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Dr. Keith R. Beurskens
Journal of Military Learning
Editor in Chief

Welcome to the April 2023 edition of the *Journal of Military Learning (JML)*. This edition includes a manuscript from four Royal Netherlands Army writers and two from the U.S. Air Force Academy. Also included in this edition is a summary of research conducted over the past year as part of the Army University Research Program (AURP). The AURP conducts applied research to support evidence-based innovation in the learning sciences. The research is conducted through collaboration with U.S. Army schools and research institutes. I hope you enjoy this selection of articles and encourage all our readers to submit manuscripts for a future edition's consideration.

The *JML* brings current adult-learning discussions and educational research from the military and civilian fields for continuous improvements in learning. Only through critical thinking and challenging our education paradigms can we as a learning organization fully reexamine and assess opportunities to improve our military education. The *JML* is published online each April and October. A detailed call for papers and manuscript submission guidelines are found at https://www.armyupress.army.mil/Journals/Journal-of-Military-Learning.

Peer Reviewed

Beyond STEM Attrition

Quantifying the Flow of U.S. Air Force Academy Cadets between Academic Majors to Improve STEM Persistence

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Abstract

In increasingly technological civilian and military worlds, professionals in science, technology, engineering, and mathematics (STEM) are essential. To what extent postsecondary institutions are providing quality support to STEM majors is subject to debate, but the consensus is that STEM attrition at the college level is problematic. This study examines how cadets enrolled at the U.S. Air Force Academy (USAFA) moved from initially declared majors to their final graduation majors. The sample consisted of 6,110 cadets, of which 739 (12%) switched majors at least once. These switches included within-STEM changes (38%), STEM departers (28%), within non-STEM changes (28%), and STEM arrivers (6%). Researchers noted a strong flow of cadets away from majors with more mathematics requirements. Academic disciplines that were the sources of most major changes and STEM departers were identified. Recommendations to reduce STEM attrition include changing generic "undeclared" categories to meta-majors or similar alternatives that are division-specific to better track early major flow trends, broadening the cadets' core quantitative skills by requiring at least four mathematics courses for all degree majors, providing dual credit opportunities for USAFA-accepted high school seniors interested in STEM, and performing focus

groups with STEM departers to obtain firsthand insights into their reasons for their switch.

The decision of which college major and career to pursue is, for many students, a process fraught with indecision (Brown & Rector, 2008; Choi et al., 2012; Feldt et al., 2011). For decades, higher education scholars have studied persistence in a major and major switching to help students make the best decision possible based on their specific situation (Beggs et al., 2008; Ferrare & Lee, 2014; Reardon et al., 2015). Switching majors is common. An estimated 30%–50% of students change majors at least once, 10%–25% change majors multiple times, and more than 40% do so as juniors or seniors (Kramer, 1994; National Center for Education Statistics, 2017; Peterson, 2006). Many of these changes occur within the same broad disciplinary groupings, like sciences, social sciences, or humanities (Smart et al., 2000).

Researchers have learned that students' choice of college major involves a multifaceted decision process (Beggs et al., 2008; Malgwi et al., 2005; Peterson, 2006). The relative weight of these factors is a source of academic debate. For instance, Peterson's (2006) proposed major choice is influenced by three factors: extrinsic (e.g., expected future earnings), intrinsic (e.g., academic preparedness, learning styles), and experiential factors (e.g., involved faculty, departmental culture). He also notes that, for students who changed majors, intrinsic and experiential reasons are more important in choosing the new major. Beggs et al. (2008) and Malgwi et al. (2005) suggested four main factors associated with major selection: (a) sources of information and influence, (b) job characteristics, (c) fit and interest in the subject, and (d) characteristics of the major or degree.

Regardless of the number and relative importance of factors, keeping the most competitive GPA possible is critical. When students discover they struggle in prerequisite or major-specific coursework, some may reconsider their major choice. For example, Sjoquist and Winters (2015) studied college students receiving a state-sponsored, GPA-based scholarship. They found scholarship holders switched from their original majors to those perceived to be less difficult as their GPA approached the minimum GPA required to maintain the scholarship. Wright (2018) agreed, stating most major switches could be grouped into three categories, one of which is where students realize they are unable to successfully complete coursework at a sufficient level and risk not graduating on time or not meeting scholarship GPA requirements. The other categories include the students gaining additional major information (knowledge of new majors that they had not previously known about or updated information about their original major that made them view it differently) and personal self-discovery that leads students to change their values or interests.

At the U.S. Air Force Academy (USAFA), there is a strong "carrots and sticks" incentive for cadets to keep excellent GPAs. Unlike universities where a student can lose a scholarship but remain enrolled, USAFA is unique in that every student has a four-year scholarship inextricably tied with their enrollment. If a cadet withdraws or loses their enrollment status due to deficient academic performance as juniors or seniors, cadets can be responsible for approximately $50,000 per completed semester (Belasco, 2022). Repayment can be financial or by serving the military as an enlisted airman. Alternatively, the higher a cadet's GPA, the greater the access to opportunities and benefits, such as career preferences, base preferences for pilot training, scholarships for graduate studies programs, USAFA military leadership positions, and specialized programs like airmanship.

Another factor strongly contributing to students changing majors is mathematics preparation coming from high school and performance in college mathematics (Daugherty & Lane, 1999; Nuñez-Peña et al., 2013; Perry, 2004). Bressoud (2021) argued there is a "tremendous disparity across the [U.S.] in what [mathematics] courses are offered and how teachers are prepared to teach these courses" (p. 521), including calculus, resulting in many students unprepared for college-level mathematics. Introductory calculus tends to be the biggest cause of attrition in the STEM major undergraduate pipeline, regardless of school type, student preparedness, or class size (Chen, 2015; Cohen & Kelly, 2020).

The change in college majors from STEM to non-STEM disciplines is known as STEM attrition (Ferrare & Lee, 2014; National Science Foundation, 2018). Because STEM attrition has been reported to be as high as 30%–50% nationwide (Chen, 2013; National Science Board, 2018), it has become a subject of intense study (Brewer et al., 2021; Chen,

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2015; Laskey & Hetzel, 2011; Seymour & Hunter, 2019; Shedlosky-Shoemaker & Fautch, 2015; Sithole et al., 2017; Xu, 2018). The literature has identified several potential factors for STEM attrition, including high school background in mathematics and science, academic performance in prerequisite math and science coursework, prerequisite course design, time management, study habits, self-efficacy, and fear of failure, among others (Dwyer et al., 2020).

Given the rapid pace of technological advancement, reducing STEM attrition among cadets is key to maintaining military superiority (Air Force Research Laboratory, 2022). The U.S. Department of Defense has identified a STEM workforce as essential for a strong military and an evolving and increasingly complex national and international security environment (National Academies of Sciences, Engineering, and Medicine, 2015; National Research Council, 2010, 2012a, 2012b, 2014).

