JPWS

JOURNAL OF PEACE AND WAR STUDIES

International Symposium of Military Academies (ISOMA)
Special Edition, October 2021

John and Mary Frances Patton Peace and War Center
Norwich University, USA

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ISSN 2641-841X(Print) • ISSN 2641-8428 (Online)

Journal of Peace and War Studies

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Special Edition, October 2021

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Journal of Peace and War Studies, ISOMA Special Edition (October 2021): 16–30

Educating 21st Century Thinkers: A Case for Renewed Emphasis on Liberal Arts and Humanities in Officer Education

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Abstract: As we move deeper into the twenty-first century, the pace of technological advancement continues to accelerate. This is especially true in the military, where an ever-increasing push for artificial intelligence, autonomous systems, and cyber capabilities dominates the thinking of military planners. With this emphasis on technological advantage comes an unhealthy bias toward the Science, Technology, Engineering, and Math (STEM) fields in officer education at the expense of liberal arts and the humanities. While widespread STEM education appears advantageous for working with the increasingly technical aspects of warfare, it is shortsighted and potentially detrimental to the nation's ability to outthink our opponents. Military leaders at all levels must understand the technology that enables their warfighting systems. But an officer corps made up entirely of technicians limits the military's ability to adapt and apply those technologies in creative ways to overcome our adversaries.

Educating future military officers requires balancing the need for officers with technical literacy with those who have a firm grounding in the humanities even as warfare seems to become more technical. If the services' goal is to have STEM-cognizant officers, the services should provide the specific STEM-related training they seek after commissioning. Allowing prospective officers to pursue degrees in any accredited undergraduate major and requiring minimum STEM and liberal arts prerequisites would result in an intellectually diverse officer corps that can then specialize based on the technical or critical thinking requirements of their chosen career path.

Keywords: Officer Education; STEM-Cognizant; Liberal Arts Education; Intellectual Diversity; Humanity and War; War and Society

Introduction

[T]he successful officer is more than a technician. To be sure, the Naval officer must have a thorough understanding of the operation of the ships and machines for which he is responsible… [T]he technical and military aspects of the Navy, however, constitute only a part of the general requirements of the effectively trained Naval officer.[1]

Fleet Admiral Chester W. Nimitz, 1947

As the world moves deeper into the twenty-first century, the pace of technological advancement continues to accelerate. This is especially true in the military, where an ever-increasing push for artificial intelligence, autonomous systems, and cyber capabilities dominates military planners' thinking. This emphasis on technological advantage has produced an unhealthy bias toward the Science, Technology, Engineering, and Math (STEM) fields in officer education at the expense of liberal arts and the humanities. While widespread STEM education appears advantageous for working with the increasingly technical aspects of warfare, a narrow focus on STEM is shortsighted and potentially

ISSN 2641-841X (print), ISSN 2641-8428 (online)

detrimental to the nation's ability to outthink our opponents. Military leaders at all levels must understand the technology that enables their warfighting systems. But an officer corps made up entirely of technicians limits the military's ability to adapt and apply those technologies in creative ways to overcome our adversaries.

Since the inception of the American officer corps, successful commanders have advocated for officers to be grounded in liberal education, as demonstrated by the FADM Nimitz quotation in the epigram above. Despite such advocacy, each new technological advance brings renewed calls from technologists for the need to focus on technical education. In the 1880s, it took an act of Congress to force the Navy to choose a generalist officer corps over one specialized in engineering or seamanship.[2] The advent of nuclear power in the twenty-first century brought calls that those generalists all be technically educated. With a shrinking officer corps, the end of the Cold War again saw pressure to focus officer education on STEM degrees with arguments that precious education dollars must go toward technical training.

Often the argument is that the military must choose between liberal arts or STEM education. Instead, the focus should be on liberal arts and STEM. Technology is changing fast, and the military must remain at the forefront of technological advances, but it is also essential that the officer corps successfully apply them. Rather than focusing on STEM undergraduate degrees with a modest sprinkling of liberal arts courses, the services should focus on accessing the most intelligent officers, regardless of their field of study. The services need critical thinkers above all else.

This paper explores the need to include a broad range of liberal arts and humanities in the education of the officer corps to better prepare them for leadership in the twenty-first century. It suggests that the interface between technology and humans requires more than just a robust technological background. That interface requires equally robust mastery of creative and critical thinking and an ability to communicate those ideas to others. It requires an understanding and appreciation of the past. And it requires a grounding in morality and ethics beyond the question of "what can we do" to also ask "what should we do?" The critical and creative thinking needed to address today's security and warfare challenges include skills not developed by STEM education. Put another way, STEM is inadequate on its own in developing the intellectual abilities needed by military professionals.

