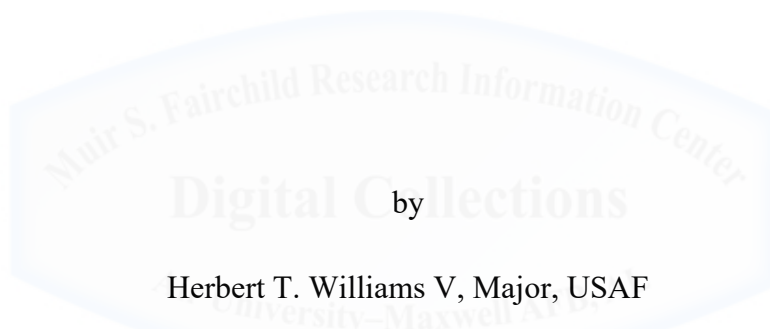


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AIR FORCE FELLOWS

AIR UNIVERSITY (AU)

A DOD EDUCATION STRATEGY FOR ARTIFICIAL
INTELLIGENCE



by

Herbert T. Williams V, Major, USAF

A Research Report Submitted to the Air Force Fellows
in Partial Fulfillment of the Graduation Requirements

Advisor:

Dr. Lynne E. Parker

White House Office of Science and Technology Policy

Maxwell Air Force Base, Alabama

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Disclaimer

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Contents

Contents	iii
Illustrations	iv
Tables	v
Preface.....	vi
Abstract.....	vii
Why the DOD Needs an AI Education.....	1
Congressional Mandate.....	2
Historical Precedent.....	2
Current AI Strategy.....	3
Purpose and Scope	5
Surveying a Foundation	6
AI Education Now	10
Voluntary Online Education and Certification	10
Mandatory Computer Based Training	11
Executive Leadership Seminars.....	13
AI Education Now Conclusion	14
AI Education for the Future	14
Precommissioning Education.....	16
Primary Education	17
Intermediate Education	19
Senior Level Education.....	23
General and Flag Officer Education	27
Implementation	32
Conclusion	36
Bibliography	41

Illustrations

Figure 1: Officer Professional Military Education Curriculum.....15

Figure 2: Prioritization Chart.....35



Tables

Table 1: AI Workforce Model (Adapted by author. Removed questions for departments columns and added examples column using NSCAI archetype examples).....7



Preface

The idea for this project developed from my perception of a “say-do” gap between what senior military leaders said about the importance of artificial intelligence technology and what I was learning in professional military education. To me, it seemed that AI was a buzzword used as magic solution that would solve very difficult problems like multi-domain command and control and less than a minute sensor-shooter targeting cycles. During the project I’ve found that there is real work happening to educate servicemembers about AI, but it still does not match the rhetoric of senior leaders or the real potential for the technology. The focus remains on technology, hardware and gadgets, instead of “our most important weapon systems,” our people. This paper aims to increase emphasis and effort to educate the military about artificial intelligence.

I would like to thank members of the White House Office of Science and Technology Policy for their guidance and assistance with this project. Thanks to my paper advisor, Dr. Lynne Parker, in particular. I also thank OSTP for welcoming onto their team for my fellowship.

Finally, thanks to wife, who continues to encourage and support me throughout my career.

Abstract

This paper addresses the lack of a strategy to educate officers in the Department of Defense about artificial intelligence (AI) and provides a recommendation for what such a program should include. The National Defense Strategy and senior military leaders agree that AI will be a key technology for future warfighters. There is little guidance on how to prepare warfighters to use AI and no specific plans to include AI into professional military education. This paper will describe why the Department of Defense (DOD) needs an education strategy and what it should include. It notes that Congress mandated DOD create an AI strategy to cover nine topics including AI design, software coding, military applications for AI, and AI decision-making, among others. Congress did not dictate, however, who should receive this education. The paper recommends options for educating the workforce about AI now and adapting joint professional military education to include AI across the continuum of learning. The conclusion is that by implementing these solutions, the DOD can help maintain both a cognitive and technological edge over adversaries with AI technologies.

Why the DOD Needs an AI Education

Continued American leadership in AI is of paramount importance to maintaining the economic and national security of the United States and to shaping the global evolution of AI in a manner consistent with our Nation's values, polices, and priorities.

— President Donald J. Trump¹

The United States National Security Strategy and National Defense Strategy both highlight artificial intelligence (AI) as a key technology for national security.^{2,3} Other nations, most significantly China, have similarly concluded that AI is a vital technology and are aggressively pursuing military applications for AI.⁴ Many believe that AI will be the next revolution in military affairs and fundamentally change the character of war. Our current period could be similar to the inter-war period when the development of aviation technology led to enormous change in warfare operations and tactics. But what is AI? How can you use it?

Here there is less consensus. Often, going one layer beneath the superficial superlatives used to describe the importance of AI exposes a concerning lack of knowledge. Many leaders in DOD do not understand the fundamentals of AI; definitions, benefits, drawbacks, risks, and rewards. This lack of knowledge impairs DOD's ability to imagine what AI can do, thereby delaying the incorporation of AI into the fabric of the DOD.

Again, aviation technology provides an illustrative comparison. During the inter-war period, airpower advocates like Brigadier General Billy Mitchell tried to demonstrate that airplanes had changed warfare. He argued this new technology required the military to change everything from strategy to tactics and revamp the way the military was organized, trained, and equipped. Institutional inertia and entrenched senior leaders delayed this transition, which placed the United

States at a disadvantage in equipment and doctrine when World War II began. America spent the first two years figuring out how to apply aviation technology in warfare.

Today, no one needs convincing that AI is a key military technology. However, the DOD will be unable to make the necessary changes to incorporate AI, as it did with aviation, until the DOD better understands AI. Understanding requires education.

Congressional Mandate

The National Defense Authorization Act of Fiscal Year 2020 became law on December 20, 2019. Section 256 requires that the Secretary of Defense shall “develop a strategy for educating servicemembers in relevant occupation fields on matters relating to artificial intelligence.” This curriculum shall include instruction in –

- (A) artificial intelligence design;
- (B) software coding;
- (C) potential military applications for artificial intelligence;
- (D) the impact of artificial intelligence on military strategy and doctrine;
- (E) artificial intelligence decision making via machine learning and neural networks;
- (F) ethical issues relating to artificial intelligence;
- (G) the potential biases of artificial intelligence;
- (H) potential weakness in artificial intelligence technology;
- (I) opportunities and risks;
- (J) and any other matters the Secretary of Defense determines to be relevant.⁵

Clearly, Congress recognizes the need for AI education in the DOD and directs the Secretary of Defense to develop a strategy. Congress does not dictate who should receive this education, however. The phrase “relevant occupational fields” allows the DOD to determine who needs AI education and who does not. This paper aspires to inform that strategy and aid in educating warfighters in the technologies of the future.

Historical Precedent

Technological change is a constant part of human evolution and war. From the chariot to gunpowder to nuclear weapons, those able to adopt and implement a new technology have enjoyed

an advantage over their adversaries. The degree of advantage provided by technology is variable in size and time based on how well the technology can be integrated into military tactics and operations and how rapidly an adversary can adapt. A constant is the importance of people to the successful use of the new technology, among other factors. For example, in 1940 the Germans were able to combine mechanized infantry and airpower to create the Blitzkrieg. Key to that success was the tactical skill of the soldiers and operational planning of the German staff in using those technologies in effective ways.

Another historical example is Operations Desert Storm and Iraqi Freedom. In both cases, the United States was quickly able to sweep away a large and well-equipped Iraqi military. While the U.S. had a technological edge, experts predicted those battles would be more difficult and costly. The difference was that the Iraqi military was poorly trained and led, while the U.S. military was better prepared.

These historical examples demonstrate technology is important and maintaining a technological edge is a factor in military advantage. It is more important, however, to have well trained people that can integrate the technology into sound tactics and operational plans. This is why military leaders constantly emphasize, “People are our more important weapons system.”⁶

This further underlines the need to educate the military on AI. If AI will be the new chariot, cannon, or nuclear weapon that changes the character of war then the military must heavily invest into its human resources to ensure it is prepared to use AI better than our adversaries are.

