An Exploratory Single-Case Study Unveiling the Promise of Artificial Intelligence in Aviation Education

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Abstract

Higher education institutions continuously seek ways to improve teaching methods and enhance student learning experiences by leveraging emerging technologies in the classroom. One such technology is ChatGPT, an artificial intelligence (AI) application. The integration of AI technology in aviation education has the potential to transform teaching and learning experiences. This study aims to investigate the acceptance and integration of ChatGPT in aviation education and understand the benefits and challenges associated with integrating such technology. The study employs a mixed methods approach, combining qualitative focus group discussions with aviation professors and a quantitative survey administered to students. The study included 50 participants. The qualitative sample consisted of four aeronautical science professors with varying course expertise. The study's quantitative portion comprised 46 undergraduate students enrolled in the aeronautical science degree program. The participants were selected from two upper-level writing-intensive courses, aviation legislation and the senior capstone course. The qualitative findings highlight the potential benefits of AI, including personalized learning experiences, exposure to diverse educational resources, enhanced research capabilities, and interactive learning opportunities. However, concerns were raised regarding the dependency on AI, the limitations of AI-generated feedback, and the potential reduction of individualized guidance from educators. The quantitative results indicate a significant positive impact of AI on students' learning experiences, critical thinking skills, and learning outcomes. Students reported that AI-assisted learning enhanced their engagement, comprehension, and ability to synthesize large amounts of data. However, some students expressed reservations about overreliance on AI and the potential limitations and biases associated with AI systems. This study highlights the need to strike a balance between the benefits of AI and the preservation of meaningful instructor-student interactions. Future research directions include investigating the long-term impact of AI integration in aviation education, examining the alignment of learning outcomes with AI implementation, and redefining instructional strategies to integrate AI tools effectively.

Keywords: *Artificial Intelligence, Aviation Education, Perceptions, Technology*

Introduction

Integrating advanced technologies in education can revolutionize teaching and learning experiences. Educational institutions are constantly exploring innovative approaches to enhance these teaching and learning experiences by leveraging the power of emerging technologies (Herrington et al., 2009; Marks & Thomas, 2022; Ouyang et al., 2022). One such technology is ChatGPT, a powerful language model developed by OpenAI. ChatGPT is an artificial intelligence (AI) technology that can generate human-like responses and interactive conversations, making it a promising tool for educational applications (OpenAI, 2023). Aviation education, a specialized field that prepares individuals for careers in aviation and aerospace industries, requires a comprehensive understanding of complex concepts and procedures. Traditionally, aviation education heavily relies on textbooks, lectures, simulations, and practical training to impart knowledge and skills to students. However, there is growing recognition that the integration of advanced technologies, such as ChatGPT, could revolutionize education by providing personalized and interactive learning experiences (Albirini, 2007; Tuma, 2021).

Incorporating Chat GPT in aviation education holds several potential advantages. First, ChatGPT can serve as a virtual assistant, providing students with immediate access to information and guidance (OpenAI, 2023). According to OpenAI (2023), learners can interact with ChatGPT to clarify doubts, seek explanations, and receive personalized feedback, facilitating a more efficient and tailored learning experience. Secondly, Chat GPT can generate realistic simulations and scenarios, enabling students to participate in decision-making in a safe and controlled environment (OpenAI, 2023). This could enhance aviation

students' critical thinking, problem-solving, and decision-making skills, which are crucial in the aviation industry. Thirdly, ChatGPT can adapt its responses and interactions based on individual learner characteristics and needs, promoting a personalized and adaptive learning environment (OpenAI, 2023). This personalized approach can enhance student engagement, motivation, and knowledge retention.

However, the integration of ChatGPT in aviation education also raises important considerations and potential challenges. One significant concern is the potential dependency on technology and its impact on human-to-human interactions (Edwards et al., 2016) in the classroom. It is essential to strike a balance between the use of technology and the preservation of meaningful instructor-student interactions, ensuring that the human element of education is not compromised. Therefore, the present study aims to understand the acceptance and integration of ChatGPT (e.g., artificial intelligence) in aviation education. By examining the impact of ChatGPT on knowledge acquisition, student engagement, and overall learning outcomes, this study seeks to provide insights into how this technology can be effectively integrated into aviation education curricula. A mixed methods approach enabled the researchers to provide a holistic understanding of the potential benefits and challenges associated with incorporating artificial intelligence in aviation education.