Military postsecondary institutions like USAFA, which recruit and enroll cadets with outstanding academics and leadership skills, also experience STEM attrition. A previous study showed that, after cadets are accepted into USAFA but before they start their first coursework sequence, about two-thirds of them were likely to pursue STEM degrees. Four years later, less than half of them received a bachelor's in a STEM discipline. According to Dwyer et al (2020), this rate of STEM attrition seems related to their experience with Calculus I, Physics I, and Chemistry I. Another study also explored related factors associated with STEM attrition at USAFA using data from academic years 2019–20 and 2020–21 (O'Keefe et al., 2022). The researchers found five factors were individually associated with an increased likelihood of STEM departure: (a) USAFA preparatory school attendance, (b) scholars program nonparticipation, (c) low GPA, (d) low SAT mathematics scores, and (e) low SAT reading and writing scores. Of the factors studied, GPA emerged as the strongest factor associated with cadets leaving STEM (O'Keefe et al., 2022).

The current policy at USAFA is that "cadets may declare a major as soon as they desire," though it is encouraged for cadets to wait at least until their second semester. The deadline for declaring a major is "the registration deadline of their third semester" (U.S. Air Force Academy [USAFA], 2021, p. 111). However, academic and nonacademic reasons may result in a small number of cadets unable to complete their chosen program. In this case, USAFA provides an alternate path to their eight-semester graduation requirements where cadets may earn a bachelor of science without any major.

Purpose and Research Questions

The purpose of this study is to better understand the flow of cadets into and out of individual majors to specifically examine the effects of STEM majors. The research questions guiding this study were as follows:

- To what extent are cadets who change their original STEM major remaining within STEM as persisters or becoming STEM departers?
- To what extent are cadets who change their original non-STEM major staying within non-STEM as persisters or becoming STEM arrivers?
- Which STEM majors experience the most and least attrition, by sheer numbers and as percentages of total initial enrollment?
- Which factors contribute to STEM attrition?

The answers to these research questions are important for USAFA departments so they may perform additional major flow analyses and brainstorm potential interventions to reduce attrition (National Science Board, 2018).

More broadly, reducing STEM attrition at USAFA is an urgent matter. Since the mid-1990s, less than half of the Air Force officer corps is commissioned with STEM undergraduate degrees, and the inventory of officers with STEM master's degrees fell from about 7,000 in 1989 to just over 5,000 currently. To meet Air Force needs, it is estimated that about 10,000 officers with *graduate* STEM credentials are needed (Air Force Research Laboratory, 2022). Achieving this goal is only possible if more *undergraduates* with STEM degrees are produced, whether through USAFA or other commissioning sources.

Methodology

This study relied on data from the Office of Student Academic Affairs and Academy Registrar collected during academic years 2019–20, 2020–21 and 2021–22. Although numerous variables were present in the data, this analysis used (a) CODE ID (a random code assigned to each cadet to maintain confidentiality); (b) cadet MAJOR, the main variable of interest; and (c) DATE to keep track of when cadets switched majors, if any, over their time at USAFA. A total of 505 freshmen cadets from academic year 2021–22 were classified as undeclared (they did not declare a major within the time frame of the study) and were removed from the dataset. The researchers coded each combination of major switching, from those cadets who declared a major and never switched, to cadets who switched multiple times. Finally, the dataset was classified by each major and Sankey diagrams were prepared to visually illustrate cadet flow by major.

The data was categorical in nature, so analyses consisted of descriptive statistics and Chi-Square tests when appropriate. Because of the exploratory nature of the study, minimum statistical significance was assigned a probability (p) value of 0.05 or less to balance the risks of Types I and II errors.

To simplify the graphical representation of the findings, several abbreviations were used in the Sankey diagrams. These include the following:

- **noSwitch:** cadets remaining in their original major.

- **SwitchSTEM:** cadets who switched from their original major to STEM majors.
- **SwitchNONSTEM:** cadets who switched from their original major to non-STEM majors.
- **Final STEM:** cadets who switched major multiple times with STEM as the final major.
- **Final NONSTEM:** cadets who switched major multiple times with non-STEM as the final major.
- **Back to:** cadets who left a major but eventually returned to it.

Due to the Sankey diagram's size limitations and the variety of majors, USAFA majors and abbreviations are listed in the Table.

Results

Demographics

The sample consisted of 6,110 cadets with major history on file. Of these, 4,361 (71.4%) were male and 1,749 (28.6%) were female. This included 3,905 (63.9%) Caucasian, 642 (10.5%) Asian, 622 (10.2%) Hispanic, 559 (9.2%) Black, 200 (3.3%) "unknown," 123 (2.0%) Hawaiian/Pacific Islander, and 59 (1.0%) Native American.

The dataset included cadets from several graduation years: five cadets from 2019, 995 from 2020, 1,071 from 2021, 1,101 from 2022, 1,062 from 2023, 1,081 from 2024, and 795 from 2025 (which had many undeclared cadets). Because of the exploratory nature of the study, it is worth pointing out that three years' worth of data were examined, meaning some cadet cohorts had longer data collections than others. For example, there is only one year's worth of data for cadets who graduated in 2020 or who will graduate in 2025, two years for cadets who graduated in 2021 or will graduate in 2024, and three years for cadets who graduated in 2022 or will graduate in 2023.

Cadet Flow for All Major Switchers

Out of 6,110 cadets in the dataset, 5,371 (87.9%) never switched majors and 739 cadets (12.1%) switched majors. Of these, about two thirds (n = 491) were STEM majors, compared with non-STEM majors (n = 248). STEM switchers split somewhat evenly between STEM persisters (n = 269, 54.7%) and STEM departers (n = 222, 45.2%). In contrast, the proportion of non-STEM switchers was more than to 5:1 between non-STEM persisters (n = 210, 84.6%) and STEM arrivers (n = 38, 15.3%). Using a 2x2 Chi-square test revealed this difference in discipline persistence versus departure was statistically significant, $X^2(1, n = 739) = 105.7, p < 0.00001$.