STEM and the Services

Science, technology, engineering, and mathematics are the broad categories that comprise the STEM education so coveted by the services, especially the more technology-based naval and air services. A classic liberal arts curriculum does not ignore STEM. Instead, it tempers the myopic focus on technology with the study of the humanities—languages, literature, philosophy, history, archaeology, anthropology, human geography, law, politics, religion, and art.[3] In the twenty-first century American collegiate system,

degree specialization, with its deep and narrow focus on specific areas of study, has replaced the classic liberal arts curriculum. To gain the same broad knowledge base within the officer corps, services should encourage officers to study a similarly broad range of subjects, thus gaining diversity of thought at the macro level.

Each of the American military services places a different emphasis on undergraduate STEM degrees for their respective officer corps. The ground-focused services, the Army and the Marine Corps, allow prospective second lieutenants to major in any certified degree program.[4] The maritime services take different approaches. The Coast Guard Academy offers primarily STEM majors, but its Officer Candidate Program admits candidates from any major.[5] The Naval Academy offers STEM degrees primarily but also requires a liberal arts core curriculum. The Navy prioritizes STEM in its other commissioning sources, including Reserve Officer Training Corps (ROTC) and Officer Candidate School (OCS). The Air Force takes pride in its reputation as the most technical of the services.[6] Like the Naval and Coast Guard academies, the Air Force Academy offers STEM degrees primarily with a liberal arts core curriculum. The Air Force ROTC encourages cadets to study STEM-related subjects.[7] The Space Force has yet to establish specific pre-commissioning requirements but is likely to be similar to its parent service, the Air Force. Since the air and maritime services put particular emphasis on STEM over other degree programs, the majority of this paper will address those services.

War is a Human Endeavor

War is fundamentally a human endeavor. Technology may provide the means of war, but it remains the responsibility of people to employ those means. Failing to sufficiently value the liberal arts and humanities as viable paths to commissioning inhibits the creative and critical thinking necessary within the officer corps to react to the uncertainty that is war.

Former prisoner-of-war Vice Admiral James B. Stockdale, USN, famously credited his survival in the prisons around Hanoi to his study of philosophy.[8] It helped sustain Stockdale when everything else was stripped away. In today's highly technological world, there is a tendency to believe that technology will solve all problems. Stockdale's imprisonment is an extreme example countering that belief and demonstrates that the officer corps must prepare for more than just understanding technology. It also must understand how to act when that technology fails. With or without war-winning technology, military leaders need to understand the human condition.

It is the human aspect of warfare that remains immutable, regardless of the means employed. In other words, humanity is the constant, technology is the variable. For every technological military advance, humans have developed tactics to employ and defeat it. Tactics are the human element that translates technological combat potential into combat power, the violent employment of force. Or as Carl von Clausewitz states, "Tactics teaches the use of armed forces in the engagement" of forces with each other—

in other words, combat.[9] Despite regular predictions that advances in technology would bring about fundamental changes in the nature of war, it has not. The introduction of new technology in warfare begets counter-technologies, evolving into a cycle of technological advances. Still, the goal of war remains the same, to impose one's will on another through means of violence and force.[10] Thus it is the human element that matters: The side that develops methods, tactics, techniques, and procedures to best employ or defeat the wielded technology gains the upper hand.

The ability to think critically—to see the capabilities, intended or unintended, of technology, and to apply them—indeed provides an advantage in warfare. As one recent commenter has concluded, "An obsession with military technology and science in isolation can distort the general picture of war whose character in any given case is the product of many factors—political, social, economic as well as technological."[11] And it is that conglomeration of factors that demands the officer corps include officers trained in the constants, the humanities that prepare their minds, the ultimate weapon of war. Officers trained in technology, the variable and often evolving element of war, remain essential, but without those who study humanity, technology is likely to be applied without consideration for the constant, human, element of war.

Those That Fail to Learn from History Are Doomed to Repeat It

The aphorism "those that fail to learn from history are doomed to repeat it"[12] is so often repeated that it deserves some notice and consideration from military professionals. History is replete with warfare. Failure to study past warfare to critically analyze historical conflicts' successes and failures makes for an uninformed military doomed to repeat past mistakes. The study of history is more than just knowing such and such a battle took place or knowing who won this or that war. It is the study of the causes and effects of war, the causes and effects of combat, the causes and effects of the entire military and national apparatus that prepared leaders for war. It can and should include an analysis of the technology employed—both its development and how it was employed relative to its intended purpose. The burgeoning field of war in society demonstrates the ever-present need to understand warfare and its impact on humans, not only military technology.

