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Using Artificial Intelligence for Learning and Transition: Student Veterans' Experiences in Engineering Education (WIP)

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Introduction

As artificial intelligence (AI) becomes embedded in higher education, understanding how diverse learners engage with these technologies is increasingly important for developing inclusive engineering programs. Student veterans represent a growing but underexamined population in engineering education [1]. The implementation of the Post-9/11 GI Bill has significantly increased the presence of military veterans in higher education, as these individuals often utilize academic credentials as a primary tool for transitioning into the civilian workforce [2], [3]. Within STEM fields, more than 130,000 veterans utilized these benefits between 2019 and 2021, with computer science and engineering serving as the most prominent areas of study [4]. This population represents a unique opportunity to expand and diversify the engineering workforce, as veteran cohorts frequently include higher proportions of women and underrepresented minorities compared to traditional engineering student demographics [3]. Despite the technical expertise gained during military service, veteran participation in STEM occupations remains relatively low, suggesting a critical need for better institutional support in translating military credentials into civilian engineering roles [5]. While they bring discipline, teamwork, and applied problem-solving skills from military service [6], they face challenges transitioning to academic learning environments [7]. Prior studies have explored veteran students' transitions into engineering [8]. However, very limited research explores how using AI impacts veteran students' transition experience. Therefore, the purpose of this study is to explore how student veterans in engineering engage with or experience AI tools in their learning and to navigate the broader transition from military to college life. Specifically, the study seeks to address two research questions: 1. How do student veterans engage with or experience AI tools in their engineering learning? 2. How do student veterans engage with or experience AI tools as they navigate the broader transition from military to college life?

Theoretical framework

The study utilizes Schlossberg's 4S transition theory [9] as the theoretical framework to explore how student veterans in engineering engage with or experience AI tools in their learning and to navigate the broader transition from military to college life. A transition is defined as any event, anticipated or unanticipated, or a non-event, which is an expected occurrence that fails to happen, such as a promotion that never materializes [9]. These transitions are significant because they alter an individual's roles, relationships, routines, and assumptions. Because transitions necessitate a renegotiation of identity and a period of unlearning old behaviors, the theory emphasizes that the impact of a transition depends less on the event itself and more on the degree to which it disrupts an individual's core sense of self and daily life [10]. According to

Schlossberg's 4S transition theory [9], there are four major categories of factors that influence an individual's experience of the transition: situation, self, support, and strategies. The *situation* refers to the specific context of the transition, including its timing, the person's perceived control over the event, and any concurrent stresses that might complicate the process. *Self* encompasses an individual's internal resources, such as demographic characteristics and psychological assets like resilience, optimism, self-efficacy, and commitment. *Support* identifies external resources available at the time of transition, including social networks, family, peer groups, and institutional services. Finally, *strategies* are the specific actions or responses individuals employ to modify the situation, reframe its meaning, or manage the stress associated with the transition. This theory has been applied in prior research to understand student veterans' career transition experience from military to academic trajectories. For example, Hunter-Johnson et al. [7] utilized the 4S model to identify institutional barriers and the social disconnect veterans feel when compared to their civilian peers. In addition, Main et al. [1] applied the theory to explore the diverse, non-linear pathways veterans take into engineering education.

Literature review

Student veterans in engineering

Student veterans bring significant technical capital and a variety of unique assets to engineering programs, including discipline, persistence, maturity, and leadership [11], [12]. Their decision to major in engineering is often rooted in the technical responsibilities they held during their military service, which they leverage as internal resources for navigating rigorous curricula [1], [13]. According to the study by Camacho et al. [8], veterans often view their service-related experiences, such as patience and technical discipline, as distinct advantages that provide them with a clearer sense of purpose and focus compared to their civilian peers. In addition, many veterans prioritize social responsibility and creative problem-solving, values that align closely with professional engineering identities and improve their connection to the field [14], [15]. Transitioning from a structured military environment to the individualistic and often ambiguous culture of higher education presents significant challenges [16]. Veterans frequently encounter cultural dissonance when moving from a "reward and punishment" military model based on behaviorism to the self-directed, andragogical model prevalent in academia [2], [17]. Beyond cultural shifts, student veterans in engineering face practical hurdles such as math preparation gaps due to long breaks in schooling and service-related physical or mental health conditions, including hearing loss or traumatic brain injuries [11], [18]. In addition, the presence of negative stereotypes, such as the myth that veterans are rigid thinkers or suffer disproportionately from psychological issues, can lead to social isolation and institutional barriers when held by faculty and staff [19], [20]. To facilitate successful transitions, institutions are increasingly implementing targeted support structures and specialized interventions. Effective strategies include the establishment of Veterans Resource Centers, priority registration, and veteran-specific orientations that help ease the administrative and social transition [11], [21]. Programs that utilize an andragogical framework, such as specialized support seminars and learning communities, have been shown to increase camaraderie, financial security, and engineering identity among veteran students [22]. In addition, peer mentorship and institutional efforts to award academic credit for military technical training remain essential components for improving veteran retention and professional success [16], [18].