Of the cadets who switched majors, 63 did so multiple times, including 46 cadets (73%) originally in STEM majors and 17 cadets (26.9%) originally in non-STEM ma-

Table

STEM and Non-STEM Majors and Their Abbreviations

STEM Majors	Non-STEM Majors
• Aeronautical Engineering (AeEn)	• Behavioral Science (Beha)
• Astronautical Engineering (AsEn)	• Economics (Econ)
• Basic Sciences (BasS)	• English (Engl)
• Biology (Biol)	• Foreign Area Studies (FAS)-
• Chemistry (Chem)	• Geospatial Sciences (GeoS)
• Civil Engineering (CiEn)	• History (Hist)
• Computer Engineering (CoEn)	• Humanities (Huma)
• Computer Science (ComS)	• Legal Studies (Lega)
• Cyber Sciences (CybS)	• Management (Mana)
• Data Science (DatS)	• Military and Strategic Studies (MSS)
• Electrical and Computer Engineering (ElCoEn)	• Philosophy (Phil)
• General Engineering (GeEn)	• Political Science (PolS)
• Mathematics (Math)	• Social Science (SocS)
• Mechanical Engineering (MeEn)	
• Meteorology (Mete)	
• Operations Research (OpsR)	
• Physics (Phys)	
• Space Operations (SpaO)	
• Systems Engineering (SyEn)	

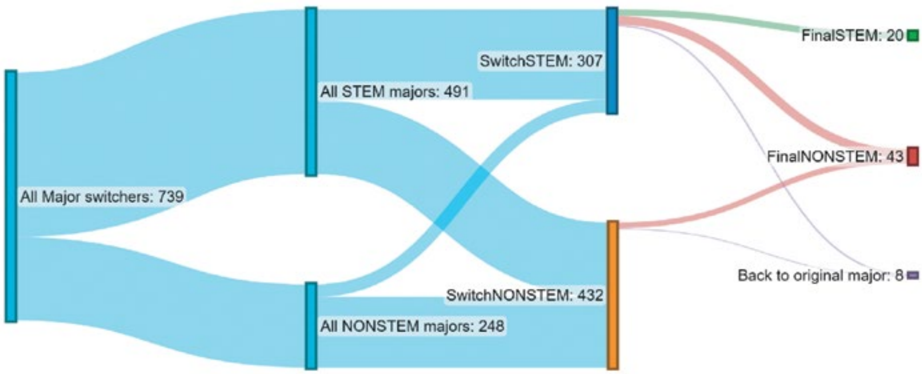
jors. For STEM multi-switchers, 26 (51%) departed STEM and 25 (49%) remained in STEM, including five cadets who returned to their original STEM major of record. For non-STEM multi-switchers, 20 (100%) remained in non-STEM, including three cadets who returned to their original major. Figure 1 summarizes overall flows for all major switchers.

To evaluate the role of mathematics, described in the literature as a strong indicator of major switching, original and final majors were combined into groups based on required mathematics courses. Each cadet also takes a course in statistics, taught by either the math or behavioral sciences departments, and these statistics courses are not included in the discussion of required math courses. The resulting categories included the following:

- **13 courses:** Mathematics
- **6 courses:** Aeronautical Engineering, Astronautical Engineering, Mechanical Engineering, Operations Research, Physics

Figure 1

Cadet Flow for All STEM and Non-STEM Major Switchers



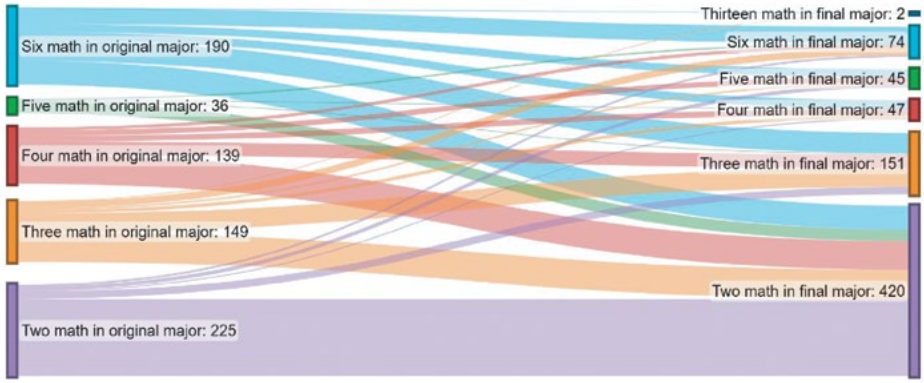
- **5 courses:** Civil Engineering, Data Science
- **4 courses:** Basic Sciences, Computer Science, Cyber Science, Electrical and Computer Engineering, Meteorology, Space Operations
- **3 courses:** Biology, Chemistry, Economics, General Engineering, Systems Engineering
- **2 courses:** Behavioral Sciences, English, Foreign Area Studies, Geospatial Science, History, Humanities, Legal Studies, Management, Military & Strategic Studies, Philosophy, Political Science, Social Sciences

Major flow from all regrouped original and final majors can be seen in Figure 2.

For this case, the total number of cadets who switched majors was 739. The number of cadets in majors requiring six math courses decreases from 190 (25.7%) to 74 cadets (10%). The cadets in majors requiring four math courses decreases from 139 (18.8%) to 47 cadets (6.4%). In contrast, the cadets in majors requiring two math courses almost doubled, from 225 cadets (30.4%) to 420 cadets (56.8%). Interestingly, for majors requiring five and three math courses, the number of cadets remained similar, hovering around 5%–6% and 20%, respectively. A 2x5 Chi-square test comparing the number of cadets in original and final majors by the number of required math courses revealed a statistically significant difference, $X^2(4, n = 1{,}476) = 156.4$, $p < 0.00001$.

Because non-STEM majors have fewer mathematics requirements, it is unclear whether mathematics versus new career goals based on an emerging interest in non-STEM majors are driving STEM attrition. One way to untangle these interacting variables is to modify the Sankey diagram by focusing on major flow between courses requiring only four, five, or six mathematics courses, since they are all STEM majors. Figure 3 shows the results. A 2x3 Chi-square test comparing the number of cadets in original and final majors by the number of required math courses revealed

Figure 2
Cadet Major Flow as a Function of the Number of Required Math Courses Within Majors



a statistically significant flow of cadets from majors requiring more to fewer math requirements, $X^2(2, n = 240) = 23.4, p < 0.00001$.

Although the statistical test showed a trend in cadets seeking majors with fewer required mathematics courses, it would not be appropriate to infer an exclusively causal link. Factors like curriculum changes, course structure, and coursework pace could also be associated with STEM attrition.

Cadet Flow for All STEM Departers

The percentage of departures by STEM major was calculated by dividing the number of STEM departers by the original number of within-major cadets. This percentage ranged from 1.5% (mathematics) to 44.4% (space operations). Three majors with higher levels of STEM attrition, cyber science, data science, and computer science, were all related to computers. A few majors such as general engineering and basic sciences had low enrollments (six cadets or fewer) and showed no STEM departures, likely because they were seniors who could not meet the requirements of their original majors and did not have time or the proper prerequisites to switch into anything else. Enrollment values were added to Figure 4 to contextualize the STEM attrition rates.

More than half of all STEM departers originated from four majors: biology, computer science, aeronautical engineering, and systems engineering. The number of STEM departers from other STEM majors are presented in Figure 5. The percentages are calculated using the total number of STEM departers.