Similar arguments exist for the range of humanities. Stockdale's story demonstrated the value of philosophy to military officers. As artificial intelligence gains strength, the ethics of using such technology requires significant thought and discussion. Officers with in-depth knowledge of human geography, law, politics, and religion inform the entire officer corps of the environment, allowing the military to best employ the technology of the day.

These applications of the humanities appear to focus on the operational level of war, the level fought by senior officers. As a result, many argue that junior officers, who operate at the tactical level of war, should be trained in STEM, reserving the study of humanities for

the transition between the two levels of war. But this is a false corollary. A better approach is to focus on recruiting officers from a wide range of academic backgrounds and then training them for the career paths they fall into. Few junior officers "use" their degree in the initial tours, so their field of study matters little to the job they are asked to perform. Preference toward STEM undergraduates stifles the intellectual diversity within the officer corps from which senior officers are drawn.

Technology Alone Is Not Enough

Technology alone is not enough to guarantee victory. Radar was introduced broadly aboard U.S. Navy warships in 1940.[13] Radar's ability to "see" at night and through weather conditions impossible for the human eye gave a great theoretical advantage in naval combat. Unfortunately, Navy commanders possessed an incomplete understanding of the technology and, therefore, misemployed available radar-equipped ships, especially in the bloody naval surface actions in the waters surrounding Guadalcanal from August to November 1942.[14] While this fact seems to argue for better technical training of naval officers, it also points out technology's limitations without human application in combat.

The Navy installed early shipboard radar sets where space was available, often in locations far away from the decision-makers who could benefit from the information radar provided. Then-Lieutenant Commander J.C. Wylie, Executive Officer in USS *Fletcher* (DD 445), fighting in those battles around Guadalcanal, recognized these limitations. To overcome them, he stationed himself where he could interpret the radar readings into information useful to decisions in fighting his ship and pass them along to the captain. As one historian put it, "Thus, Wylie was himself the Navy's first Combat Information Center, or CIC, a concept and term that had yet to be invented."[15]

Wylie went on to spearhead a team of Pacific Fleet naval officers who developed the CIC concept, which resulted in the redesign of U.S. Navy warships to consolidate the technology needed for decision making—radar, sonar, communications, fire control computers—into a single location, and perhaps more importantly, a doctrine for employment and coordination of these technologies to more effectively fight the ship.[16] Thus, it was not technology alone, but officers with the vision and creative thinking skills to see how the technology could be best employed in combat that fully realized its benefits.[17]

Diversity of Thinking

One emphasis in developing successful teams is diversity—bringing together people of different backgrounds and experiences. This sort of diversity broadens viewpoints and provides unique angles to problem-solving. More than just different races, genders, or ethnicities, diversity includes variety in education and training. Lack of diversity on a team leads to outcomes biased toward the majority members of the team.[18] When the team is preferentially formed of technicians, regardless of their racial, ethnic, or gender diversity,

the team's bias is toward technical answers to whatever problem is presented. Therefore, when a service preferentially offers scholarships for STEM degrees—such as the Air Force and Navy officer accession programs—that bias in choice for technical expertise permeates the entire officer corps and dilutes diversity.

This fight over the emphasis on STEM degrees for naval officers dates to the introduction of steam for ship propulsion. The Navy's technological transformation of the late 1800s culminated in a reorientation of the United States Naval Academy curriculum toward technical subjects, so much so that today all Naval Academy graduates, regardless of major, are awarded a bachelor of science degree. The counter to this emphasis on the profession's technical aspects was the founding, during the same period, of the U.S. Naval War College, where students went to study the art of naval warfare.[19] The debate has ebbed and flowed over the intervening century.