Literature Review

Integrations of Technology in Education

Technology has always been a hallmark of our educational system, and even the most rudimentary technologies (e.g., radio, telephone, television, etc.) have been used to enhance teaching and learning (Bozkurt, 2020; Mhlanga, 2023). However, the establishment of the World Wide Web (WWW) in the early 1990s dramatically changed the learning and teaching landscape by introducing a powerful and untapped educational tool, thus dubbing the 21st century the digital knowledge age (Bozkurt, 2020). As technology evolves and new technologies emerge, educators constantly seek ways to leverage these technologies to improve and enhance learning. AI technology is one of the most recent advancements that is taking over the conversation in education. Such technology integration helps keep our nation globally competitive and increases student engagement (Nelson et al., 2019).

Incorporating advanced technology, such as AI, into the classroom has many benefits. Educators can use AI to incorporate enhanced critical thinking and problem-solving activities into the curriculum to assist with developing those essential skills (Kasneci et al., 2023). Additionally, educators and students can both benefit from time saved. A student can use the technology to edit papers, assist with brainstorming ideas or obtain instructional support that enables them to stay on task while making trial-and-error learning less intimidating (Jantakun et al., 2021; Mhlanga, 2023). Educators can use the technology to create instructional content, give feedback on student work, or help provide interventions to increase learning (Mhlanga, 2023). Both students and educators can expedite and streamline tedious tasks so that more time can be spent on other cognitively demanding workloads.

Even the most advanced technology can be beneficial, but not without its challenges. Bonfield et al. (2020) argue that the job market is changing, and as digital skills are expected, soft skills will still be sought after and thus still need to be taught and nurtured within the classroom. Other challenges can include not understanding AI's limitations or not using the tool responsibly. Students can see this technology as an opportunity to take shortcuts which can encourage laziness and, if not used properly, can hinder critical thinking and problem-solving skills. Students must also learn to use the tool discerningly by looking for biased or inaccurate information. Educators can also face the same challenges as students. However, they must also consider that budgets must be adjusted to account for additional professional development training and realize that identifying AI-generated work is becoming more difficult as technology improves. Data breaches and unintentional confidentiality violations (e.g., FERPA, HIPPA) are also causes of concern. If educators use AI to upload student work, students' rights could be violated (Kasneci et al., 2023). Therefore, users must be cautious in their use of AI technology, such as ChatGPT.

Andragogical Approaches for AI Integration

The notion that adults learn differently than children is not novel. The concept of adult learning theory, or andragogy, has been around since the early 1970s. One of the major facets of andragogy is that "adult learners have a strong desire for self-directed learning" (Knowles et al., 2012, p.242). Since higher education is comprised of adult learners, it is important to highlight and reflect upon effective adult learning processes. Pedagogical approaches have conditioned learners to rely on the teachers and children are often not self-directed inquirers (Knowles et al., 2012, p.116). As learners move from pedagogical approaches to andragogical approaches, learners must first learn how to learn, and, considering technology is one of the major forces shaping adult learning in the 21st century, learning how to learn with advanced technology is even more important (Knowles et al., 2012).

As higher education institutions adapt to the needs of the newer generations, there are many opportunities for advanced technology integration, such as ChatGPT. The educator can use this AI technology to tailor personalized learning experiences for students, fill in learning gaps,

enrich learning activities, and even assist with grading (Kasneci et al., 2023; Vázquez-Cano, 2021). Students can use ChatGPT for self-directed learning or as a tutoring or writing assistant. Vázquez-Cano (2021) continues to assert that regardless of the implementation, AI integration should be constructed with instruction principles in mind that create diverse, accessible, and sustainable learning environments.

Any abuse or academic integrity issues with the use of AI can present major challenges for classroom integration; therefore, there is a need for higher education institutions to develop AI policies that set clear parameters for using AI, ensuring that it is employed ethically and responsibly within the education context. By defining boundaries and guidelines, institutions can mitigate the risks associated with AI misuse and prevent potential abuse such as plagiarism. Chan (2023) summarized this rationale by suggesting that clear parameters for using and understanding AI to promote knowledge and skills that learners can capitalize on for future use. By educating students about the ethical, social, and economic issues surrounding AI, institutions can foster a critical mindset and equip students with the knowledge necessary to navigate the complexities of AI (Chan, 2023).

Some may wonder if AI will replace teachers and traditional learning. Teaching and learning are more than just transmissions of information. The process is a humanizing experience, an art, that involves back-and-forth communication between student and teacher. The process is much more complex than any technology could ever try to duplicate. AI has an important role in education and will be forever evolving, but it is a learning tool and not a replacement for a teacher so caution must be taken when implementing it in the classroom (Felix, 2020).