Figure 3

Cadet Major Flow for Majors Requiring Four, Five, or Six Mathematics Courses

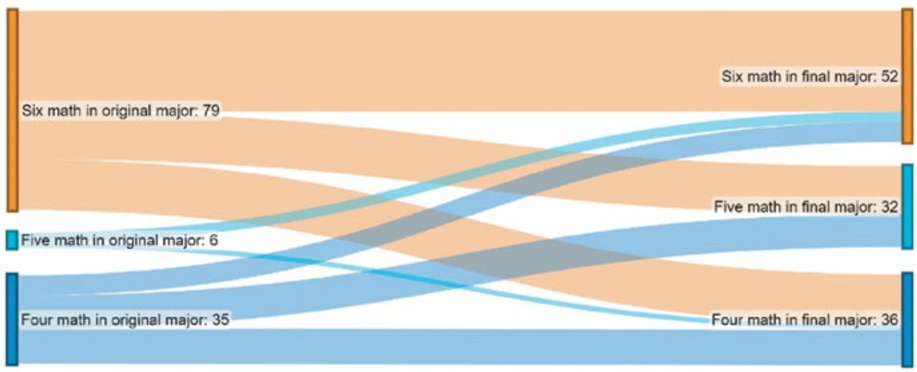


Figure 4

Original Enrollment and Percentage of STEM Departers by Major

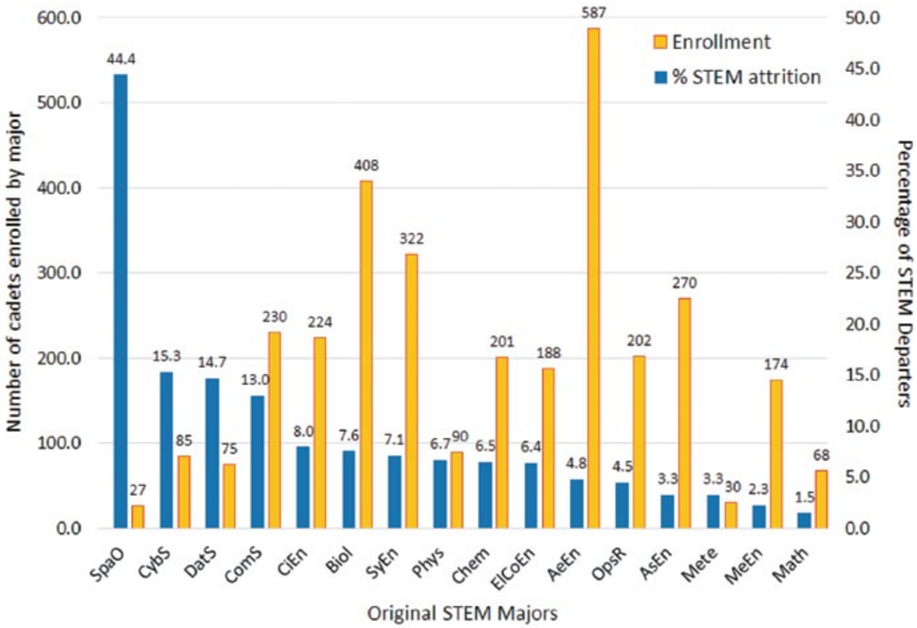


Figure 6 compares the number of cadets who switched to STEM and non-STEM majors. The diagonal represents a ratio of 1:1, cadets changing majors evenly between STEM and non-STEM majors. Seven majors had more cadets switching from STEM to non-STEM: biology, space operations, civil engineering, computer science, cyber science, data science, and systems engineering. Of particular concern were civil engineering, space operations, and biology, which had non-STEM/STEM switching ratios of 6:1, 4:1, and 3:1, respectively. Ratios may be interpreted using slopes from the origin to major in Figure 6.

Pairwise Chi-square tests were used to compare the proportion of cadets who remained in their original STEM major, switched to another STEM major, and switched out of STEM. These tests complement Figure 5 because they account for cadets who remained in their original major. The results are displayed in the chord diagrams (Figure 7). The thicker the connecting lines between two majors, the more similar the major flows are.

The diagrams confirm biology and civil engineering are similar in their high major flow of STEM departers (top-left). Data science, computer science, and cyber science share a similar cluster of relatively high major flow (top-center and top-right). In the region of moderate flow there are two clusters centered around aeronautical engineering, which tie both to operations research and systems engineering on one end (bottom-left), and physics, chemistry and electrical, and computer engineering on the other (bottom-center). Finally, astronautical engineering and mechanical engineering share a similar, low flow of STEM departers (bottom-right). Mathematics, space operations, and meteorology are not in the chord diagrams because of low sample sizes in a category needed to perform the Chi-square tests.

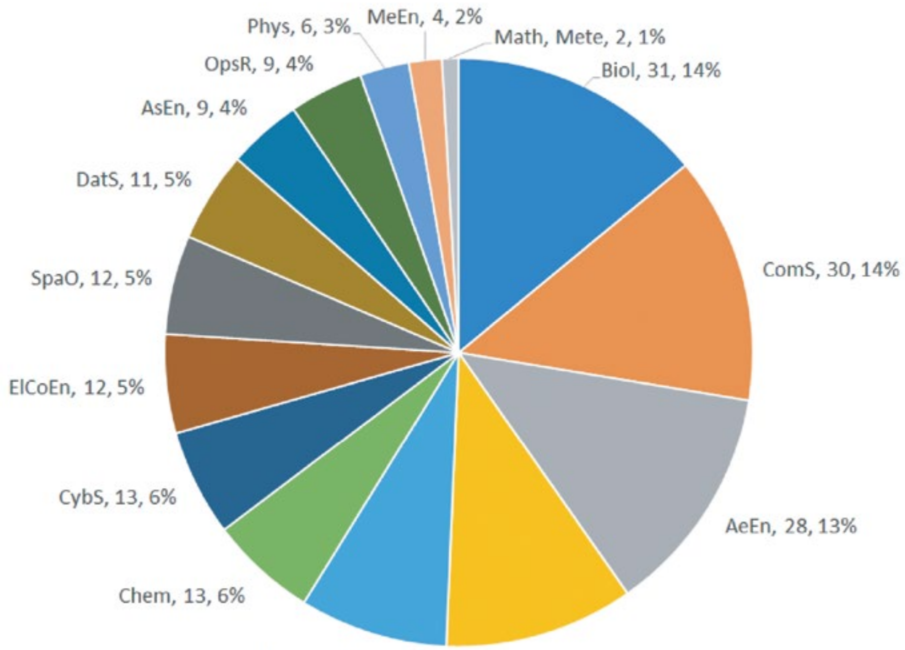
Management received almost a third of all STEM departers, with four other majors receiving another third: military and strategic studies, behavioral science, legal studies, and foreign area studies. Additionally, geospatial science, economics, and English received a sizable number of STEM departers. Figure 8 displays destination majors for STEM departers.