When the United States rapidly expanded its officer corps for World War II, the services set education criteria for officer candidates centered around post-secondary education. Speaking at a symposium entitled "Liberal Education in the Military Forces," no less than General of the Army Dwight D. Eisenhower, Marine Corps General Alexander A. Vandegrift, and Nimitz spoke on the value of liberal arts education for officer candidates. Nimitz stated unequivocally,

"[T]he exigencies of war forced us to reduce the number of liberal subjects in the training curriculum to what we considered an absolute minimum. But the Navy has learned over a period of years that the successful officer is more than a technician. To be sure, the naval officer must have a thorough understanding of the operation of the ships and machines for which he is responsible, and he must be well trained in the ways of the sea and in the rudiments of military procedure. Knowledge of the technical and military aspects of the Navy, however, constitute only a part of the general requirements of the effectively trained naval officer."[20]

Expanding further on the need for naval officers to possess not only technical prowess but also a broad range of capabilities provided by traditional liberal education, Nimitz continued, "The youngest ensign becomes at once a military leader and a minor diplomat in the service of our nation. For this reason, alone, a liberal education becomes a necessity in the training of our officers… In brief, the Navy demands that its officers be well-rounded individuals, capable of meeting the diverse problems of their profession."2[1]

Nimitz concluded, "With the view in mind of increasing the diversities of its officers, the Navy will in the future allow its NROTC trainees the prerogative of taking any legitimate bachelor's degree."[22] These remarks, presented at the dawn of the Cold War, guided the initial post-WWII education of naval officers. But the advent of nuclear power in the 1950s again challenged the idea of liberal education in the U.S. Navy's officers.

The Rickover Effect

Often referred to as "the Rickover Effect," the bias toward technical degrees among naval officers in the 1950s and 1960s was tied to the growth of the nuclear-powered fleet. At one point, the Navy aimed to field an all-nuclear fleet with nuclear-powered aircraft carriers, escort ships, and submarines. To operate and command that fleet, nuclear proponents argued, the Navy needed technically trained officers, so much so that by 1975, the Naval Academy required 85 percent of all midshipmen to enroll in STEM degree programs. Although the dream of an all- nuclear fleet had waned by the late 1980s, the search for ways to defeat massed Soviet air attacks brought with it renewed calls for technically trained officers to operate the new Aegis weapons system. Regardless, the technical aspects of the Navy appeared to dictate that all officers be technicians.[23]

Ironically, Admiral Hyman G. Rickover, the Father of the Nuclear Navy, was not the strident proponent of technical education that people might think. An outspoken critic of the American education system, Rickover recognized the need for a balanced program grounded in classic liberal education. Rickover argued vigorously that foundational learning in reading, writing, and arithmetic should form the basis of all education before any specialty training took place. He understood that these foundational topics ensured students were able "to read, to write clearly, to calculate, to think critically and logically, and to acquire knowledge of the world through history, literature, science, and art." Testifying before the Senate Subcommittee on Education in 1963, Rickover stated unequivocally,

"I believe that every student, whoever is possible of absorbing it, should be given a good liberal arts education. I would much prefer, even in a scientific endeavor, to hire a graduate of a liberal arts school than anybody else. I want to make that point, because I think I'm being misquoted frequently."[24]

When he created the Navy Nuclear Power Program and commissioned the first nuclear-powered ship, Rickover, who was a specialized Engineering Duty Officer, selected a line officer, an officer with experience in command of ships at sea—and not a professional engineer—to be the first commander of USS Nautilus (SSN 571) in 1954.[25] While the initial nuclear-trained officers were also experienced engineers, demand for officers grew in the 1980s as the Navy expanded toward 600 ships and began accepting officers into the nuclear power program from all degree fields. One of those accepted in that expansion was this author, who held a bachelor of arts in history yet served over 20 years in the Naval Nuclear Power Program, including two years as an instructor at the Naval Nuclear Power School teaching chemistry, materials science, and radiological fundamentals. In fact, by the late 1980s, the Navy had recognized that no one area of undergraduate study proved more effective than another in developing line officers to lead its sailors and had removed all academic major restrictions on NROTC scholarships, just as Nimitz had done in 1946.[26]

The debate over the proper ratio of "bull" (humanities and social sciences) to STEM continues. The Navy currently reserves 85 percent of its NROTC scholarships for midshipmen seeking STEM degrees[27] and, as recently as 2016, considered curtailing scholarship offers to non-technical majors as a cost-cutting measure. The plan aimed to fully fund only engineering degrees with scholarships and to use the Air Force ROTC model of partially funding liberal arts and language degrees. Then-Secretary of the Navy Ray Mabus tabled that plan against the recommendation of then-Chief of Naval Operations Admiral Jonathan W. Greenert. In an interview following Mabus' decision, Admiral James Stavridis, a former Supreme Allied Commander, Europe, and a member of the ROTC Scholarship Review Board, said, "In all honesty, I found the situations I encountered in the course of my career, I was more benefited by what I had studied about the world international relations and history and all of the other aspects of those disciplines than my electrical engineering background."[28] Stavridis did admit that it is unlikely the ratio needs to be fifty-fifty, but his comments highlight that the training gained in a technical undergraduate degree program does not necessarily translate to the real-world requirements for officers.