To successfully implement AI as a learning tool in aviation education, the learning objectives and outcomes of the lesson must be clearly defined (Eager & Brunton, 2023). Having a comprehensive outline of what students should learn is a requisite and standard practice in any teaching pedagogy. Additionally, it is equally important to give explicit thought to how the AI learning tool will be implemented within the lesson to optimize effectiveness and add to students' learning. Teachers should continually collect student progress data to identify areas for improvement, collect feedback from students, and adjust implementation accordingly (Alam, 2021). Careful consideration should be given if the tool is not enhancing student learning or meeting learning objectives. If this is the case, then the teacher should consider altering how AI is being used or eliminating it from the lesson. AI is a supportive learning tool that complements the expertise of the educator (Dennen & Hao, 2014).

Aviation Education Expectations

From most aviation higher education degree programs, students are expected to acquire skills such as good decision-making aptitude, practical and applicable knowledge of aircraft and airline operations, and higher-order thinking skills (HOTS). In aviation, skill is defined as "a goal-oriented and efficient execution of a task or behavior that reflects high proficiency and synthesis of information" (Albelo et al., 2022, p.10). That means a proper aviation curriculum should combine theoretical knowledge with practical training, and opportunities for hands-on experience. It is important to highlight that an aviation degree prepares most students to pursue careers as pilots, but it can also prepare other students who acquire this degree to become aviation managers, air traffic controllers, or other roles within the aviation industry.

Another expectation of aviation education is the acquisition of critical thinking skills. The cultivation of critical thinking skills enables aviation professionals to assess situations diligently, analyze complex problems, and select appropriate courses of action (Davies, 2015; Walker & Finney, 1999). Moreover, critical thinking facilitates effective risk management by aiding the evaluation and mitigation of potential hazards, encompassing weather conditions, mechanical issues, and air traffic complexities. Aviation's dynamic and ever-evolving nature necessitates adaptability, wherein critical thinking enables professionals to respond adeptly to unforeseen circumstances (Davies, 2015). Furthermore, critical thinking empowers individuals to interpret and apply rules effectively, ensuring adherence to industry best practices (Walker & Finney, 1999).

Research Question

In pursuing advancing education methodologies and harnessing the potential of emerging technologies, this study delves into the integration of AI within aviation education curricula. The research was grounded in two fundamental questions:

1. How does the integration of artificial intelligence (AI) in aviation education curricula impact knowledge acquisition, student engagement, and overall learning outcomes?
   - H0: There is no significant difference in knowledge acquisition, student engagement, and overall learning outcomes between aviation education curricula that integrate AI and those that do not.
   - H1: The integration of AI in aviation education curricula positively impacts knowledge acquisition, student engagement, and overall learning outcomes.

2. What insights can be gained to enhance the effective utilization of this technology in educational settings?

Understanding these impacts is crucial for optimizing the incorporation of this technology into educational curricula. Contributing valuable insights to educators and policymakers seeking to enhance the learning experience in aviation higher education. The findings from this study can inform instructional strategies, curriculum design, and technology integration practices, ultimately improving the effectiveness of education in the aviation field.

Methods

According to Creswell and Plano Clark (2018), mixed methods research allows for a comprehensive understanding of the research topic by integrating quantitative and qualitative data collection and analysis techniques. Moreover, Creswell and Creswell (2018) suggest employing a case study whenever researchers explore a particular phenomenon to gain a rich and detailed understanding of its complexities, dynamics, and underlying processes. Combining these methods allowed the researchers to develop a more holistic picture, capturing the phenomenon's breadth and depth. The study was devised into three phases: qualitative data collection and analysis, quantitative data collection and analysis, and integration of findings.

For the qualitative data collection, the researchers conducted a focus group with multiple aviation professors that provided in-depth qualitative insights. Open-ended questions were used to explore their perspectives towards the integration of Ai in aviation education. The discussion covered various aspects of the integration of AI, including its strengths, weaknesses, and potential improvements. Once the qualitative data was gathered, the researchers analyzed the data utilizing thematic and content analysis. Thematic analysis allowed the researchers to identify recurrent themes within the data (Creswell & Poth, 2018), while content analysis enabled the researchers to identify specific patterns within the data (Creswell & Poth, 2018). This involved coding and categorizing text data to draw insights.