Cadet Flow by STEM Major

Although Sankey diagrams for cadet major flow were prepared for all STEM majors, only those corresponding to the seven majors identified in Figure 6 are presented due to the concerning number or rate of STEM departures. The diagrams (Figures 9–15) are divided into four main regions:

- **Left:** the number of cadets and their original major.
- **Center-left:** cadet split between those who remained in the major (noSwitch), who changed majors to a different STEM one (SwitchSTEM), and who departed STEM (SwitchNONSTEM).
- **Center-right:** the number of cadets and their destination majors.
- **Right:** the number of cadets who switched major multiple times and their final destination discipline. Cadets who returned to the original major are noted.

Figure 5
Number and Percentage of STEM Departers by Their Original Major



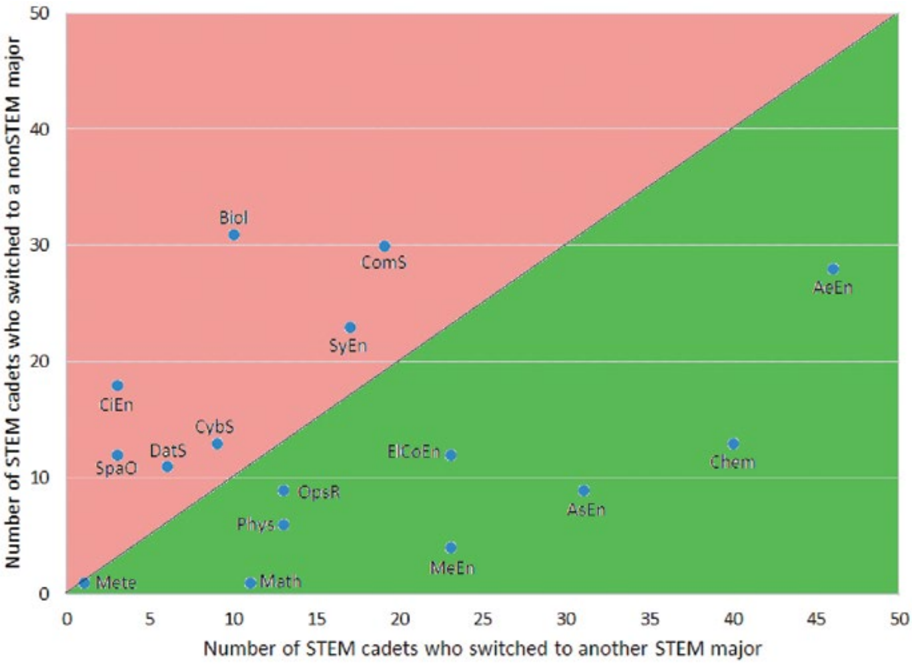
Discussion and Recommendations

At first glance, the pattern of major switching at USAFA compares favorably with previous publications in the literature. For instance, the percentage of cadets who switched majors multiple times (10%) is within the 10%–25% range that the extant literature has reported by Kramer (1994), Peterson (2006), and others. About two-thirds of cadets who switched majors remained in their broad STEM or non-STEM disciplines, consistent with the findings of Smart et al. (2000). Even the overall percentage of cadets who change majors at USAFA (12%) and the number of STEM departers (28%) is much lower than the national average (30%–50%), which can be explained by USAFA's highly selective criteria for admission and recommendation for cadets to not declare a major until after the first semester of class.

However, previous studies with USAFA cadet data have reported that cadets are weighing options and changing their minds regarding which major they plan to declare while in the "undeclared" status, especially after completing quantitative core courses (Dwyer et al., 2020; O'Keefe et al., 2022). In fact, the latest data on cadet career preferences from a basic science division survey, completed in the summers of 2021 and 2022,

Figure 6

Ratio of Non-STEM to STEM Switching for All Cadets With an Original STEM Major



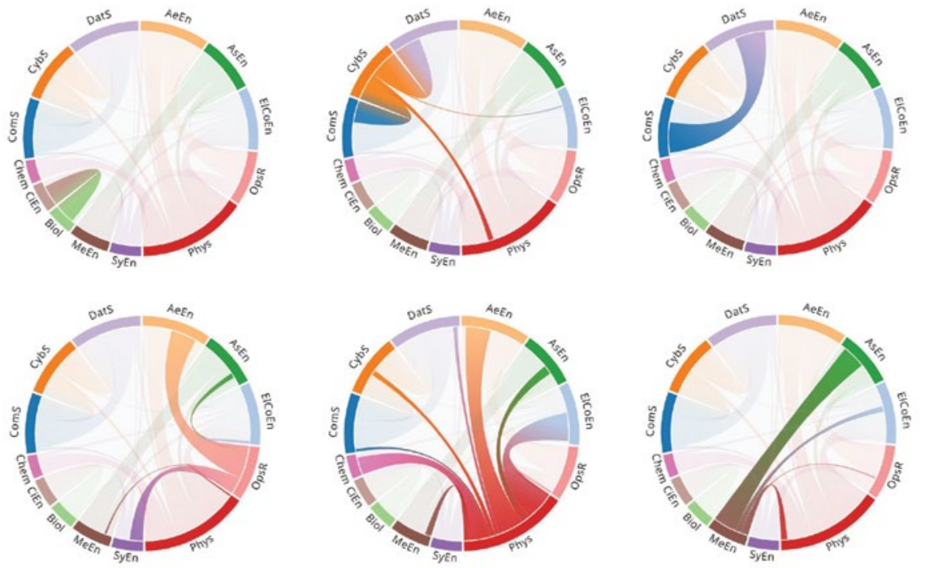
and prior to their first semester, showed 57% of cadets considered majoring in STEM very likely or likely, 32% considered majoring in non-STEM very likely or likely, and about 11% had no stated preference (Lt. Col. David Meier, personal communication, 22 July 2022). Unfortunately, there is a knowledge gap spanning many months, from the time cadets report their planned major in the basic science division survey to the time cadets declare, and the researchers hypothesize there may be significant attrition during this period. It is recommended for USAFA to replace the generic "Undeclared" major category with ones reflecting the division the cadet is planning to join, as follows:

- Undeclared-Basic Sciences (BS)
- Undeclared-Engineering (E)
- Undeclared-Humanities (H)
- Undeclared-Social Science (SS)

For example, a cadet who is "Undeclared-BS" is considering majoring in biology, chemistry, mathematics, physics, or meteorology, while another cadet who is "Undeclared-H" is planning to study languages, fine arts, international studies, history, or philosophy.

This recommendation follows the literature on implementing meta majors to reduce college attrition. Using students' interests as a starting point, meta majors organize aca-

Figure 7
Chord Diagram of Major Flow by STEM Major



demic programs broadly, creating general areas of interest that allow students to complete coursework in these areas before they decide on a more specific major or program of study (Schudde et al., 2020; Waugh, 2016). For USAFA, having additional insight into cadet major intentions fills knowledge gaps and may help track STEM-interested cadets beginning to struggle in quantitative courses and who may never declare STEM.