In 2019, then-Acting Secretary of the Navy Thomas B. Modly issued the sweeping "Education for Seapower Strategy, 2020" which looked to overhaul how the Navy considered education across the entire force—officer and enlisted.[29] Proponents of liberal education lauded its quest for diversity in education, its emphasis on aligning education to career milestones, and the acknowledgement that an "intellectual overmatch" was required for the U.S. Navy to maintain its military advantage.[30] The elation was short-lived however when a new Secretary of the Navy put the new document "under review" six-months after its release, and the envisioned increases in education funding within the service failed to materialize.[31]

The Role of Humanities in a Technological Service

In the Air Force, the emphasis on technical education began at the service's inception. The Air Force prides itself on being the most technical of the services, and therefore preferentially chooses officers with, or who are seeking, STEM degrees.[32] While the current Air Force ROTC scholarship program does not include an outright quota of STEM degrees, its "scholarships are merit-based, therefore students pursuing a technical major may receive priority in the selection process."[33] A 2010 study commissioned by the U.S. Air Force and the National Research Council concluded, among other STEM-related elements, that,

"Only five Air Force officer career fields currently require a STEM degree…. All other officer career fields, such as pilot, navigator, air battle manager, maintenance, space and missiles, and program management, have no stated requirements for STEM education, but a significant percentage of officers in these career fields do hold STEM degrees. For example, 45 percent of pilots have science or engineering degrees. While the committee found no direct data showing cause and effect, current and former Air Force officials who interacted with or were members of the committee believe the high degree of technical expertise among its pilots contributes significantly to the U.S. Air Force's operational and tactical excellence [emphasis added]."[34]

Such a non-scientific conclusion seems ironic in an argument for increased STEM education but represents the bias those holding STEM degrees exert over the system. A closer look at the conclusion above shows that more than half of the Air Force's pilots at the time did not have STEM degrees. The term "ducks pick ducks" is oft-repeated. Such thinking fails to recognize the validity of diverse backgrounds, especially in the officer corps' undergraduate education. The argument, "I am a STEM major, and I was successful; therefore, all officers should be STEM majors to be successful," is a logical fallacy.[35] Instead, the services should assess the best and brightest officers and then train them for specific jobs based on demonstrated performance, not arbitrary quotas coming out of high school or college.

Even the STEM community recognizes the requirement for more than just STEM. The growth of artificial intelligence (AI) highlights the need to include humanities in the development of technology. As Dr. Sylvester Johnson, Director of the Virginia Tech Center for Humanities, told the author, "Technology is inherently comprehensive and transdisciplinary, with the hardest problems existing at the human frontier—policy, ethics, regulation, societal impact, etc."[36] The transdisciplinary nature of future technology is reflected in the recent revision of technology studies at leading universities such as the Massachusetts Institute of Technology, Stanford, and Oxford. The Stanford Institute for Human-Centered Artificial Intelligence website leads with the idea that "the creators and designers of AI must be broadly representative of humanity. This requires a true diversity of thought—across gender, ethnicity, nationality, culture, and age, as well as across disciplines."[37] Realizing that the future of technology is inexorably connected with humanity, a transdisciplinary officer corps would best position the military at the forefront of the AI revolution. Including a broad range of humanities-trained officers among STEM-trained officers sets the military up to not only take advantage of technology but also to spearhead the ethical and moral application of that technology.[38]

Education Required to be a Junior Officer

One of the challenges of determining appropriate officer undergraduate degrees is the lack of correlation between civilian university degrees and military officer career fields. Few undergraduate degrees prepare officers directly for their roles in any of the military services. Some military specialties align with technical civilian degree programs, such as meteorology, naval architecture, or civil engineering, but only for officers going directly into those specialties. Most officers will enter their service in generalist billets, albeit within their chosen branch of each service. The skills necessary to perform as a junior officer have little to do with a STEM degree's technical aspects and more to do with human interaction and leadership.