Furthermore, for the quantitative data collection, the researchers utilized a pre- and post-survey approach. This involved administering surveys to students before and after they engaged with AI within the aviation education curriculum. The pre-survey aimed to establish a baseline understanding of students' perceptions and background concerning the use of AI in aviation education. The post-survey, on the other hand, assessed any changes or impacts on knowledge acquisition, student engagement, and overall learning outcomes. The pre- and post-survey responses were analyzed using a paired sample t-test to compare the survey results. The researchers looked for changes in students' perceptions of knowledge acquisition, engagement levels, and learning outcomes after their interaction with AI in the aviation curricula.

Participants and Site

Fifty participants were included in the study. The qualitative purposive sampling consisted of four aeronautical science professors with a wide range of areas of expertise, including Human Factors, Aviation Safety, Aviation Law, Crew Resource Management, and Aviation Curriculum Development. The quantitative convenience sampling comprised 46 students enrolled in academic courses requiring extensive writing assignments (see Table 1). The two selected courses were aviation legislation and the senior capstone course for a bachelor's degree in aviation. The research took place at a higher education institution focused on aviation education. This institution is in the Southeast of the United States. It serves approximately 7,000 students across multiple disciplines within the aviation and aerospace fields.

Table 1

Participants Demographics

Characteristics	Subgroup Categories	N	Average Age	Percentage
Race	Asian	13	20	28.26%
	Black	3	21	6.52%
	Hispanic/Latino	5	21	10.87%
	White	24	22	52.17%
	Declined to answer	1	19	2.17%
		46		100%
Academic Standing	Freshman	-	-	-
	Sophomore	12	20	26.09%
	Junior	17	20	36.96%
	Senior	17	23	36.96%
		46		100%
Gender	Female	5	20	10.87%
	Male	39	21	84.78%
	Non-Binary	2	20	4.35%
		46		100%

Results

Qualitative Phase

In this exploratory mixed methods research, the qualitative phase involved conducting a focus group with four aviation professors with expertise in different areas of aviation education. The focus group aimed to gather in-depth insights and perspectives from these individuals to develop a baseline to understand the implications of implementing AI in aviation education (see Appendix **??**). The focus group also helped guide the prompts for the quantitative instrument. After the data was transcribed and a clean file was returned to the participants to conduct

a member check (Creswell & Poth, 2018), four themes emerged during the data analysis (see Table 2).

The integration of AI in aviation higher education presents both advantages and limitations. From a faculty point of view, there is a growing dependency on AI, which offers personalized learning experiences and exposes students to diverse educational resources. For example, one participant noted that, "from my perspective, the incorporation of AI in aviation education will lead to an invaluable expansion of educational resources. AI's ability to provide diverse information and answers to specific queries will broaden the scope of learning perspectives to our students." These findings are consistent with the pedagogical approaches studied by Kasneci et al. (2023) . However, it should be noted that the perceived accuracy of tailored feedback provided by AI systems cannot be fully verified. Moreover, relying heavily on AI may lead to a lack of individualized guidance from educators, resulting in a less comprehensive and nuanced learning experience for students. For instance, one participant noted that "the perceived accuracy of AI-generated feedback raises questions about its reliability Despite advancements, AI systems may not always grasp the subtleties of student comprehension or the context of their learning journey." These findings align with Bozkurt's (2020) conclusion that technology has an equal opportunity to enhance or weaken the learning process. Thus, while AI brings promising opportunities, careful consideration of its limitations is necessary to ensure a balanced and effective approach to aviation higher education.

Conversely, AI enhances research capabilities, enabling students to delve deeper into their academic pursuits. AI also facilitates high-level data analysis, providing concise and valuable insights from informed decision-making. Nelson et al. (2019) and Bonfield et al. (2020) arrived at similar findings as they argued that advances in technology encourage student engagement and provide the asset of skills the labor market might seek. Additionally, AI technology can address accessibility challenges by supporting students with disabilities through features like speech-to-text. These findings align with Vázquez-Cano's (2021) conclusion that technology creates a diverse, accessible, and sustainable learning environment. Furthermore, there is confirmation that technology is a major force that helps shape adult learning and fosters self-directed learning (Knowles et al., 2012). These advances in AI contribute to a more effective and inclusive learning environment in aviation higher education.

Quantitative Phase

The quantitative phase gathered data on the current level of AI integration in aviation education. The research instrument provided an overview of the extent to which AI is integrated into various aspects of aviation education, such as curriculum, training program, and learning resources (see Appendix **??**). The survey was administered twice, once before starting their academic course (pre-) and once after completing a writing assignment with the optional assistance of ChatGPT (post-), through an online survey platform. Clear instructions were provided, emphasizing the importance of honest and accurate responses.