On a related topic, although discouraged, USAFA cadets can declare a major at any point during their first year or the first semester of their sophomore year and can switch majors at any time. In fact, the researchers noted several multi-switchers over a single semester. USAFA may consider a restricted timeline for declaring and switching majors similar to the U.S. Naval Academy, where cadets declare majors in March of their freshman year and should not switch majors until after the drop date in November of their third semester, except on a case-by-case basis (Dr. Carl E. Mungan, personal communication, 27 July 2022; U.S. Naval Academy, 2022). This strategy assures cadets complete some sophomore-level courses in their original major before switching and avoids impulsive major changes.

A strong flow of cadets from majors with more required mathematics courses to majors with fewer ones was identified in the dataset, consistent with findings by Bressoud (2021), Daugherty and Lane (1999), Nuñez-Peña et al. (2013), and Perry (2004). Despite an attempt to separate the role of mathematics and non-STEM courses in STEM attrition via various Sankey diagrams, it is difficult to determine whether the identified major flow is a

Figure 8

Number and Percentage of STEM Departers by Non-STEM Destination Major

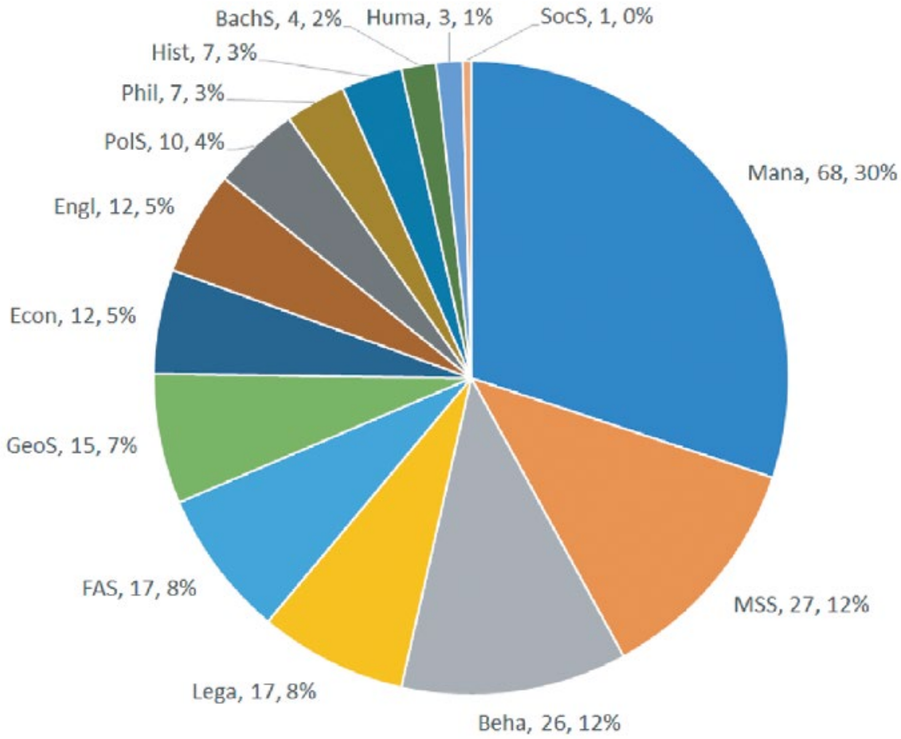


Figure 9

Cadet Flow for Biology Majors

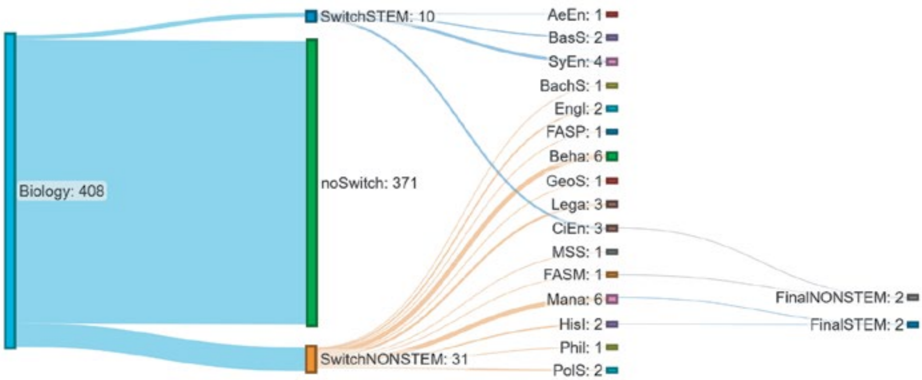


Figure 10

Cadet Flow for Civil Engineering Majors

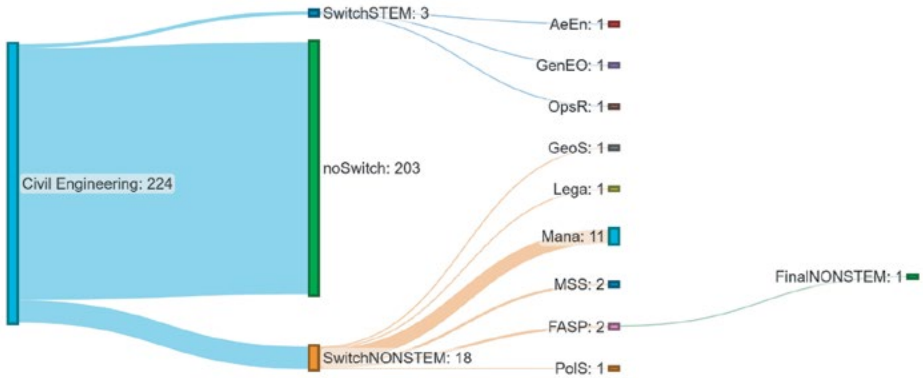


Figure 11

Cadet Flow for Computer Science Majors

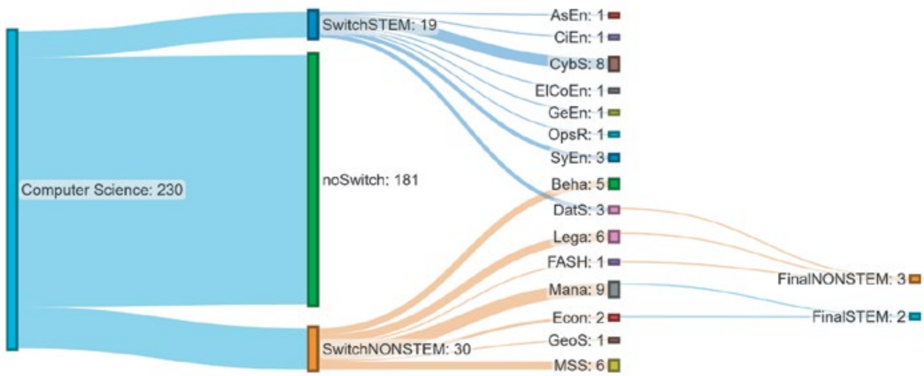


Figure 12

Cadet Flow for Cyber Science Majors

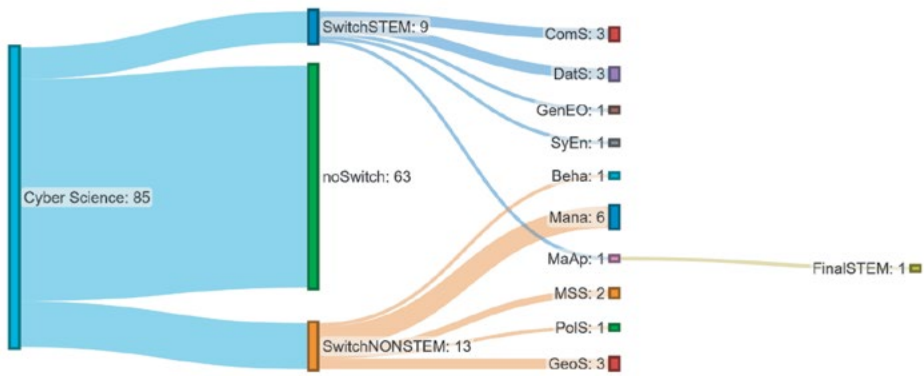


Figure 13

Cadet Flow for Data Science Majors

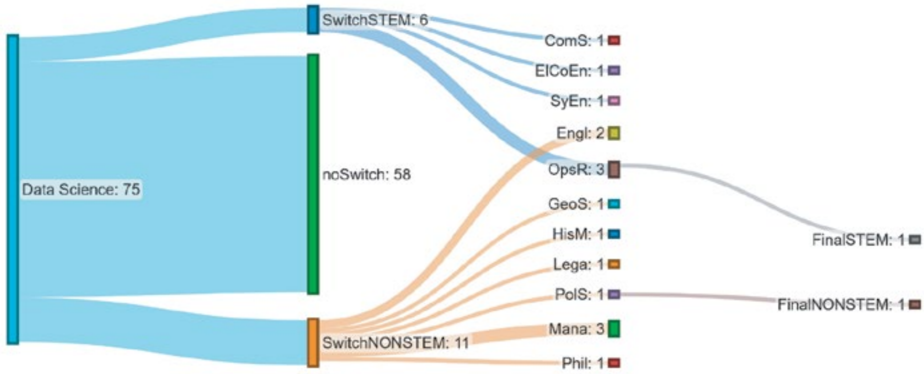


Figure 14

Cadet Flow for Systems Engineering Majors

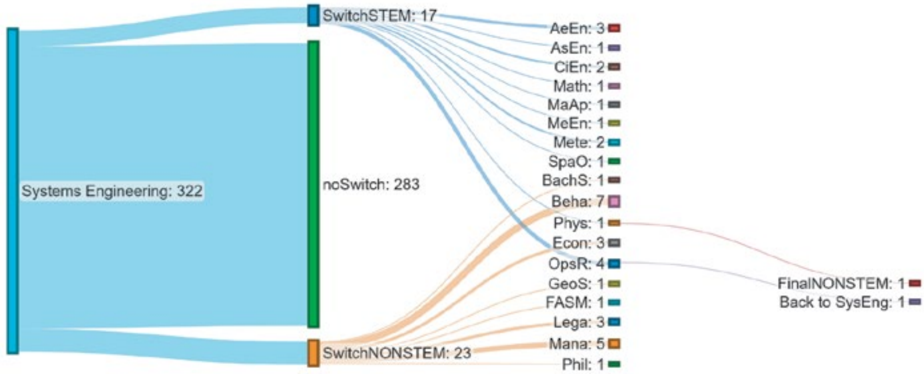
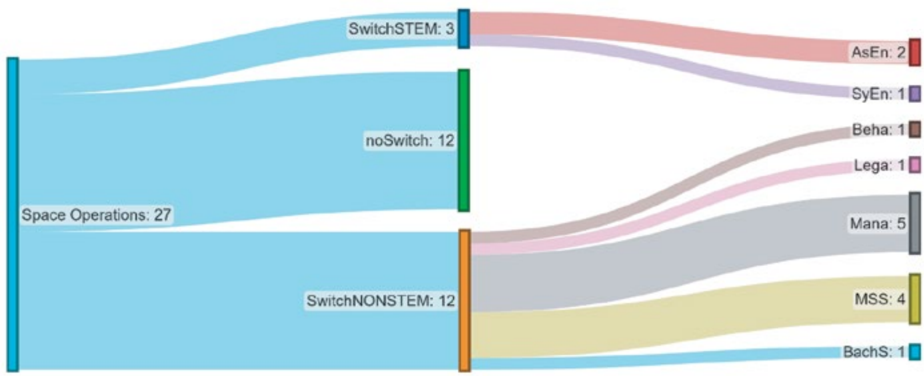


Figure 15

Cadet Flow for Space Operations Majors



causation or a correlation with performance in mathematics, disenchantment with STEM majors, cadets trying to maintain the highest GPA possible, as proposed by Sjoquist and Winters (2015) and Wright (2018), or other factors (Dwyer et al., 2020).