While the U.S. Army has no explicit quota for STEM or liberal arts majors, there remains debate over the right balance of technical and liberal education. Colonel Greg Kaufmann, U.S. Army (Ret.), wrote in 2015 that the Army should embrace liberal arts

education since it aligns with the Army's leader development narrative. The complex environment in which the Army expects its officers to operate requires an understanding of "human, cultural, and political continuities."[39] "[S]uch a leader possesses a high tolerance for ambiguity and is comfortable in such situations. Accepting that a new lieutenant receives the necessary technical and tactical training prior to the first platoon leader assignment, then the cognitive preparation of that lieutenant can best be fulfilled through a pre-commissioning liberal arts education."[40] So, while technological knowledge is necessary for the development of weapons systems and such, the development of leaders requires knowledge of the brain housing group. The same need for leadership holds in the other services as well.

A 2020 study by the Center for Education and the Workplace at Georgetown University determined that the top five workplace skills most in demand among professional workers, a group in which military officers claim membership, were communication, teamwork, sales and customer service, leadership, and problem-solving and complex thinking. STEM skills, in this report, were on average two to three times less important than these five attributes. Admittedly, humanities were near the bottom of the list, but even STEM-related fields valued communication and problem solving/complex thinking over the more STEM-associated skills like mathematics, physics, and engineering.[41] The emphasis here is that the skills most in-demand in the workplace are not STEM, but instead, people skills that are developed effectively through the study of liberal arts and humanities and correlate with Admiral Rickover's testimony of 60 years ago.

As Fareed Zakaria writes in In *Defense of a Liberal Education,* liberal arts degrees are not so much about learning to think but learning to write; as learning to write forces you to think and communicate with your team, subordinates, and superiors.[42] This aligns with the number one workplace skill listed above. The ability to articulate thoughts and express them in a manner most easily understood by their intended audience is a core tenant of liberal education. Anecdotal experience with the officer candidates this author frequently encounters bears this out. The STEM majors, even those with high grade point averages (GPA), often struggle with their ability to communicate clearly, while the cadets majoring in history, political science, national security affairs, foreign languages, and psychology move to the head of the pack in getting others to understand the why behind their ideas. What good is an officer with vast technical knowledge who cannot communicate their thoughts and ideas to the people they lead and serve?

Recommendation

Educating future military officers requires balancing the need for officers with technical literacy with those who have a firm grounding in the humanities even as warfare seems to become more technical. The National Resource Council study on the U.S. Air Force's STEM workforce needs presented the terms "STEM-trained" and "STEM-cognizant" to describe the officer corps the Air Force requires. The study defined STEM-cognizant as "such individuals [who] have a

foundation in the use of the scientific method in decision making."[43] Expanding on that definition, STEM-cognizant individuals are "(l)acking a specific degree in science, technology, engineering, or mathematics, but having a minimum of 30 hours of undergraduate course work in these subjects or equivalent training or experience and being conversant in these subjects."

STEM-cognizant should be the goal of the armed forces officer corps, not STEM-trained. Except for some narrow specialties, the officer corps is not called upon to design technology but instead to employ it. An example of this is, again, the Naval Nuclear Power Program. The program takes officers of all majors and provides a year of intensive training in the theory and practice of operating a nuclear propulsion plant. Graduation from Nuclear Power School does not qualify an officer to design new reactor plants, but it does produce a STEM-cognizant officer who is fully capable of supervising, operating, and maintaining naval nuclear propulsion plants. And that STEM-cognizance expands beyond nuclear power to technical literacy across a range of missions. Flight school provides a similar technical education to officers from the entire range of undergraduate degrees, arguably achieving STEM-cognizance. If the services' goal is to have STEM-cognizant officers, then the services should provide the specific STEM-related training they seek as they do in these examples. Allowing prospective officers to pursue degrees in any accredited undergraduate major and requiring minimum STEM and liberal arts prerequisites would result in an intellectually diverse officer corps that can then specialize based on the technical or critical thinking requirements of their chosen career path.

Perhaps the concern is to ensure prospective officers complete degrees with sufficient academic rigor. In that case, the services can set higher standards for GPA or demand specific courses in addition to the chosen major. Again, looking at the 1980s Navy ROTC example, midshipmen were allowed to enroll in any academic major. However, to ensure minimum technical knowledge all were required to take calculus and calculus-based physics, which remains a requirement today. Additionally, all midshipmen are required to take one of several national security-related history or political science courses. These requirements are separate from whatever university-required core courses are required for graduation. While the Naval Nuclear Power Program accepts officers of all majors, those with non-STEM degrees had a higher GPA threshold to enter the program. Suppose sufficient academic rigor is a criterion for military officer candidates. In that case, such a sliding GPA scale by degree program could be applied to all commissioning efforts, provided it is transparent and clearly stated at the beginning of a candidate's academic career.