Current AI Strategy

The DOD’s current AI strategy builds from the 2018 National Defense Strategy (NDS). In defining the strategic environment, the NDS states that AI, along with related technologies like advanced computing, robotics, and “big data” analytics, is part of the “rapid technological

advancements and the changing character of war.”⁷ Advancing autonomous systems, including AI, is later highlighted as necessary to modernize key capabilities and solidify the US’s competitive advantage through the NDS’s first line of effort, build a more lethal force. Finally, under the “cultivate workforce talent” section in the “build a more lethal force” line of effort, the NDS emphasizes information experts and data scientists for civilian workforce expertise, but there is no mention or allusion to uniformed workforce talent and AI.⁸

The 2018 DOD AI Strategy includes more detail regarding how the DOD plans to harness AI to advance the US’s security and prosperity. It makes clear that failure to adopt AI will result in a “decline in our prosperity” and “legacy systems irrelevant to the defense of our people.”⁹ It also recognizes the potential of AI to alter our way of life;

AI is poised to transform every industry, and is expected to impact every corner of the Department, spanning operations, training, sustainment, force protection, recruiting, healthcare, and many others.¹⁰

The AI strategy also recognizes that the military’s greatest strength is the innovative character of its forces and that the “most transformative uses of AI-enabled capabilities” will come from users themselves.¹¹ Cultivating an AI workforce is part of the DOD strategy and recognizes the need to educate its workforce to “navigate the AI era.”

It falls short, however, of directing a program or defining objectives for workforce cultivation and instead states that the DOD workforce will have access to AI training programs. There is no mandatory requirement or recommendation to include AI education as part of the military’s education curriculum. This seems at odds with the broad proclamation that “AI is poised to transform every industry.” If this technology will be so transformational, as stated by the DOD, then should not the education policies change so that all members of the military will be better educated and prepared for this transformation?

The NDS and the DOD AI Strategy both discuss the importance of incorporating AI expertise from outside of the DOD. Specifically mentioned are partnerships with industry and academia. There are also mentions that allude to importing AI talent into the DOD through “non-traditional paths.”¹² These efforts are important, particularly considering some portions of the industry have been reluctant to work with the military.¹³ But they ignore the fact that the vast majority of the uniformed military will need to understand and use AI tools. This somewhat glaring omission seems in contradiction with the emphasis on workforce talent and personnel development espoused by military leadership.

Purpose and Scope

The purpose of this paper is to outline “who” needs “what” education “when” and “how” using best practices from industry and civilian workforce education and expert recommendations within and outside of the DOD and government. While enlisted servicemembers will need AI education, this paper will only address officer education as the “who” to manage scope and scale. Additional study is required for an enlisted education strategy.

The nine learning objectives outlined in the National Defense Authorization Act provide a baseline for “what” this strategy must teach. These learning objectives provide ample guidance for military education on artificial intelligence. The “artificial intelligence design” objective should address fundamentals of definitions and descriptions of different types of AI and machine learning. “Software coding” enables some practical application of AI, as well as increasing depth and skills. The remaining objectives aid in the application of AI from theory to practice in military environments and cover important topics such as bias and ethics, strengths and weaknesses, and how AI will change the character of war.

With “who” and “what” broadly addressed, the “when” and “how” will be the primary focus of this paper. The sections will cover an officer’s career chronologically from commissioning source through the continuum of professional military education to end with senior leader education.

Surveying a Foundation

The United States must train current and future generations of American workers with the skills to develop and apply AI technologies to prepare them for today’s economy and jobs of the future.

— President Donald J. Trump¹⁴

What does an AI education mean? Who needs it and why? This paper contributes to answering these questions. One source of information is the National Security Commission on Artificial Intelligence. The Fiscal Year 2019 John S. McCain National Defense Authorization Act established this independent Commission to “consider the methods and means necessary to advance the development of artificial intelligence, machine learning, and associated technologies to comprehensively address the national security and defense needs of the United States.”¹⁵

The Commission worked with the Defense Innovation Board and Joint Artificial Intelligence Center to create an AI workforce model. This workforce model has not been officially adopted by the US military, but it provides a helpful framework to understand who needs what type of education. The team developed the workforce model in consultation with leading AI companies in the private sector, traditional companies that have successfully integrated AI, human resource and force structure experts within the government, and includes prominent AI and organization theory discussed in business and academic literature. Figure 1 is adapted from their AI workforce model.

Table 1: AI Workforce Model¹⁶ (Adapted by author. Removed questions for departments columns and added examples column using NSCAI archetype examples)

Worker Archetypes	Output	Capabilities (Ethics Throughout)	Examples
AI Expert	Leads the ethical design, development and deployment of AI-driven technologies; oversees test and evaluation (verification and validation) to determine technology readiness; helps maintain and leverage supporting data architecture; translates requirements into capabilities; translates technical topics for senior leaders	Expert in data science, machine learning (e.g., deep learning), AI lifecycle, applied ethics and one or more of the following; natural language processing; computer vision; robotics; human-computer interfaces; human centered systems engineering; algorithmic and computational theory	AI research engineer, AI software and systems architect, AI machine learning software engineer
AI Developer	Data selection and preprocessing; model selection, training, and validation; partnership with domain knowledge experts and end users; discovery of local opportunities	Computational statistics and data science; programming (e.g. Python or R); model development using a ML library	Data engineer, data analyst, software engineer
Deployment Specialist	Infrastructure installation and maintenance, review, input/output sent by end-users, additions to training data sets, rough examination of training data sets, training/testing existing models, deployment	Hardware/Software installation and maintenance, training aid management, model verification/validation, algorithm development, data cleansing	AI hardware engineer, AI systems engineer
End User	Daily business augmented/enabled by AI	Use of systems and apps	Tracked vehicle maintenance, all-source intelligence analyst, F-35 pilot
Non-Technical Tactical Leader	Gathers tactical requirements to guide the development of new AI-enabled capabilities, oversees deployment to ensure tactical requirements are met; partners with technicians, data engineers, and AI experts; leads normal operations	Tactical domain implementation expert, basic data collection and management, basic understanding of AI decision making within the context of use and the sources of failures and errors, ethics applied to tactical use	Battalion/Squadron commander, program manager, senior intelligence analyst
Non-Technical Strategic Leader	Oversees the creation of strategic and enterprise objectives, considers the ethics of new capabilities, oversees deployment and scaling, partnership with experts, developers, and tactical leaders; career management	Basics and ethics of AI lifecycle, strategic and enterprise expertise, tactical domain management, software development processes	Deputy Assistant Secretary of Defense, US Central Command Commander, Deputy Director of National Intelligence for Mission Integration
Support Roles	Acquisition and contracting of AI hardware and software, services, and identification of commercial opportunities; legal support, legislative affairs, human resources, etc.	Understanding of software purchasing, data boundaries/limitations and rights; funding requirements; computer purchases, identification of skill and qualifications of AI practitioners; legal and ethical aspects of development and deployment	Human resource specialist, staff judge advocate, legislative fellow

The NSCAI highlights that the “most important takeaway from this model is that building an AI workforce will require much more than highly educated, deep technical experts.”¹⁷ The model divides the workforce into two segments: technical roles and enablers. The technical roles are the red colored worker archetypes. These workers are the expert AI talent like engineers, data scientists, and software experts. The enabler roles compose nearly everyone else in the military from vehicle mechanics to program managers to combatant commanders.

In 2020, the NSCAI’s First Quarter Report provided further recommendations to strengthen the national security AI workforce. This report identified eight issues and provided fifteen recommendations. The deficiencies of the government’s abilities to recruit, hire, and retain top AI talent are clearly explained with reasonable suggestions for improvement. This talent is critical for the successful implementation of AI tools in the military, but is not the focus of this paper. The NSCAI also recommended that “many if not most” end users will need to gain a baseline understanding data management requirements, ethical use, and limitations of AI.¹⁸ The Commission goes further to say that a “lack of AI literacy is particularly challenging in the DoD because of the high stakes and large scale involved in AI adoption.”¹⁹ This implicitly supports this paper’s recommendation that all military officers receive education on AI.