Since it is difficult to disentangle the roles of mathematics, pressure to keep a strong GPA, and changes in career interests in the dataset, two recommendations are proposed. Cadets, like many college students, may have low self-efficacy associated with their mathematics proficiency and may think the solution is to avoid mathematics. A possible answer may be to do the opposite, by having USAFA help cadets further develop their quantitative reasoning by increasing the required mathematics courses for all majors to at least four, plus two additional quantitative science courses. This would be consistent with sister institutions like the U.S. Naval Academy, which requires Calculus I, II, and III, with a fourth mathematics course that could include differential equations or data science (Dr. Carl E. Mungan, personal communication, 27 July 2022). For USAFA, in addition to Calculus I and II, it is recommended for cadets to complete Calculus III and Differential Equations, as well as Chemistry II and Physics II.

Additionally, increasing the number of required quantitative core STEM courses would help cadets who switch between STEM majors, as sometimes cadets have limited options based on majors' requirements. For instance, civil engineering and biology are the only two STEM majors requiring Chemistry II and Biology (i.e., without the option to take Physics II), and these two STEM majors have also experienced some of the highest ratios of STEM departures. Further, for biology students, the three required mathematics courses would not be enough to transfer to most other STEM majors, so non-STEM might be the cadets' only viable alternative.

Given the previous recommendation, the space operations major deserves a more detailed analysis because, despite requiring Chemistry II, Physics II, and four mathematics courses, including Differential Equations (but not Calculus III), it has the highest percentage of major switches per capita and one of the higher flow ratios out of STEM. It is likely the elevated level of STEM attrition may be attributed to a curriculum misalignment within the space operations major. Since the USAFA course of instruction indicates that "prior completion of Calculus III is strongly recommended" (USAFA, 2021, p. 343) for Differential Equations, space operations should require Calculus III to introduce cadets to multivariate calculus concepts used in Differential Equations.