AI in engineering education

The integration of AI in engineering education has transitioned from an emerging area of interest into a period of rapid development and application [23]. This transformation represents a comprehensive realignment of educational frameworks, driven by external societal and technological pressures alongside internal academic efforts to improve curriculum quality [24]. Current scholarly work identifies seven primary domains of AI application in engineering education, including virtual experiment environments, learning prediction, learning analytics, robotics, intelligent tutoring systems, automatic evaluation, and assisted learning [25]. This systemic shift reflects a broader transition toward human-computer cognitive collaboration, where AI systems and human instructors co-evolve to foster the innovation and interdisciplinary skills required for the modern era [23], [24]. Within engineering programs, AI is utilized to create personalized and adaptive instructional experiences. Intelligent tutoring systems (ITS) and specialized AI-tutor platforms provide students with customized feedback and explanations, simulating the social presence of a human tutor to support iterative learning gains [26], [27]. AI-driven virtual laboratories and simulation tools allow students to conduct hands-on experiments in safe, realistic environments [24], [28]. This is especially helpful for exploring complex phenomena such as fluid dynamics and structural analysis. Furthermore, AI-enabled prediction models use evolutionary computation and data mining to analyze learning processes and summative data [29]. This helps educators identify key variables, such as knowledge acquisition and class participation, and predict academic performance in online engineering courses. Introductory modules are also being designed to improve student confidence in future job competencies by teaching AI fundamentals as part of undergraduate engineering programs [30].

The benefits of embedding AI into engineering curricula focus on enhancing student engagement and instructional efficiency. AI tools facilitate personalized learning by tailoring course content and assignments to individual cognitive profiles and learning styles [27], [31]. These systems offer real-time, formative feedback, enabling students to build a strong foundational knowledge through iterative improvement before advancing to more complex material[27], [32]. For educators, generative AI optimizes time by automating repetitive tasks such as lesson planning, content generation, and grading, which allows faculty to focus more on student mentorship and higher-order cognitive activities [28], [31]. Furthermore, AI can help keep curricula current by tracking and integrating the latest industry standards and research findings [24], [28]. However, the widespread adoption of AI in engineering education also raises critical concerns regarding academic integrity, reliability, and equity. The emergence of powerful generative tools has necessitated a re-evaluation of assessment practices, as tools like ChatGPT can generate passable responses to traditional engineering tasks, potentially undermining assessment integrity[27], [33]. There are also significant risks associated with hallucinations or the generation of incorrect information, which requires students to exercise due diligence and use critical thinking to verify AI-generated outputs [27], [28]. From an ethical perspective, some scholars call for a transition toward "Engineering Education 5.0", which emphasizes that technological application must be balanced with sustainability, humanism, and ethics [34]. In addition, concerns about the digital divide persist, as more privileged students may benefit significantly more from AI advancements than those in disadvantaged or developing regions, where structural gaps in curriculum and infrastructure often remain [24], [27], [35].

Artificial intelligence as a transition resource

Artificial intelligence functions as a critical bridge during career transitions, acting as both an academic facilitator and a strategic tool for professional development. For example, AI serves as a sensemaking resource that helps individuals interpret the evolving demands of the labor market and adapt their professional identities to new technological realities among knowledgeable workers [36]. In the specific context of military veterans, AI can act as a skills multiplier, creating new pathways into high-demand technical sectors by helping translate military experience into civilian job requirements [37]. Furthermore, specialized AI-powered career navigation platforms can now assess automation risks at the task level, offering transitioners personalized guides that identify which existing skills to retain and which new competencies, such as digital literacy and prompt engineering, to acquire for a secure transition [38]. By leveraging AI's predictive and data analysis capabilities, Transition Assistance Programs can move beyond one-size-fits-all models to create dynamic, personalized, and culturally responsive transition plans [39]. This technology allows for the identification of unique emotional and systemic hurdles, ensuring that support strategies are tailored to the specific needs of diverse populations [39]. In addition, for first-generation college students, who are often the most vulnerable to displacement, early engagement with generative AI tools during their academic career facilitates a smoother transition into professional or entrepreneurial roles, as direct experience with the technology tends to mitigate anxieties regarding its impact on their future careers [40]. Despite its potential as a transition resource, the use of AI is constrained by significant technical and ethical limitations. Generative AI can sometimes make up information or give answers that sound confident but are actually wrong. Because of that, students and people transitioning into new roles need enough basic knowledge in the topic to check whether the AI's answer is correct [27]. In addition, AI algorithms can perpetuate existing societal biases, raising significant concerns about equity for underrepresented groups in both higher education and the workforce [27], [31]. While AI is effective at automating repetitive and technical tasks, it remains limited in its ability to replicate human-centric elements of work that involve high-stakes subjectivity, novelty, and deep interpersonal engagement [36].