This sort of foundational education is recommended by Major General Mick Ryan of the Australian Army and Commander of the Australian Defence College. General Ryan suggests AI will find uses in “intelligence analysis, strategic decision support, operational planning, command and control, logistics, and weapons systems across all environments.”²⁰ To harness the capability of this technology and its wide applications, General Ryan recommends that Western military professional education add another pillar to their continuum of learning. He notes that professional military education focuses on three key areas: national security policy and strategy, joint

warfighting, and command, leadership, and ethics. He recommends adding another pillar that focuses on “technical literacy, the ethics of advanced technology, and procurement and logistics” to “create a wider institutional capacity to understand new technologies, foster quality control, and address the risks of bias and misbehaving algorithms.”²¹

General Ryan’s suggestions align with the guidance in the NDAA with the inclusion of specifics for who and when—everyone and throughout their career.

This perspective does not seem to align with draft guidance from the Joint Chiefs of Staff. This draft vision, titled “Developing Today’s Joint Officers for Tomorrow’s Ways of War,” identifies that the changing character and conduct of war and operations demands, among other things, “deeper understanding of the implications of disruptive and future technologies for adversaries and ourselves.”²² This demand drives a professional military education program that creates warfighting joint leaders, senior staff officers, and strategists who, among other outcomes, “anticipate and lead rapid adaptation and innovation during a dynamic period of acceleration in the rate of change in warfare under the conditions of great power competition and disruptive technology.”²³

While these excerpts suggest a vision that includes disruptive technology (which one assumes includes AI), the rest of the document lacks specifics on how to incorporate disruptive technology into professional military education. Instead, as part of the critical task to adapt and innovate professional military education, the JCS vision is to shift from a topic-based model to an outcomes-based approach and emphasis on “ingenuity, intellectual application, and military professionalism in the art and science of warfighting while deepening knowledge of history.”²⁴

The draft vision was released prior to the 2020 NDAA, which may explain why there could be a disconnect between the Joint Chiefs’ vision and Congress’s direction. Hopefully, the final

vision document will include more specifics regarding the role of disruptive technology. The Joint Chiefs should consider Major General Ryan's recommendation to include another pillar to the professional military education foundation. This pillar of technological literacy, procurement, and logistics contributes significantly to "Developing Today's Joint Officers for Tomorrow's Ways of War." At a minimum, the vision should reflect the direction of Congress and importance of AI for tomorrow's ways of war.

A successful military AI education strategy must address two issues: AI education now and the continuum of learning. The DOD cannot wait for a new generation of officers, born and raised in the AI era, to begin to adapt and implement AI technologies. It needs to act now to educate the workforce immediately. This immediate education will be broad to provide basic AI literacy. Officers will gain a deeper understanding of AI by incorporating AI education across the continuum of learning.

AI Education Now

This section discusses options for the DOD to educate its current workforce in the near to medium term (0 to 5 years). The purpose of these recommendations is to improve AI knowledge now while the military develops and implements curriculum for its professional military education. The recommendations range from voluntary courses to mandatory training. The military is already pursuing some of these ideas, an encouraging sign of adaptation.

Voluntary Online Education and Certification

The DOD is creating AI education resources for its workforce. Leveraging digital content and massive open online courses (MOOCs), the DOD AI Strategy envisions a curated learning experience with in-person augmentation from industry AI experts and academia.²⁵ An initial

concept of this idea is the Air Force's Digital University, which will use the same providers as Silicon Valley firms to train Airmen on data science and AI.²⁶ The DOD's intent with these programs is to give servicemembers access to this content and information if the person finds it interesting. This "pull" strategy may reach some parts of the military, but penetration will depend on consistent and sustained senior leader emphasis and incentives. DOD's AI strategy mentions "badging" and similar gamification to entice participation in these voluntary educational opportunities. Another incentive is to provide extra pay for proficiency in computer languages, similar to how the DOD pays servicemembers who speak foreign languages. This benefit could equal an extra \$500 a month for people who qualify in certain coding languages.

Special experience identifiers are another option to encourage servicemembers to develop expertise in AI voluntarily. Servicemembers can earn these special experience identifiers by completing certain training requirements. These identifiers help the military personnel system match people with special skills and experience to jobs that require their expertise. As AI expertise becomes more valuable to the DOD, these experience identifiers help servicemembers be more competitive for career-progression by placement in high-profile positions or promotion.

The NSCAI also recommends the DOD sponsor "certified self-development" courses and encourage servicemembers to take them with financial and career enhancing rewards. The NSCAI proposes Congress set aside \$20 million dollars to establish and execute certified self-development courses and compensate servicemembers for successful completion.²⁷

Mandatory Computer Based Training

Voluntary education, however, will not enable the DOD to excel in the AI era by itself. The DOD should strongly consider mandatory training to provide a baseline of education for its current workforce. This requirement will likely be strongly opposed. The primary reason for resistance is

that military personnel already have several mandatory training requirements. These cover a range of topics from combat first aid to government credit card rules and, most notably, information assurance and cyber awareness. Many servicemembers dislike the mandatory information assurance and cyber awareness training required by the DOD. Despite attempts to gamify the training, it becomes repetitive and annoying after accomplishing the same thing year after year.²⁸ So why does the DOD subject all its employees to this tedious yearly requirement?

The reason is that the DOD recognized the importance of information assurance and cyber awareness and made the training mandatory. Without educating its entire workforce on basic cyber and information security practices and policies, there would continue to be leaks and vulnerabilities in DOD networks. This example is illustrative of a method DOD could repeat to accomplish a broad AI education introduction so that all DOD employees have a baseline literacy in AI before AI enabled technologies begin to appear. Cyber awareness training could even be a potential way to incorporate baseline AI education.

DOD leaders have recently pushed back against overly burdensome mandatory training requirements. In 2018, military departments eliminated, reduced, or condensed several requirements in response to complaints regarding redundancies and overwork.²⁹ It will take dedicated and sustained senior leadership commitment to introduce new mandatory training requirements for AI. Leaders will need to explain why this is important enough to consume valuable training time. It may be unlikely that DOD leadership would institute mandatory education unless there is an outside requirement such as Congressional or Presidential direction.

This resistance to new requirements makes adding AI training to the information assurance and cybersecurity awareness training a potentially more attractive option. One of the complaints of military personnel is that the training content is the same year to year.³⁰ Adding AI fundamentals

introduces new subjects and content and expands on an existing requirement instead of generating a new one.

The NSCAI recommended this type of program in its First Quarter Recommendations. Their recommendation cites a lack of baseline AI knowledge as the reason DOD struggles to implement AI solutions. According to the NSCAI, this mandatory training should “focus on end users and their ability to collect and manage data, and include a short introduction to AI with an emphasis on machine learning, data management, the capabilities and limitations of AI, software decision-making, probabilistic reasoning, and an introduction to the responsible and ethical development and fielding of AI.” The NSCAI suggests Congress set aside \$20 million dollars to establish and execute mandatory AI annual training.³¹

While this mandatory training will help across the range of enabler worker archetypes, non-technical strategic leaders may need additional education to be prepared to make informed decisions about AI technology.

Executive Leadership Seminars

These “non-technical strategic leaders” have a crucial role in adopting AI technology for military purposes. In the military, these officers select programs for research and acquisition, drive doctrine and develop strategy, lead large organizations and command combat forces, and provide military advice to civilian policymakers and government leadership. Some experts suggest these leaders have an “AI literacy gap” that could throttle the adoption of AI technology due to a lack of understanding and knowledge.³² An executive course or seminar designed to teach senior organization leaders about AI and how to leverage it for success would help these officers make knowledgeable decisions regarding AI. Several universities offer these courses or the DOD could

contract with a university or national security think tank to provide an executive course designed specifically for “non-technical strategic leaders.”

AI Education Now Conclusion

To summarize, adding AI education to existing mandatory information awareness and cybersecurity training is a low impact option to introduce servicemembers to AI fundamentals. Voluntary programs, coupled with incentives like payment and special experience identifiers, will encourage some in the military to develop more expertise. The DOD can and should enact these measures immediately.

Mandatory baseline education and voluntary incentives will not provide the level of AI expertise necessary to ensure the DOD is ready and able to use this revolutionary new tool to maintain our competitive advantage against our adversaries. The DOD should include AI education as a core element throughout an officer’s professional military education.

