meetings" in the IS-242.C: Effective Communication course. You should apply EC tips from Table 4 on page 14 in (Aydiner, 2022).

Conclusion

The direct approach provides a roadmap for tailoring structural studies based on the needs and goals of trainers and professionals to develop CTEC skills in the future workforce of aviation, security, and related fields. This research examines three main tools to apply in an interdisciplinary course to develop CTEC skills for security, aviation, and other general education students:

Asking right questions, red teaming techniques, and applying effective communication recommendations for critical thinking and effective communication development.

The asking right questions and red team techniques were analyzed based on their commonality and applicability in the selected fields. We then discussed when it is appropriate to use these techniques when developing critical thinking. Finally, practical and effective communication recommendations were selected from FEMA's continuing education courses based on five types of communication: active listening, verbal, nonverbal, written, and visual. Direct approaches to teaching and applying critical thinking and effective communication skills are preferred over indirect approaches in this study.

However, using direct methods to develop CTEC skills requires higher education and professional support. Therefore, by addressing the needs of academics and security professionals (that is, hands-on exercises, professional scenarios, case studies, sub-discipline conceptualization efforts) based on

educational, training, and application goals, instructors, can be supported their efforts to develop students and future aviation and security workforce.

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