Figure 1 depicts the pre-survey results that aimed to assess the perceptions and background of participants concerning the use of AI in aviation education. Based on the results, a significant number of participants (66.3%) perceived that AI would not be beneficial in their aviation education. Sixty percent (60%) of the participants agreed that their learning experience would not be significantly different if they were allowed to use AI in aviation education. Pre-survey findings suggest that a significant number of participants (53.3%) did not find previous usage of AI to contribute to the development of necessary skills to achieve the learning outcomes in their aviation education.

Figure 2 depicts the post-survey results that aimed to assess the experience and perception of the students after being allowed to use AI in their aviation education. Results of the survey indicate that a large percentage of participants (86.6%) found that the use of AI assisted them in enhancing their learning experience and critical thinking skills. A small number of participants (13.4%) still had negative sentiments towards the use and effectiveness of AI in their aviation education learning experience.

Figures 3 and 4 highlight the responses to the questions regarding the benefits and challenges of integrating AI in aviation education. The results indicate that the two top perceived benefits of AI in aviation education are its ability to synthesize large amounts of data in a short period of time, and its potential to create interactive learning opportunities, such as the expansion of virtual reality. Conversely, the two top perceived concerns of AI usage in aviation education were overcoming instructors' resistance to adopting new technologies and addressing the ethical concerns related to blindly using AI without verifying its information against scholarly sources.

Integration of Findings

To complement the data collected from the pre-survey and post-survey, three hypotheses were tested. The researchers utilized paired sample t-tests at a significance of 0.05 to test the hypotheses. The null hypothesis ($H_0 1$) that there is no significant difference in the perceived benefits and challenges reported by students who utilize artificial intelligence in their assignments in aviation education compared to those who refrained from using artificial intelligence was tested. The mean of perception scores of students who see benefits in AI ($M = 3.90$, $SD = 0.682$) was larger than the mean of perception scores of students that