AI Education for the Future

“There is more to sustaining a competitive advantage than acquiring hardware; we must gain and sustain and intellectual overmatch as well...This cannot be achieved without substantially enhancing the cognitive capacities of joint warfighters to conceive, design, and implement strategies and campaigns to integrate our capabilities globally, defeat competitors in contests we have not yet imagined, and respond to activity short of armed conflict in domains already being contested.”

— Draft Joint Chiefs of Staff Vision for Professional Military Education and Talent Management³³

The military designs officer professional military education to develop officers across the continuum of their career. This begins at the commissioning source where officers learn the fundamentals of leadership, ethics, history, and tradition. Then the officer progresses through

primary, intermediate, and senior level education intended to grow the officer from a tactical expert and small unit leader into a strategic leader of large organizations and an expert in joint warfare.

Chairman of the Joint Chiefs of Staff Instruction 1800.01E Officer Professional Military Education Policy outlines this continuum. This policy organizes military education into five levels; precommissioning, primary, intermediate, senior, and General/Flag Officer. Figure 2 describes the five education levels and their purpose across the continuum.

EDUCATION	CADET/MIDSHIPMAN PRECOMMISSIONING	O-1/O-2/O-3 PRIMARY	O-4 INTERMEDIATE	O-5/O-6 SENIOR	O-7/O-8/O-9 GENERAL/FLAG
EDUCATIONAL INSTITUTIONS, PROGRAMS AND COURSES	SERVICE ACADEMIES ROTC OCS/OTS/DC	<ul style="list-style-type: none"> BRANCH WARFARE OR STAFF SPECIALTY SCHOOLS PRIMARY-LEVEL PME COURSES 	<ul style="list-style-type: none"> Air Cmd and Staff College Army Cmd and Gen'l Staff College College of Naval Cmd and Staff Marine Corps Cmd and Staff College JFSC: Jt & Combined Warfighting School, AJPME National Intelligence Univ 	<ul style="list-style-type: none"> Air War College Army War College College of Naval Warfare Marine Corps War College Eisenhower School National War College JFSC: Jt & Combined Warfighting School, AJPME JFSC: Jt Advanced Warfighting 	<ul style="list-style-type: none"> CAPSTONE Jt Functional Component Cmdr Courses SJIOAC JFOWC COEC PINNACLE
LEVEL OF WAR EMPHASIZED	Conceptual Awareness of all Levels	TACTICAL OPERATIONAL STRATEGIC			
FOCUS OF MILITARY EDUCATION	<ul style="list-style-type: none"> Intro to Service Missions U.S. Constitution U.S. Gov't 	<ul style="list-style-type: none"> Assigned Branch of Staff Speciality Domain Knowledge (Land, air, sea, space & cyber) 	<ul style="list-style-type: none"> Warfighting w/in context of Op Art Intro to Theater Strategy, Plans, NMS, NSS Op Art in All Domains Joint leader Development 	<ul style="list-style-type: none"> Svc Schools: Strategic Leadership/Leader Development NMS, Theater Strategy NWC: NSS Eisenhower: NSS w/emphasis on resource components All: Theater Strategy & campaigning, planning processes and systems, JIIM capability & Int. 	<ul style="list-style-type: none"> Jt Matters & Nat'l Security Interagency Process Multinat'l Ops
CAREER-LONG DEVELOPMENT	LIFE-LONG LEARNING SKILLS/SELF-DEVELOPMENT/ADVANCED EDUCATION				
JOINT EMPHASIS	CULTURAL EDUCATION: FROM AWARENESS TO COMPETENCE				
JOINT EMPHASIS	<p>Joint Introduction</p> <ul style="list-style-type: none"> Nat'l Military Capabilities (in all domains) & Organization Foundations of Joint Warfare 	<p>Joint Awareness</p> <ul style="list-style-type: none"> Joint Warfare/Cross Domain Fundamentals Joint Campaigning Operational Adaptability 	<p>JPME Ph I</p> <ul style="list-style-type: none"> Nat'l Mil Capabilities Cmd Structure & Strategic Guidance Jt Doctrine & Concepts Jt & Multinat'l Forces at Operational Level of War Jt Planning and Execution Process Jt C2 Operational Adaptability Desired Leader Attributes AJPME 	<p>JPME Ph II</p> <ul style="list-style-type: none"> NSS & NMS Jt Warfare, Theater Strategy & Campaigning in Jt, IA, Intergov't & Multi-Nat'l Envrmt Nat'l & Jt Planning Systems and Processes across all domains. Integration of Jt, IA, Intergov't & Multinat'l Capabilities Desired leader Attributes Strategic Adaptability AJPME 	<p>CAPSTONE</p> <ul style="list-style-type: none"> NSS Jt Op Art Jt Func Component CC courses & JFOWC NSS Nat'l Planning Systems & Org Theater Strategy, campaigning and mil ops in Jt, IA, Intergov't & Multinat'l Environments IO PINNACLE
DESIRED LEADER ATTRIBUTES	<p>1. UNDERSTANDING SECURITY ENVIRONMENT AND INSTRUMENTS OF NATIONAL SECURITY</p> <p>2. ANTICIPATING AND RESPONDING TO SURPRISE AND UNCERTAINTY</p> <p>3. ANTICIPATING AND RECOGNIZING CHANGE AND LEADING TRANSITIONS</p> <p>4. OPERATING IN INTENT THROUGH TRUST, EMPOWERMENT, AND UNDERSTANDING</p> <p>5. MAKING ETHICAL DECISIONS BASED ON THE PROFESSION OF ARMS</p> <p>6. THINKING CRITICALLY/STRATEGICALLY AND APPLYING JOINT WARFIGHTING PRINCIPLES AT ALL LEVELS OF WARFARE</p>				

Figure 1: Officer Professional Military Education Curriculum³⁴

The following sections provide suggestions for where to integrate the Congressionally mandated elements of AI education into the officer continuum of learning. Evidence from professional publications or civilian sector experiences support these recommendations. These objectives are written using Bloom's Taxonomy as described in the CJCSI.³⁵ As a reminder, here is the direction from Congress in the 2020 National Defense Authorization Act; the Secretary of

Defense shall “develop a strategy for educating servicemembers in relevant occupation fields on matters relating to artificial intelligence.” This curriculum shall include instruction in –

- (A) artificial intelligence design;
- (B) software coding;
- (C) potential military applications for artificial intelligence;
- (D) the impact of artificial intelligence on military strategy and doctrine;
- (E) artificial intelligence decision making via machine learning and neural networks;
- (F) ethical issues relating to artificial intelligence;
- (G) the potential biases of artificial intelligence;
- (H) potential weakness in artificial intelligence technology;
- (I) opportunities and risks;
- (J) and any other matters the Secretary of Defense determines to be relevant.³⁶

Precommissioning Education

Officer candidates receive precommissioning education at institutions and through programs that produce commissioned officers on graduation. These include the Service academies, Reserve Officer Training Corps (ROTC) units, and Officer Candidate or Officer Training Schools (OCS/OTS). Precommissioning education focus on preparing officer candidates to become officers through a basic grounding in US defense establishment and their chosen service as well as leadership, management, civil-military relations, ethics, history, international relations, culture and “other subjects necessary to prepare them to serve as commissioned officers.”³⁷

At this level, military education about AI should introduce officer candidates to general principles of AI. The intent is to develop a foundation of language and concepts that facilitates a more detailed education at the primary level. Here is a suggested learning objective written for inclusion into the CJCSI:

Comprehend the fundamentals of artificial intelligence design including machine learning, data science, and algorithms. Apply fundamentals through a basic coding exercise.

This objective would be added in Learning Area 2 – Foundation of Joint Warfare and the Profession of Arms. It could incorporate several of the Congressional requirements but focus on AI design and some basic software coding. This minimal requirement is suitable for application in all precommissioning schools, including OCS/OTS. OCS/OTS have the least amount of classroom academic time compared to service academics and Reserve Officer Training Corps, necessitating a minimal introduction to AI. The service academies and ROTC could expand their curriculum to include knowledge of potential military applications of AI and AI decision making via machine learning or neural networks.