Although military services employ highly technical capabilities, those systems are still run by people. As Rear Admiral Grace Hopper quipped, "A human must turn information into intelligence or knowledge. We've tended to forget that no computer will ever ask a new question."[44] In the age of machine learning and AI, this may no longer be wholly true, but keeping the human in the loop will continue to require a human(ity).

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10. Matthew Hughes, "Technology, Science, and War," in *Palgrave Advances in Modern Military History,* editors Matthew Hughes and William J. Philpott (London: Palgrave Macmillan, 2006), 232.
11. Ibid., 252.

12. Attribution of this aphorism is disputed but it most likely came from this passage in George Santayana's *The Life of Reason:* "Progress, far from consisting in change, depends on retentiveness. When change is absolute there remains no being to improve and no direction is set for possible improvement: and when experience is not retained, as among savages, infancy is perpetual. Those who cannot remember the past are condemned to repeat it."
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15. Eric Hammel, *Guadalcanal: Decision at Sea* (New York: Crown, 1988), 253.
16. John B. Hattendorf, introduction to *Military Strategy: A General Theory of Power and Control,* author J.C. Wylie (Annapolis, MD: Naval Institute Press, 2014), xiv-xvii.
17. Wylie went on to write *Military Strategy: A General Theory of Power and Control,* in which he posits that there are "four ideas relating to war and war strategy—that there will be war, that the aim of war is some measure of control, that the pattern of war is unpredictable, and that the ultimate tool of control in war is the man on the scene with a gun." (p. 74) It is that pattern of unpredictability in establishing the "man on the scene with a gun" to assert control that requires critical and creative thinking, the ability to adapt to changing and unpredictable circumstances, and the mental agility to rapidly apply tools at hand, that argue to increase liberal arts education in today's officer corps.
18. The advantage of diversity in teams is discussed in a wide variety of scholarly papers. Two such papers are: Daryl E. Chubin, Gary S. May, and Eleanor L. Babco, "Diversifying the Engineering Workforce," *Journal of Engineering Education* (January 2005), 73-86; and Verena Watzek and Regina H. Mulder, "Team Learning Behaviours and Team Affective Reactions: an Empirical Study on Interdisciplinary Work Teams," V*ocations and Learning* (2019) 12:1–22.
19. Scott Mobley, *Progressives in Navy Blue: Maritime Strategy, American Empire, and the Transformation of U.S. Naval Identity, 1873–1898* (Annapolis, MD: Naval Institute Press, 2018), 207-33.
20. Eisenhower, Nimitz, and Vandegrift, "Liberal Education in the Military Forces," 36.
21. Ibid.
22. Ibid.
23. John Kuehn, "US Navy Cultural Transformation, 1945-2017: The Jury is Still Out" in *The Culture of Military Organizations,* edited by Peter R Mansoor and Williamson Murray (Cambridge: Cambridge University Press, 2019). 351-377, doi:10.1017/9781108622752.

24. Hyman G. Rickover, Testimony before the Subcommittee on Education of the Committee on Labor and Public Welfare of the United States Senate-Eighty-Eighth Congress, *Education Legislation-1963* (Washington, U. S. Government Printing Office, 1963), Vol. V, 2568.
25. Dave Oliver, *Against the Tide: Rickover's Leadership Principles and the Rise of the Nuclear Navy* (Naval Institute Press: Annapolis, MD, 2014), 11–19; Paul Stillwell, "Eugene P. Wilkinson: Nuclear Navy Pioneer," USNI News, news.usni.org, July 16, 2013.
26. The author was a midshipman 1986-1990 and benefited directly from this change, shifting from general engineering to history during freshman year after being informed that any degree-granting major was allowed to remain on scholarship and earn a commission.
27. Naval Education and Training Command, NETC Instruction 1533.3A Change Transmittal 1, "Academic Major Selection Policy for Naval Reserve Officer Training Corps Navy Option Scholarship Midshipmen," September 11, 2015.