Figure 1

Pre-Survey Results

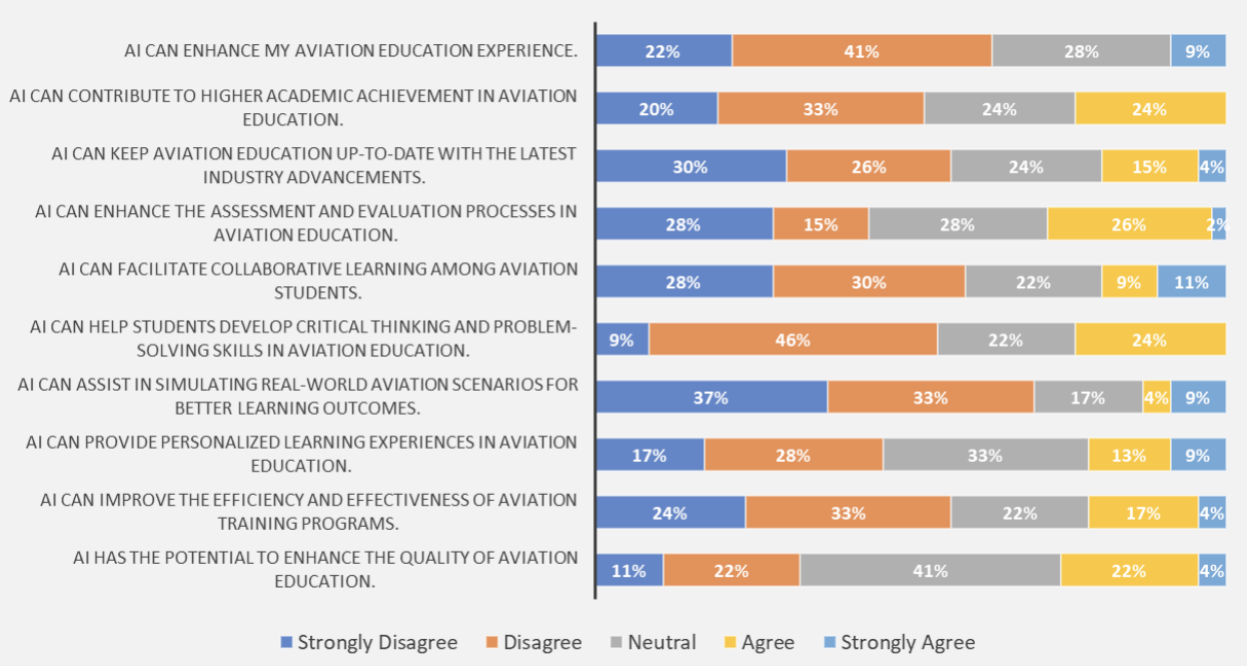


Figure 2

Post-Survey Results

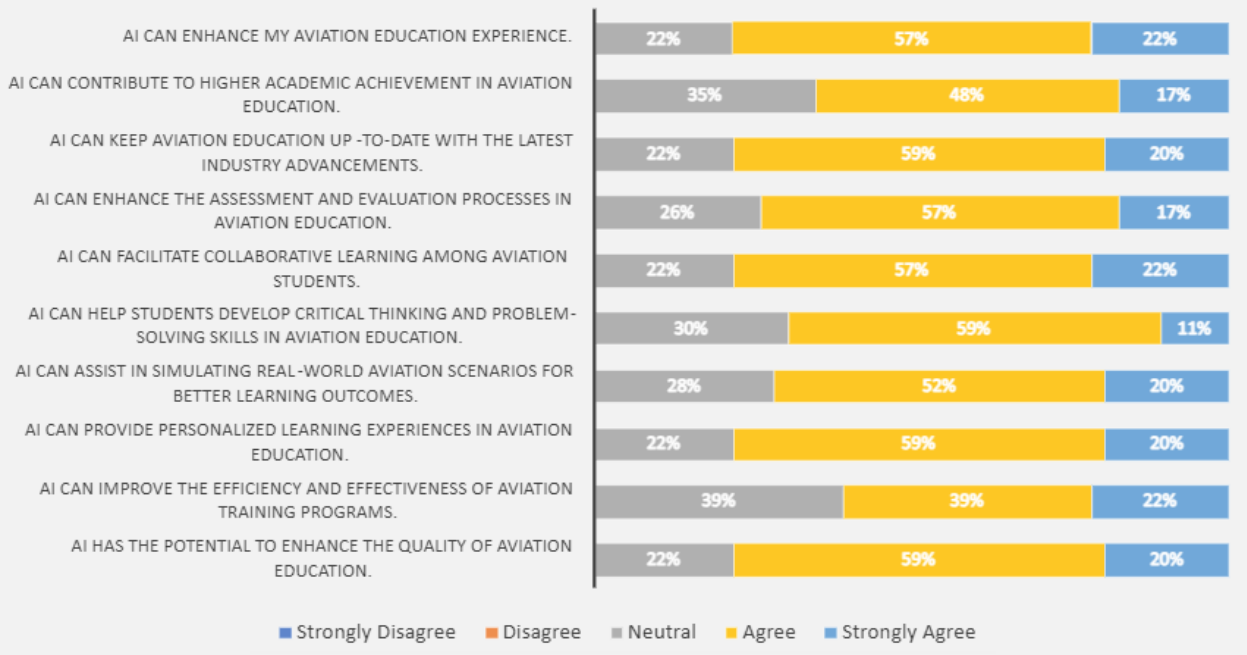


Table 2

Themes and Descriptions

Theme	Description
Impact on Learning	• There will be a dependency on artificial intelligence. • Students will have exposure to diverse educational resources. • The perceived tailored feedback is not 100% accurate since it cannot be verified. • Students will miss individualized guidance from educators, resulting in a less comprehensive and nuanced learning experience.
Practical Usefulness	• Enhanced research capabilities. • High-level, yet concise data analysis and insights. • Address accessibility challenges such as speech-to-text and text-to-speech to support students with disabilities.
Inquiry Learning Experience	• Overreliance on AI • AI systems can be susceptible to biases and limitations. • Students could supplement search engines and digital library inquiries to gather relevant information.
Higher Order Thinking Skills	• AI could provide limited perspectives of content. • Excessive dependence on AI will hinder students' ability to think critically