Primary Education

The primary level of education happens at branch, warfare, staff specialty schools, and Service professional military education courses. These schools prepare officers to operate as part of a Joint Task Force and as leaders at the tactical level. Examples of these types of schools include advanced infantry training, pilot training, Captain's Career Course, Squadron Officer School, and Expeditionary Warfare School.

At these schools, officers receive education and training in their specialty. This may be where officers are first introduced to specific AI programs. Predictive maintenance systems are one example of an AI program that an officer may need to master at this level. These programs help maintenance units keep their equipment mission capable by using algorithms and machine learning to determine when to replace parts before they fail. These predictive maintenance programs are safer and less expensive than traditional maintenance practices while improving mission capable rates. They have been in use in parts of the civilian sector for years. Understanding how the AI in the predictive maintenance system functions would enable the maintenance officer to make critical decisions to follow or deviate from the program's recommendations. Officers may also be better

able to manage and lead their enlisted subordinates who perform key AI functions like data collection (and they turn the wrenches).

Similarly, an intelligence officer may use image recognition software to process imagery. Understanding how AI processes images, generates confidence levels, and performs labeling functions will aid the intelligence officer to assess the accuracy of the program's results. This enables better application of human judgment and mitigates potential biases involved in the program.

In the near future, pilots will fly with loyal wingman aircraft designed to aid and supplement air combat missions. Understanding how these loyal wingman aircraft make decisions and operate is vital to maximizing their utility.

Many AI programs improve using performance feedback from users. Line officers will be at the forefront of providing that feedback so the system learns the appropriate lessons and eliminates undesirable behaviors. This ability to learn and improve across the system is one of the most powerful aspects of AI tools, but it can be dangerous if the wrong lesson is shared. Ensuring the front-line officers know the fundamentals about how the system works, not just how to use it, will be key to enabling the success of AI tools in tactical applications.

For these reasons, and to satisfy the requirements from Congress, the Chairman should update the professional military education policy for primary military education by adding the following objective to Learning Area 1 – Joint Warfare Fundamentals and the Profession of Arms:

Comprehend how artificial intelligence systems function and learn, including potential bias, decision making, and ethics associated with using artificial intelligence for military purposes. Apply artificial intelligence to tactical problems or mission requirements and supervise the use of artificial intelligence in units.

This objective incorporates Congressional direction to educate servicemembers about AI system design, potential military applications of AI, AI decision making, and bias, ethics, and

weaknesses of AI technology. These objectives are appropriate for officers using AI tools to lead line units in combat and support functions and necessary at the primary level of education.

Intermediate Education

Intermediate level schools teach warfighting at the operational level. Designed to educate field grade officers for positions on key military staffs and as commander, the intermediate level of education has more learning areas than both the precommissioning and primary level combined. This level of education is vital as officers must grow from tactical level leaders to operational planners and larger unit commanders with understanding of joint warfare and doctrine, national and military strategy, ethics, culture, and operational leadership. Using the NSCAI worker archetypes, these school prepare officers for roles like “non-technical tactical leader.”

One key role of officers at this level is to work in various staff organizations that develop, manage, and implement military policy and plans. These staffs can range from combatant commanders charged with planning and conducting military activities to staffs that organize, train, and equip the Services with military capabilities and personnel. Since each organization has different functions in the development and use of AI, officers require a broad education in AI to satisfy these various requirements.

Combatant command and subordinate service component staffs are responsible for planning and employing the military instrument of power. These staffs plan the “operational” part of the military. AI tools can help with a variety of tasks from the joint planning process to logistics to personnel.

Many visionaries see AI as a tool to aid these operational level planners. Machines can help create, plan, and evaluate courses of action in ways and at speeds impossible for humans. Given objectives and desired end states, the computer will calculate the best ways to achieve the goals

while minimizing losses or consequences. By including real-time information about friendly and enemy actions, the machine can continuously update the plan and adjust for the fog and friction of war. In this way, the military will be able to “out maneuver” the enemy by executing a faster decision cycle than the adversary, forcing the enemy to react to our initiative.

This type of AI-enabled command decision making is the focus of Chinese programs developed for the People’s Liberation Army. The Chinese military is broadly investing in military AI tools and capabilities from autonomous weapon systems to information and intelligence processing and analysis to intelligent support to command decision-making. The goal of these programs, as described by some People’s Liberation Army thinkers, is to approach a “singularity” on the battlefield where human cognition can no longer keep pace with the decision-making tempo of future battlefield.³⁸

Officers in the “organize, train, and equip” side of military staff need an education in AI to perform their duties as well. These staffs are responsible for creating, implementing, and managing training and education programs (like the one this paper recommends) that prepare Service forces for combat operations. They are also responsible for the design, development, procurement, and deployment of military equipment and capabilities and the management of human resources. Finally, these officers create the military’s budget recommendation and allocate funds for use by military organizations.

AI tools can assist in many of these duties. AI can aid with education and training. Many military training programs are already adapting tailored education experiences that use student performance as feedback to speed up or slow down curriculum and allocate training resources to students that need the most assistance. In the future, connecting military education and training systems with military personnel systems will help to achieve improved allocation of human

resources. Personalists will be able to more easily identify top and bottom performers, track individuals towards jobs that match their talents, and more effectively target retention incentives. Even officers making the budget will benefit from programs that can run multiple scenarios for meeting national security objectives through the best balance of acquisitions, operations and maintenance, personnel, and infrastructure maintenance.

In the future, AI tools may aid staff officers in the performance of their duties. In a somewhat circular way, these officers will be responsible for procuring the AI tools that will help them do their jobs better. It makes sense, therefore, that they need an education in AI before they have the tools on hand, so they can procure the correct tools for the job.

Commanders will also interact with AI systems and often find themselves at the other end of staff systems for personnel, readiness reporting, budgeting, and other administrative functions. Additionally, commanders may receive mission orders and plans developed with assistance of AI. It is a commander's responsibility to take these plans, understand the intent and mission, then translate the plan into action for their unit.

The intermediate level of education must prepare officers for these likely uses of AI. Again, using the direction from Congress and Bloom's Taxonomy, the Chairman should add the following objective to officer professional military education policy:

Apply artificial intelligence design and software coding to potential military applications for artificial intelligence. Analyze the impact of artificial intelligence on military strategy and doctrine. Evaluate artificial intelligence decision making for opportunities, risks, bias, and ethics.

This objective does not neatly fit into any of the six learning areas identified in the current CJCSI for professional military education policy. It has potential in the areas of Joint Operational Leadership and the Profession of Arms (ethics, decision making), Joint Command and Control (military strategy, decision making), and Joint Planning and Execution Processes (military

applications, military doctrine, decision making). Of these three, inclusion into the Joint Planning and Execution Processes may be best fit unless the learning areas are reorganized.

What would be the outcome if the military adapted these recommendations? There are already some real-world examples where small teams with some experience in AI and machine learning are already having an impact.

Often, people imagine military applications of AI as sentient machines or “killer robots.” Instead, the military may want to focus on tedious tasks that relieve human capacity for more critical thinking. The JIGSAW program is an excellent example. Developed in 2017, JIGSAW is an AI tool that helps the Combined Air Operation Center in Qatar plan aerial refueling missions. Before JIGSAW, it would take three officers eight to ten hours to plan one day of aerial refueling mission in the Middle East. These officers would receive the mission locations, aircraft tasking, and fuel requirements. Then they would use a whiteboard and magnetic “pucks” to plan out when aircraft would need refueling, how much, and where. JIGSAW can accomplish this process in minutes. Perhaps even more beneficial is the ability to quickly adjust the plan when contingencies like aircraft maintenance force a change. Not only was it faster and more flexible, JIGSAW was more efficient than the human process, saving Air Force’s Central Command an estimated 350,000 pounds of fuel a week.³⁹

This is one of many manual processes performed at the operational level that would benefit from AI tools. A similar tool could aid naval planners to ensure ships are efficiently replenished at sea and in port or Army logisticians to supply a brigade combat team. The Air Force could use another tool to help create the Master Air Attack Plan which pairs the best available weapons and aircraft to approved targets as part of the Air Tasking Order. Computers and machines are already involved in this process but they are not interconnected and do not share data. This requires a

person in the loop to input a target model into a computer, simulate different weapons attacking the target, select the best result, and then translate that result onto a different system to match the weapon to the appropriate aircraft and schedule the mission. A computer algorithm could use imagery to generate a model of the target, simulate attacks against the target, select the optimal solution based on human provided guidance, and schedule the sortie for human approval.