    The NROTC uses a three Tier system with Tier One being engineering majors, Tier Two being other technical majors and certain languages, and Tier Three being all other majors. Within the 85 percent STEM scholarships, awards are biased toward Tier One majors. Once a scholarship is awarded, students must gain permission to change majors to a higher numbered tier. "NROTC's primary goal is for Navy Option Scholarship midshipmen is to produce 65 percent technical major graduates." Ironically, the Naval Academy argues that is needs to focus on STEM because NROTC and OCS do not, despite the same 85 percent STEM requirement in those commissioning sources.
28. Sam Lagrone, "CNO Greenert: Navy Could Take New Look at ROTC Scholarship Mix," *US Naval Institute News,* 17 October 2014, https://news.usni.org/2014/10/17/cno-greenert-navy-take-new-look-rotc-scholarship-mix.
29. U.S. Navy, *Education for Seapower Strategy 2020,* https://media.defense.gov/2020/May/18/2002302033/-1/-1/1/NAVAL_EDUCATION_STRATEGY.PDF.
30. Ibid, 3.
31. Sam LaGrone "Navy 'Education for Seapower' Program Under Review by New SECNAV," *US Naval Institute News,* June 30 2020, https://news.usni.org/2020/06/29/navy-education-for-seapower-program-under-review-by-new-secnav; Sarah Wood, "U.S. Navy Plans to Cut Part of Higher Ed Funding, Requests Increase to Sexual Assault Prevention and Mental Health," *Diverse Issues in Higher Education,* June 2, 2021, https://diverseeducation.com/article/216662.
32. National Research Council 2010, *Examination of the U.S. Air Force's Science, Technology, Engineering, and Mathematics (STEM) Workforce Needs in the Future and Its Strategy to Meet Those Needs* (Washington, DC: The National Academies Press, 2010), https://doi.org/10.17226/12718.

33. https://www.afrotc.com/scholarships/desired-majors/.
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35. The specific formal fallacy at work here is a modal fallacy in which a conclusion is drawn from two true statements that is not necessarily true. Bo Bennet, "Logically Fallacious" (Archieboy Holdings, 2020), accessed March 7, 2021, https://www.logicallyfallacious.com/logicalfallacies/Modal-Scope-Fallacy.
36. Sylvester Johnson to author, email dated March 11, 2021.
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38. The Joint Artificial Intelligence Center, founded in 2018, states "To help operationally prepare the Department for AI, the JAIC integrates technology development, with the requisite policies, knowledge, processes and relationships to ensure long term success and scalability." The role of the humanities in this office is not mentioned in their mission statement. Perhaps an influx of humanities trained officers, including those who have studied in an transdisciplinary program, can add the human element to military AI.
39. Greg Kaufmann, "Liberal arts and military officers (II): To get the officers it says it wants, the Army should give them liberal arts educations," *Foreign Policy,* November 5, 2015. https://foreignpolicy.com/2015/11/05/liberal-arts-and-military-officers-ii-to-get-the-officers-it-says-it-wants-the-army-should-give-them-liberal-arts-educations/.
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41. Anthony P. Carnevale, Megan L. Fasules, and Kathryn Peltier Campbell, *Workplace Basics, The Competencies Employers Want* (Washington, DC: Georgetown University Center on Education and the Workplace, 2020), 16, 20.
42. Fareed Zakaria, *In Defense of a Liberal Education* (New York: W.W. Norton and Company, 2015), 72-73.
43. National Research Council, Examination of the U.S. Air Force's STEM Workforce, 26-27.
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REFERENCES: JPWS uses *The Chicago Manual of Style's* notes and bibliography system with endnotes. For further information on references, please consult The Chicago Manual of Style, 17th edition.

Books: Feldman, Lily Gardner, *Germany's Foreign Policy of Reconciliation: From Enmity to Amity* (Lanham, MD: Rowman and Littlefield Publishers, 2012), 20-33

Book chapters: Terence Roehrig, "Stability or Instability? The US Response to North Korean Weapons," in *North Korea and Nuclear Weapons: Entering the New Era of Deterrence,* eds., Sung Chull Kim and Michael Cohen (Washington DC: Georgetown University Press, 2017), 129-56.

Journal articles: Friedberg, Aaron, "The Future U.S.-China Relations: Is Conflict Inevitable?" *International Security* 32, no. 2 (2005): 7-35.

Online sources: Bonenberger, Adrian, "The War No One Notices in Ukraine," *New York Times,* June 20, 2017, https://www.nytimes.com/2017/06/20/opinion/ukraine-russia.html .

For multiple notes referencing the same work, please use the following shortened note form after the first reference.
Feldman, *Germany's Foreign Policy of Reconciliation,* 73-78.
Roehrig, "Stability or Instability?," 131.

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