Figure 3

Perceived Benefits of AI Integration in Aviation Education

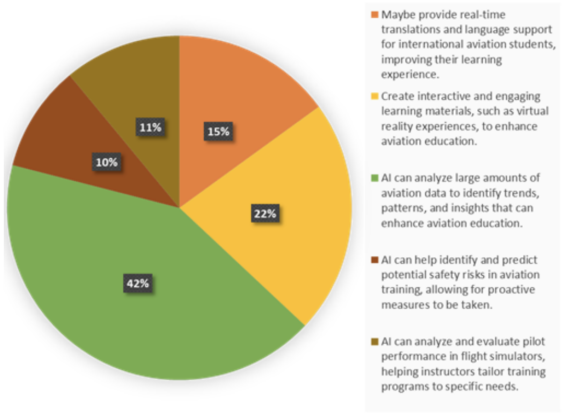
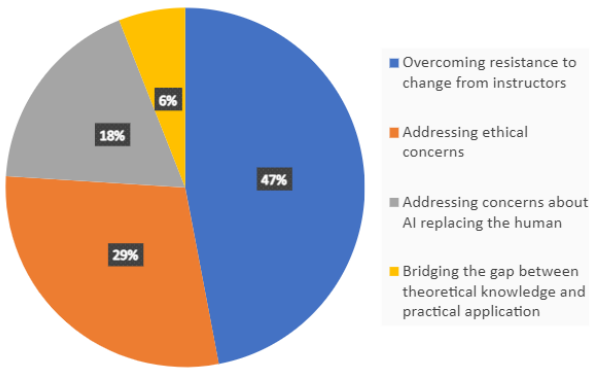


Figure 4

Perceived Challenges of AI Integration in Aviation Education



do not see benefits in using AI (M = 2.64, SD = 1.105). A dependent variable t-test was significant at the alpha level of .05, $t(45)$ =, $p < 0.021$. Therefore, the null hypothesis was rejected. Cohen's d = 0.63, which is a medium effect.

The null hypothesis ($H_0 2$) that there is no significant difference in students' perceptions of their learning experience between coursework completed without an artificial intelligence assistant and, with the assistance of artificial intelligence, was tested. The mean of perception scores of students who see benefits in AI (M = 3.95, SD = 0.649) was larger than the mean of perception scores of students that do not see benefits in using AI (M = 2.54, SD = 1.196). A dependent variable t-test was significant at the alpha level of .05, $t(45) = 0.0317$, $p < 0.031$. Therefore, the null hypothesis was rejected. Cohen's d = 0.71, which is a medium effect.

Lastly, the null hypothesis ($H_0 3$) is that there is no significant difference in learning outcomes between students who completed assignments without the use of artificial intelligence and those who were allowed to complete assignments utilizing artificial intelligence as a supplement was tested. The mean of perception scores of students who see benefits in AI (M = 3.91, SD = 0.689) was larger than the mean of perception scores of students that do not see benefits in using AI (M = 2.31, SD = 1.119). A dependent variable t-test was significant at the alpha level of .05, $t(45) = 0.027$, $p < 0.027$. Therefore, the null hypothesis was rejected. Cohen's d = 0.81, which is a large effect.

Conclusion

In summary, this paper offers valuable insights into the potential benefits and challenges of incorporating artificial intelligence in aviation education. The study's findings shed light on the overwhelmingly positive impact of AI on students' learning experiences and outcomes. Firstly, the research revealed that students see a significant and positive benefit to the integration of AI in their aviation education. This sentiment emphasizes the increasing recognition among students of the value AI brings to their learning process. AI-powered tools and technologies can revolutionize traditional teaching methods by providing personalized, adaptive, and data-driven approaches to learning. The enthusiasm displayed by the students and faculty towards AI implementation indicates the relevance and applicability of AI in the aviation education domain. Secondly, the perception that AI enhances students' learning experience highlights the value AI brings in augmenting the educational journey. The ability of AI to analyze vast datasets, identify patterns, and adapt content to individual learning styles empowers students to engage with the material in a more personalized manner. This enhances the learning experience and fosters greater comprehension, retention, and application of knowledge, ultimately leading to improved academic performance and a deeper understanding of aviation concepts. Moreover, the participants' conviction that they can achieve their learning objectives more effectively through AI underscores the transformative potential of AI in aviation education. The confidence instilled by AI-powered tools encourages students to take ownership of their learning, become proactive in their educational pursuits, and set higher aspirations for their academic and professional growth.