Current manual processes for these types of planning tasks are functional in a lower intensity, irregular warfare environment. Peer conflict and competition would likely require a higher functioning system that is capable of operating at machine speed. It is not difficult to imagine multiple AI tools to aid military decision-making at the operational level and, in some disconnected ways, these tools already exist. Developing these tools and connecting them to each other will be a critical activity for staff officers over the next decade. Educating these officers about AI provides them with the tools necessary for success. As Russian President Valdimir Putin says, “the one who becomes the leader in this sphere (AI) will be the ruler of the world.”⁴⁰

Senior Level Education

The purpose of senior level education is to develop strategic leaders who can think critically and apply military power in support of national objectives in a joint, interagency, intergovernmental, and multinational environment. These officers are normally of the rank or selected to become O-6 (Colonels or Captains of the Navy). This rank occupies a vitally important position in the US military as the translation point between the national, strategic level of warfare and the operational level. They can lead combat organizations of thousands or direct staff teams that create operational plans, budget millions of dollars, recommend new weapon systems, and choose which younger officers are assigned to key positions or receive special education and training.

In the corporate world, this role may be filled by a vice president or described as upper middle/lower senior management. Regardless, these senior military leaders, most with more than twenty years of military experience, are enormously important. They are responsible for implementing and executing the plans ordered by General officers AND for developing the plans and options that the Generals choose. As such, these officers straddle between the NSCAI's worker archetypes of non-technical tactical and non-technical strategic leader depending on their roles and position.

Poor or ignorant leadership from O-6 officers can contribute to a "frozen middle." Organizations use "frozen middle" to describe situations where top-level leadership request and promote innovative solutions and bottom-level workers develop new ideas but middle level management squashes these ideas. This frustrating stifling of innovation creates cynicism and disenchantment for bottom-level workers and more frantic calls for innovation from senior leaders. Unit performance can stagnate and morale can plummet when these leaders are not up to their task.

The O-6 level leader in the military is often the gate-keeper between General officers looking for innovative solutions and company and field grade officers with fresh ideas. Without an education in AI, it may be harder for a junior officer to get the necessary senior leader support to implement innovative AI solutions. Some knowledge and understanding of AI would enable this critical cohort of officers to help utilize AI in the best ways instead of becoming another skeptic for innovators to convince.

This is just one example of why senior level military education must cover aspects of AI. These officers are often key decision makers that will use AI aided decision tools, consume AI produced information, and manage AI systems and networks that span from strategic to tactical.

Senior level professional military education focuses on five learning areas: National Strategies; Joint Warfare, Theater Strategy and Campaigning for Traditional and Irregular Warfare in the Joint, Interagency, Intergovernmental and Multinational Environment; National and Joint Planning Systems and Processes for the Integration of JIIM Capabilities; Command, Control and Coordination; and Strategic Leadership and the Profession of Arms.⁴¹

The expansive and essential duties of this level of military leadership means that they will need education that covers many of the topics directed by Congress in the National Defense Authorization Act. This education will overlap and build upon previous education in primary and intermediate curriculum and should avoid redundancy while reinforcing core principles and essential knowledge requirements. As an alternative approach to previous recommendations, instead of a separate AI learning objective wedged into a learning area, the recommendations for senior level education will include AI into the existing learning objectives described in DoD professional military education policy. The numbering of the following recommendation matches with CJCSI 1800.01E Appendix E to Enclosure E Service Senior Level College Joint Learning Areas and Objectives with recommended additions in *italics*.

Learning Area 1 – National Strategies

- a. Apply key strategic concepts, critical thinking and analytical frameworks, *including the use and impact of artificial intelligence*, to formulate and execute strategy.
- c. Evaluate historical and/or contemporary security environments and application of strategies, *including disruptive technologies*, across the range of military operations.

Learning Area 2 – Joint Warfare, Theater Strategy and Campaigning for Traditional and Irregular Warfare in a Joint, Interagency, Intergovernmental and Multinational Environment

- a. Evaluate the principle of joint operations, joint military doctrine, joint functions (command and control, intelligence, fires, movement and maneuver, protection

and sustainment), and emerging concepts *such as ethical military applications for artificial intelligence tools* across the range of military operations.

- C. Apply an analytical framework that addresses the factors politics, geography, society, culture, religion, *and technology* play in shaping the desired outcomes of policies, strategies and campaigns.
- e. Evaluate how strategic level plans anticipate and respond to surprise, uncertainty, and emerging conditions. *Include potential weakness or biases in artificial intelligence decision making and the opportunities and risks of using artificial intelligence to aid strategic plans.*
- f. Evaluate key classical, contemporary and emerging concepts, including IO, cyber space operation, *and the impact of artificial intelligence on military strategy and doctrine* and traditional/irregular approaches to war.

Learning Area 3 – National and Joint Planning Systems and Processes for the Integration of JIIM Capabilities

- b. Analyze the operational planning and resource allocation processes. *Assess the opportunities and risks of artificial intelligence decision making including ethics, biases, potential weaknesses or advantages of using artificial intelligence.*
- e. Analyze the likely attributes of the future joint force and the challenges faced to plan, organize, prepare, conduct and assess operations, *including the use of artificial intelligence and other disruptive technologies.*

Learning Area 4 – Command, Control and Coordination

- c. Analyze the opportunities and challenges affecting command and control created in the joint, interagency, intergovernmental and multinational environment across the range of military operations, to include leveraging networks and technology *such as artificial intelligence.*

These recommendations attempt to infuse AI throughout the appropriate learning objectives for these senior leaders. These suggestions used the learning objectives from Service senior military education institutions, like Army War College and Air War College, but they can be easily applied to other senior level education institutes such as the National War College, Dwight D. Eisenhower School for National Security and Resource Strategy, or Joint Advanced Warfighting School.

Ideally, graduates of the senior level of professional military education will understand the fundamentals of AI, analyze the strengths and weaknesses of AI, know what problems are better for AI solutions and where are the limits of AI. This knowledge will aid these leaders in their crucial role to translate national strategy into action, lead large combat forces, and provide options for military and civilian leaders. It will hopefully enable these officers to be key supporters of AI instead of a frozen middle that increases stifling bureaucratic inertia.

General and Flag Officer Education

This final level of the military education continuum is designed to prepare General and Flag Officers (Generals and Admirals) to think critically at the national strategic level while providing oversight to mission planning and execution across the range of military operations.⁴² These officers serve as the highest level of military leadership and usually have more than 25 years of military experience. They lead organizations of tens to hundreds of thousands, manage budgets in the billions of dollars, and are responsible for the development, planning, use, and integration of the military instrument of power to achieve national security objectives. In the civilian world, they would be senior vice presidents or members of the “C-Suite” like Chief Operations Officer, Chief Financial Officer, and Chief Executive Officer. They are non-technical strategic leaders in the NSCAI’s worker archetype.

Again, these leaders need a fundamental understanding of AI because of their relationship with and use of technology. These officers will be responsible for driving innovation and change in the military where cultural inertia can be difficult to overcome. If they do not understand AI, then they may not be able to recognize a crucial opportunity and lose a first mover advantage. Since successful innovation is often more about organizational change than technological

invention, arming these leaders with an education on AI will enable them to draw upon their vast experience and training to develop a strategic vision for the use of AI technology.

The general and flag officer level of education begins with the CAPSTONE course, includes multiple courses designed for officers going to specific roles, and ends with PINNACLE. In the CAPSTONE, the educational focus is on preparing officers to lead change, elevate their learning experience, broaden global perspectives, instill tenets of intellectual development and ethical leadership, enhance the perspective on enterprise efficiency, and create a bond among these senior officers.⁴³ These goals are reflected in the four learning areas; National Security Strategy and the Instruments of National Power, Joint Operational Art, Geo-Strategic Concepts, and Joint Strategic Leader Development.