Methods

This study utilizes a basic qualitative research design as defined by Merriam and Tisdell [41], which is particularly effective for exploring how individuals make sense of their experiences and the world around them. The participants are student veterans currently enrolled in undergraduate or graduate engineering programs. To ensure a comprehensive dataset, we employed purposive sampling to identify participants who represent a range of military backgrounds, such as different branches of service and varied ranks, and engineering sub-disciplines. This is supplemented by a snowball sampling technique, where initial participants were asked to refer peers who meet the inclusion criteria. Recruitment was facilitated through established campus networks, including Veteran Resource Centers and student-led engineering organizations, to ensure that the sample includes individuals at various stages of their academic and transition journeys. Twenty participants completed the interview. The primary data collection instrument is semi-structured interviews. These interviews lasted around sixty minutes and were conducted via secure video conferencing platforms to accommodate participants from multiple geographical locations. The interview protocol is intentionally mapped to the 4S transition pillars to elicit narratives that address both research questions. Selected interview questions from the protocol include: Walk me through a recent time you used AI for a class assignment. What were you trying to do, and how did you verify the accuracy of the output? How do you use AI to connect your military skills to engineering problem-solving? Outside of coursework, how do you use AI to manage the transition to college life? If you think about your journey from the military to college, where does AI fit into that story? All interviews were recorded and transcribed verbatim, with any identifying information removed to maintain participant confidentiality.

Data analysis followed a two-phase process to ensure both emergent insights and theoretical rigor. In the first phase, we performed an inductive thematic analysis, beginning with open coding to identify recurring patterns and concepts directly from the raw interview data. This allows the unique voices of the veterans to shape the findings without being prematurely constrained by existing theories. In the second phase, we transitioned to a deductive approach by mapping these emergent themes onto the four pillars of Schlossberg's 4S transition theory. This dual-level analysis enabled us to pinpoint exactly where AI tools intervene in the transition process. To ensure the trustworthiness of the findings, the research team employed researcher triangulation and member checking, providing participants the opportunity to review their transcripts to ensure their experiences are accurately represented. This study operates under the approval of the Institutional Review Board at the primary author's university, and all participants provided informed consent.

Anticipated findings

As this is a work in progress, the findings will emerge through an inductive process, allowing the unique narratives of student veterans to define the themes. However, based on the preliminary integration of Schlossberg's 4S transition theory [5], this study anticipates identifying critical inflection points where AI tools intersect with the veteran experience. The analysis is expected to explore how AI acts as a mediator for the unlearning and relearning processes required during the military-to-college transition. Rather than viewing AI solely as a pedagogical tool, the study anticipates finding that veterans use these technologies to navigate cultural dissonance and to translate military technical capital into academic engineering competencies. Table 1 outlines the conceptual areas this study will investigate through the qualitative data.

Table 1. Conceptual Framework for Inductive Investigation

4S	Areas of qualitative inquiry	Research objective
Situation	Impact of AI on the timing and control of the transition.	Understand if AI reduces the perceived chaos of the academic environment.
Self	AI's role in shaping professional engineering identity.	Explore if AI proficiency helps veterans reconcile military and student identities.
Support	AI as a supplemental resource to human networks.	Identify if AI fills gaps in social or institutional support systems.
Strategies	Emergent prompting and learning tactics.	Categorize the specific actions veterans take to modify their learning environment.

Conclusion

This study addresses a timely gap in engineering education by exploring how student veterans engage with AI during a period of significant personal and professional transition. By utilizing a basic qualitative design and the 4S transition theory, this research moves beyond generalities to explore the lived experiences of a population that brings unique assets and faces unique challenges to the engineering classroom. The implications of this work suggest a necessary shift in how engineering programs view emerging technology. By highlighting how a non-traditional population utilizes AI to bridge preparation gaps and navigate cultural dissonance, the findings encourage faculty to move toward a force multiplier mindset. This approach leverages AI for inclusive excellence and retention, rather than focusing solely on prohibition or academic integrity risks. As engineering education enters the 5.0 era [34], the goal of this research is to ensure that technological advancements serve as a bridge rather than a barrier. These findings provide a foundation for Veteran Resource Centers, academic advisors, and engineering faculty to develop targeted, culturally responsive interventions. Therefore, this work seeks to empower student veterans to utilize AI as a strategic tool, ensuring they are successful students and competitive leaders in the future engineering workforce.

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