By acknowledging the benefits of AI in aviation duration, this research contributes to the ongoing discourse surrounding the incorporation of technology in the educational landscape. It highlights the importance of leveraging AI to foster a dynamic and engaging learning environment that aligns with students' evolving needs and preferences. As the aviation industry continues to witness rapid advancements, integrating AI into aviation education becomes crucial in preparing future professionals with the necessary knowledge and skills to tackle emerging challenges effectively. For example, future research should investigate the long-term impact of assessment. Perhaps a longitudinal study could be used to assess the long-term effect of AI implementation on students' learning outcomes and career trajectories. Examining the impact of AI in the aviation industry post-graduation will provide valuable insights into the lasting benefits of AI implementation in education. Furthermore, it will be worth investigating how learning outcomes and the program's objective must be redefined to align with the integration of AI. For example, a study investigating how faculty could reimagine the use of tools such as Bloom's Taxonomy to create effective and meaningful instruction with the integration of AI will test the relevance of the aviation degree program and its ability to prepare students for future industry demands.

All in all, the empirical evidence presented in this paper supports the contention that AI holds immense promise for revolutionizing aviation education. The positive feedback from students and their belief in AI's ability to enhance their learning experience and achieve learning objectives reaffirms the value of continued exploration and integration of Ai in educational practices. Embracing AI as an ally in aviation education can create a transformative educational landscape, empowering the next generation of aviation professionals to soar to new heights in academic and career pursuits.

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A Focus Group Semi-Structured Questions/Guide

Before commencing the interview, the researcher will go over the following steps:

- Sign the informed consent form.
- Remind the participants the interview will be audio-recorded.
- Reassure confidentiality in the study.
- The participants will be informed that they can discontinue the interview at any point.

Interview Questions:

1. What have been your experiences using ChatGPT in aviation education?
   - How did you first encounter ChatGPT, and what motivated you to use it for your aviation studies?
2. In what ways has ChatGPT influenced your learning experience in aviation education?
   - Could you provide examples of specific instances where ChatGPT has been helpful or impactful in your studies?
3. How has ChatGPT enhanced your understanding of complex aviation concepts?
   - Could you describe any specific concepts or topics that you found particularly challenging and how ChatGPT assisted you in grasping those concepts?
4. How would you describe ChatGPT as a valuable tool for personalized learning?
   - How has ChatGPT tailored its responses to your individual learning needs?
5. What are the strengths and limitations of ChatGPT in the context of aviation education?
   - Are there any specific areas where you believe ChatGPT could be improved or areas where it might fall short in supporting your learning?
6. How has the integration of ChatGPT impacted your engagement and motivation in aviation education?
   - What is your perception of the interaction between human instructors and ChatGPT in aviation education?
7. Do you believe there is a balance between human-to-human interactions and the use of ChatGPT, or do you think it impacts the instructor-student dynamic in any way? Please explain your perspective.
8. How do you see the future of ChatGPT or similar AI-based technologies in aviation education?
9. What are your expectations and hopes regarding the continued integration of these technologies into aviation curricula?
10. Based on your experiences with ChatGPT, what recommendations would you give to instructors and educational institutions looking to embrace ChatGPT or similar technologies in aviation education?
    - Are there any specific strategies or considerations that you believe would enhance the effectiveness and impact of using ChatGPT in aviation education?

B Pre/Post Survey

Instructions: This survey is designed to assess the impact of ChatGPT on knowledge acquisition in aviation education. Please answer the following questions to the best of your knowledge and abilities. Your responses will be kept confidential and used for research purposes only. There are two parts to this survey: a pre-test and a post-test. The pre-test will evaluate your current knowledge before exposure to ChatGPT, while the post-test will assess any changes in your knowledge after using ChatGPT. Please answer all questions honestly.

Section 1

Age:

Gender:

- Male
- Female
- Other

Race:

- White
- Black
- Asian
- Hispanic/Latino
- Native Hawaiian or Other Native Pacific Islander
- American Indian
- Decline to Answer

Academic Standing:

- Freshperson
- Sophomore
- Junior
- Senior

Section 2

Please rate your agreement with the following statements on a Likert scale of 1-5, where:

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

1. AI has the potential to enhance the quality of aviation education.
2. AI can improve the efficiency and effectiveness of aviation training programs.
3. AI can provide personalized learning experiences in aviation education.
4. AI can assist in simulating real-world aviation scenarios for better learning outcomes.
5. AI can help students develop critical thinking and problem-solving skills in aviation education.
6. AI can facilitate collaborative learning among aviation students.
7. AI can enhance the assessment and evaluation processes in aviation education.
8. AI can keep aviation education up-to-date with the latest industry advancements.
9. AI can contribute to higher academic achievement in aviation education.

10. AI can enhance my aviation education experience.

Section 3

Please provide brief answers to the following questions:

1. In what specific ways can AI benefit aviation education?
2. What potential challenges do you foresee in implementing AI in aviation education?