The learning objectives for these areas are suitably broad and including specific language on AI is not advisable. Instead, the Chairman may consider including a “executive course” on AI as part of the CAPSTONE experience.

Such “executive courses” are offered by many major universities including Stanford University.⁴⁴ Another promising option, closer to Washington DC where CAPSTONE happens, is from the Georgetown University Center for Security and Emerging Technology that offers a program on AI education for congressional staff.⁴⁵ The Department of Defense could even develop its own artificial executive course through the Joint Artificial Intelligence Center in partnership with a leading civilian organization or university to provide a specific executive course targeted towards military applications of AI in line with the direction from Congress.

The other education programs offered to General and Flag officers include select courses designed to provide these key leaders with specific education in functional domains. Many of these courses are intended for functional component commanders like the Combined/Joint Force Air

Component Commander Course, Combined/Joint Special Operations Component Commander Course, the Senior Joint Information Operations Applications Course, the Joint Flag Officer Warfighting Course, the Senior International Defense Management Course, and the Cyberspace Operations Executive Course.

All of these courses would benefit from the inclusion of education about AI applied to their specific focus, be it airpower, special operations, information operations, or cyberspace. Course managers should examine their curriculum and the guidance from Congress or the Chairman through a special emphasis memorandum to incorporate education about AI.

PINNACLE is the final portion of joint professional military education. This course conveys an understanding of national policy and objectives with attendant international implications and the ability to translate those objectives and policies into integrated campaign plans and is intended for prospective joint and combined force commanders. These attendees are nominated by the Services and approved by the Deputy of the Joint Staff.

As a joint or combined force commander, these leaders can expect to command large, diverse organization in a combat environment. Perhaps no other leader will be as challenged to integrate and use AI tools to aid decision making and information processing as these leaders. And perhaps no other leader is in a position to benefit from the advantages of AI technology.

In another variation, the segment below includes learning objectives for the PINNACLE course that would potentially benefit from AI technology. Parentheses are used to discuss how AI could impact the learning objective. The purpose is to show how AI education may play a role in PINNACLE without shoe-horning AI into the objectives. This hopefully illustrates how much this course and these leaders could benefit from an education about AI.

Learning Area 1 – The Joint/Combined Force Environment

- a. Analyze the changed nature of joint/combined operations, identifying fundamental differences in the way a joint/combined force commander must think critically and strategically about the environment in order to anticipate and respond to surprise and uncertainty. (AI tools can help process and display information to enable the commander to see underlying connections in data that are not easily discerned)
- b. Synthesize operational-level lessons learned from the full spectrum of recent major operations in order to evaluate them with regard to potential future operations. (This would cover the use of AI tools. Additionally, AI could use machine reading tools to evaluate and condense lessons learned to provide information gleaned from thousands of source documents)
- c. Evaluate the transformational concepts of design and planning, Mission Command and C2 enhancements, and integration of conventional and special operations forces that will be employed in future operations. (Again, many experts and senior military leaders believe AI will provide transformational tools. This objective should teach students about those tools, particularly tools to aid in decision making)
- d. Synthesize techniques for anticipating and responding to surprise and uncertainty while anticipating and recognizing change and leading transitions. (AI is excellent at recognizing patterns in data that may help predict or recognize changes in the operational environment. The use of AI tools will require leaders to manage implementation and transition to this new technology)

Learning Area 2 – Building the Joint/Combined Force

- a. Evaluate specific enablers such as the decision cycle, information/knowledge management, targeting methodologies, and battle rhythm flexibility that support the commander's decision cycle. (AI can aid each of these areas from information to targeting to help make decisions faster)
- b. Apply transformational concepts to traditional planning, organization, and manning options to develop alternative solution to joint task force creation. (AI will be one of, if not the most, transformational concepts)
- c. Evaluate contributions of the joint functions (command and control, intelligence, fires, movement and maneuver, protection and sustainment) throughout the phases of planning. (AI tools can aid the commander with this evaluation)

Learning Area 3 – Commanding the Joint/Combined Force

- a. Synthesize the processes to effectively blend the art (synergy) and science (synchronization) of commanding joint/combined forces. (AI tools can aid in synchronization)

- b. Apply and understanding of and appreciation for the design and planning necessary to translating national objectives, joint doctrine, and polices into objectives, effects, and actions. (AI tools can aid in planning and measurement of objectives and effects while monitoring actions)
- c. Analyze the impact of strategic communication and information operations on unity of effort and the achievement of national objectives. (AI can greatly aid the measurement of communications impact and assist in the creation communication strategies and plans)
- d. Evaluate the impact of emerging technologies on complex security environments, including the potential of offensive and defensive cyber operations. (AI is an emerging technology that will have large impacts on all levels and domains of warfare, including cyber)
- e. Evaluate various issues related to the deployment, employment and sustainment of forces from the perspective of the joint/combined force commander. (AI can assist in the create, execution, and monitoring of logistics requirements. Leading logistics companies like Amazona and UPS already do this)
- f. Evaluate C2 challenges facing the joint/combined force commander, including the personalities of external principles (DoD, interagency and international), the need to anticipate and recognize change leading to transitions, and Commander's Critical Information Requirements. (AI can aid in recognizing change and tracking commander's critical information requirements. AI can even perform personality assessments of key individuals)
- h. Evaluate key national authority and rules of engagement issues, including national policies and prerogatives, information sharing and titles. (AI using machine reading can ingest and analyze thousands of documents to aid in determining potential legal problems)
- i. Synthesize the absolute requirement to make ethical decision based on the shared values of the Profession of Arms in all planning and operations. (This may include the ethical application of AI)⁴⁶

More than 50% (15 of 24) learning objectives for the PINNACLE course could be influenced by AI technology. This indicates the potential impact of AI technology on the highest level of joint professional military education and how much AI could truly change the character of war from the perspective of a joint force commander.

AI Education for the Future Conclusion

This section provides detailed recommendations for ways to include AI education objectives throughout the officer professional military education curriculum. These changes establish the foundation of a future military education system that will satisfy Congress and, most importantly, ensure that the DOD is preparing its officers to understand, develop, and use AI technology in ethical, responsible ways to maintain the national security of the United States.

Beginning with precommissioning, officers will proceed through the continuum of learning while gaining increasing knowledge and expertise in AI. Combined with joint warfighting, history, strategy, ethics, and leadership, this education will develop a generation of officers to lead our nation into the second quarter of the 21st century. These skills and knowledge will enable the US to leverage the enormous potential of AI to ensure the national security of the United States.

Implementation

Professional military education is key to building effective military leaders and ensuring our national security. The National Defense Strategy criticizes military education for being stagnant and more concerned with accomplishment of mandatory accomplishment than lethality or ingenuity.⁴⁷ There are also reasons to proceed consciously, even cautiously, regarding the implementation of the suggestions of this paper.

Military education is somewhat of a zero-sum game. The addition of education about AI creates resource requirements. These requirements may be time from the student, time for the faculty to teach and create content, contracts and collaboration with organizations to create new curriculum and content, and so on. The suggestions of this paper will create ripples that effect all parts of the professional military education environment. Time and cost are two important implementation considerations.

Student time is an important resource to consider. If one does not want to increase the student's time in class, then time educating about AI is taken from a different subject. Which one? What topic is less important? Joint operations? Leadership and ethics? History? This paper has no recommendations other than to highlight that including AI likely means another subject receives less focus.

Increasing student time in the classroom is an option. This also comes with difficulties. In-resident professional military education is often seen as a time for officers to catch their breath from the demands of deployment, training cycles, temporary duty, and other operational requirements. Officers are often encouraged to “relax, recharge, and reconnect” with themselves, their families, and their purpose for serving.⁴⁸ Increasing time in the classroom is taken away from time spent with families.

The right answer to this is balance, of course. And that balance is best determined by the educators at these military education institutions in consultation with policymakers on the Joint Staff and the Office of the Secretary of Defense. These schools do change more than outsiders see, sometimes as much a third of the curriculum changes each year according to one educator.⁴⁹ It is important that including AI education is not stalled by bureaucratic negotiation and instead driven by senior leader vision.

Creating content and curriculum is another resource requirement. This will require time, effort, and money. With multiple institutes across the continuum of learning, there is great potential for varying levels of implementation and asynchronous or discordant activity. One example would be the Air Force Academy and Naval Academy competing for the same course content contract for their pre-commissioning curriculum.

One potential solution for this is to utilize the Joint Staff J7 to oversee a DOD wide contract to produce AI curriculum with a leading university or educational organization. The Department should coordinate with Congress when reporting their strategy for AI education, as directed in the National Defense Authorization Act, for funding to implement their strategy across the department. If Congress does not provide specific funding, then it is likely each Service will need to take funding from other programs, a difficult trade-off decision that could potentially result in underfunding AI education.

The National Security Commission on AI recommends at least \$33 million dollars for the Department of Defense to implement their recommendations to strengthen the AI workforce in the national security sector.⁵⁰ This amount does not include any significant revisions of professional military education and instead focuses on mandatory training and voluntary incentive programs. It does provide evidence that implementing education about AI is not free, although the benefits may be immeasurable.

Another consideration for implementation is timeline. Some of the recommendations in this paper could happen quickly. These include the promotion of voluntary self-development courses and adding special experience identifiers to servicemembers with experience or expertise in AI and data science. Other recommendations, such as mandatory AI training may reasonably take two years to implement. Incorporating AI across the continuum of learning may reasonably take three to five years to accomplish as outlined in this paper.

Finally, a prioritization may assist decisionmakers in understanding what recommendations are the most important to focus limited resources in a constrained environment. The figure below orders the recommendations in this paper using “more important, less important” and “immediate

need, long term need” criteria. Colors are used to indicate cost with green as potentially least costly and red as potentially most costly.

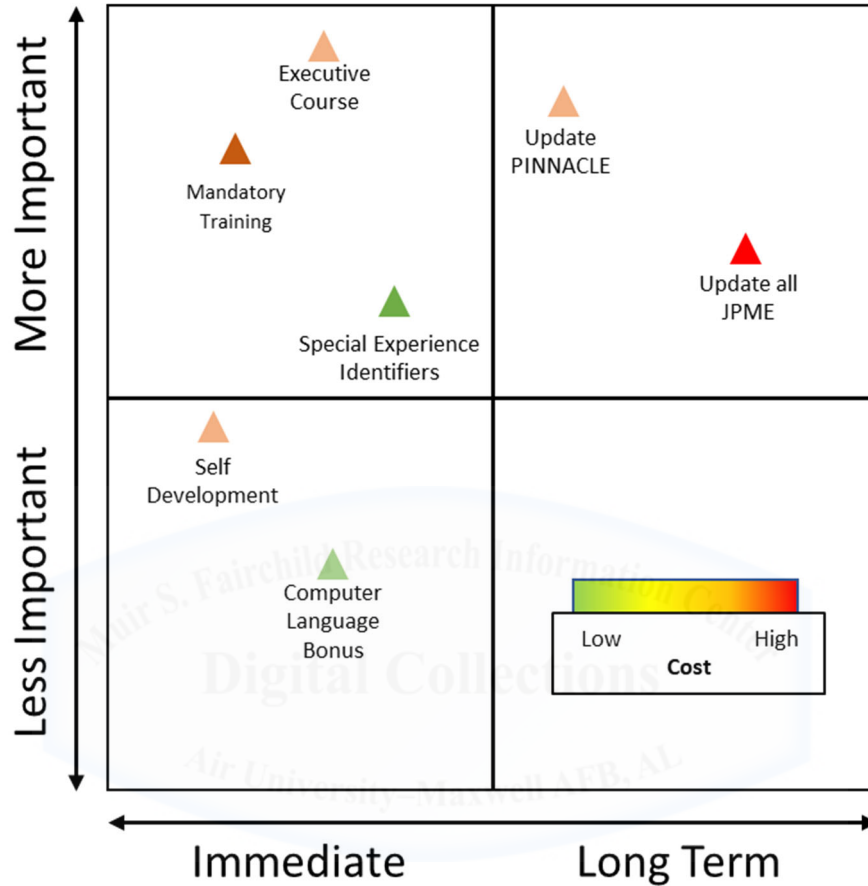


Figure 2: Prioritization Chart

Over the long term, out to twenty years or more, the requirements for education about AI will change. No one knows what those requirements will be. The draft JCS Vision for Professional Military Education calls for adaptation and innovation as key tasks for professional military education.⁵¹ This task will become ever more challenging in the future. Perhaps an AI tool will help.

Conclusion

Experts and leaders inside and outside of the military believe that AI will have a profound impact on our daily lives and our national security. This is clearly reflected in authoritative military guidance such as the National Defense Strategy and Department of Defense Strategy for Artificial Intelligence.

There is a disconnect, however, between these strategic guidance documents and plans to prepare the military workforce to execute the strategy. To reconnect the strategy and workforce, the military should educate all officers about AI.

Doing so is important to aid in maintaining the United States cognitive and technological edge against our adversaries, who also view AI as vital to success in future warfare. Additionally, Congress mandated that the military develop an education strategy that covers;

- (A) artificial intelligence design;
- (B) software coding;
- (C) potential military applications for artificial intelligence;
- (D) the impact of artificial intelligence on military strategy and doctrine;
- (E) artificial intelligence decision making via machine learning and neural networks;
- (F) ethical issues relating to artificial intelligence;
- (G) the potential biases of artificial intelligence;
- (H) potential weakness in artificial intelligence technology;
- (I) opportunities and risks;
- (J) and any other matters the Secretary of Defense determines to be relevant.⁵²

This guidance provides an ample foundation for military education about AI. The military's strategy should address two general areas; education now and the continuum of learning.

To address educating the workforce now, the military should develop a mandatory education requirement delivered through computer-based training. This education can be added to the existing information assurance and cybersecurity awareness training required for everyone in the military annually. It should cover the fundamentals of AI including definitions, ethics, biases,

potential military applications and how to apply for DOD sponsored self-development to learn more about AI.

The military should contract with and publish a list of available self-development courses funded by the Services. These courses will leverage available online university programs that meet educational objectives defined by the Joint Staff J7 and offer commercial certification in various AI related disciplines such as software coding, data management and engineering, and AI engineering.

Officers who complete these programs, or demonstrate programming skills through a proficiency exam similar to foreign language proficiency exams, may earn extra pay or receive a special experience identifier. These special experience identifiers aid personnel management system find officers with knowledge and skills for positions related to AI. Military leadership should value people with these skills and positions by promoting them to higher ranks.

The military should also develop or contract for an AI executive education course for General and Flag Officers and civilians in the Senior Executive Services. This is crucial because these leaders will need to make decisions about AI programs and very many have no education on AI. This lack of education may contribute to a lack of adoption of AI technology and lose first mover advantage to adversaries who are more aggressive to adopt AI for military purposes.

The military should also incorporate education about AI across the professional military education continuum of learning. This begins at the pre-commissioning level where officer candidates from Service academies, Reserve Officer Training Corps, and Officer Training Schools receive a foundation in the fundamentals of AI. This education continues through the primary, intermediate, senior, and General/Flag officer levels of professional military education. By incorporating education about AI across the continuum of officer professional military education,

the DOD can ensure its workforce is prepared to leverage the enormous potential of AI to ensure the United States maintains both a cognitive and technological edge against our adversaries.

Notes

¹ Executive Order 13859, Maintaining American Leadership in Artificial Intelligence, 11 February 2019.

² National Security Strategy, 2017, 20, <https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf>

³ Summary of the 2018 National Defense Strategy, 2018, 3, <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>

⁴ Gregory C. Allen, “Understanding China’s AI Strategy: Clues to Chinese Strategic Thinking on Artificial Intelligence and National Security,” Center for New American Security, 6 February 2019, <https://www.cnas.org/publications/reports/understanding-chinas-ai-strategy>

⁵ National Defense Authorization Act of Fiscal Year 2020, Public Law 92, 116th Congress, 2d sess. (20 December 2019) Sec 256.

⁶ United States Army, *Army People Strategy*. 2019. p. 3 & Chief of Naval Operations, *NAVADMIN 196/19 CNO Message to the Fleet*. 2019. Para 4.

⁷ 2018 National Defense Strategy, p. 3.

⁸ Ibid.

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