Furthermore, it is recommended for USAFA faculty to collaborate with those associated with the academy's Scholarship of Teaching and Learning Research Center to develop exit-interview protocols that can be used in short, focus group sessions with cadets who go from "Undeclared-BS," "Undeclared-E," and declared STEM majors to non-STEM majors. By obtaining firsthand knowledge of the reasons why cadets move into non-STEM majors, USAFA can design and implement interventions, such as focusing on academic support in mathematics or career and vocational advising.

Since it is known that STEM-interested first-year cadets may struggle with quantitative core courses, the last recommendation takes advantage of the recent implementation of virtual course options at USAFA and the emerging opportunities for dual credit in high schools nationwide. For STEM-interested high school students accepted into the academy before December of their senior year, a liaison between the high school and USAFA can coordinate for these students to remotely complete two spring semester USAFA non-STEM courses through learning management systems like Moodle and Blackboard. These courses will be selected so that they also fulfill the high schools' requirements.

The selection of two non-STEM courses for high school dual credit was purposeful. Compared with non-STEM curricula, the heavy course load and fast pace of the first-year STEM curriculum often causes academic struggles, frustration, and discontent for students, especially incoming first-year cadets with significant difficulties with mathematics (Romash, 2019; Seymour & Hunter, 2019). Alternatively, offering one non-STEM class and Math 130 (algebra and trigonometry) as dual credit could be considered to help cadets in reinforcing skills necessary for success in the technical core. Regardless, completing two USAFA courses before cadets arrive at USAFA will result in a reduced course load as freshmen, freeing up extra time to invest in core STEM courses for their expected STEM majors. This recommendation would also apply to military academies or other programs with strict graduation timelines. To ensure that STEM-interested cadets who complete the proposed dual credit opportunity invest their extra time studying for classes, USAFA could require adding a mandatory pass/fail STEM study hall class to its schedule, scheduling extra instruction meetings with instructors, or attending the academy's quantitative reasoning center in the evenings for a certain number of hours. Pushing these courses to virtual delivery for high school students is not without risks, as course structure and delivery might not be conducive for student success; future studies in this area are recommended.

Conclusion

The purpose of this project was to better understand the nature of major switching among cadets, particularly those who switched from STEM to non-STEM majors, as well as those majors where STEM attrition occurs more frequently. This information is critical to addressing STEM attrition at USAFA or other universities.

The first two research questions asked to what extent cadets who change their original major become STEM persisters, non-STEM persisters, STEM departers, and STEM arrivers. Of 738 cadets who changed majors, 38.1% were STEM persisters, 28.3% were STEM departers, 27.5% were non-STEM persisters, and 6.1% were STEM arrivers. The ratio of STEM departers to arrivers is almost 5 to 1.

The third research question inquired which STEM majors experienced the most and least attrition. In terms of the raw number of cadets, the top three STEM majors where cadets switched to non-STEM the most were biology, computer science, and aeronautical engineering. The top three STEM majors where cadets switched to non-STEM the most per capita were cyber sciences, data science, and computer science. The three STEM majors where cadets switched to non-STEM the least (by raw numbers) were meteorology, data science, and civil engineering. The three STEM majors where cadets switched to non-STEM the least per capita were mechanical engineering, meteorology, and astronautical engineering.

The last research question asked which factors may explain STEM attrition. It was found that most cadets who declared a STEM major either persisted in that major or switched to a different STEM discipline. This is consistent with previous studies showing that STEM attrition occurs the most while cadets have not declared a major and are completing core quantitative courses. Looking at math requirements and major specificity, math requirements appeared to account for a considerable proportion of major flow out of STEM majors. It may be helpful to analyze whether these observed trends are present at other service academies or universities. Further mixed-methods research, like focus groups or surveys, may be able to untangle these variables at USAFA and their association with maximizing GPA.

Several recommendations were proposed to gain insight about undeclared cadets' preference for STEM or non-STEM, strengthen math proficiency across the board, reduce the course load of first-year STEM-interested cadets through virtual instruction prior to matriculation, and interview cadets to obtain first-person accounts of factors that contributed to STEM attrition. These recommendations would apply to other service academies with strict four-year timelines.

One of the limitations of this exploratory study was that it only provided the most complete picture regarding major switching for upperclassmen, who are represented in all three academic years. One new area of research that could expand the literature on STEM attrition at military institutions would be to look at the major flow of cadet cohorts over their four years at USAFA. Another new area of research could be the design, implementation, and evaluation of a pilot dual-credit collaboration with a small number of high schools to measure the impact of a reduced course load of STEM cadets on their GPA and persistence in STEM. This pilot study could also identify and resolve issues related to coursework equivalency and the academic support of incoming cadets while still at their high school of origin.

Acknowledgments

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Good Governance Introduction Course

A Dutch Example of Online Constructivist Officer Education

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Abstract

Various perspectives, different interpretations, and uncertainties often make military operations multidimensional and fuzzy. Recent research shows that officer cadets find it difficult to cope with such military operational settings. Consequently, there is a need for a learning theory to deal with such complex situations during military operations. With its multidimensional worldview, constructivism can provide that learning theory. Furthermore, due to the advantages of online learning catalyzed by the COVID-19 pandemic, the usage of online education is growing. That leaves us the general question of how we can adequately provide online constructivist education to officer cadets and officers. Therefore, we sought answers to two specific questions. Firstly, what is a suitable instructional design method to enable online constructivist learning? Secondly, how can we use such an instructional design method to create an online constructivist course for officers? To this end, we examined the online constructivist courses of an educational program for physicians in training at the Academy for Postgraduate Medical Education of the Maastricht University Medical Centre+. We then used the instructional design underlying those courses to create an online constructivist course for officers at the Civil-Military Interaction Command of the Royal Netherlands Army: the Good Governance introduction course (Good GOV course). We described per phase the learning activities, including some examples of questions and assignments. The design of the Good GOV course shows how the military can employ an instructional design commonly used in another field to improve military education. Further exploration and research are required to answer the question of how military education can reap the benefits of learning sciences and take advantage of the learning experiences of other professions and organizations.

Uruzgan, Afghanistan, 2009. Dutch military forces operate in this area as part of the multinational Provincial Reconstruction Team Uruzgan under Dutch command. Kitzen (2019) defines the objective of the provincial reconstruction team as “enhancing stability by promoting good governance and facilitating reconstruction” (p. 46). Some parts of the population favor the foreign military forces and their plan of strengthening and consolidating the Afghan government. However, other parts of the population resist openly or covertly. The Dutch armed forces must make contact, negotiate, and cooperate with both the leaders of the Afghan people in Uruzgan and the representatives of numerous domestic and foreign organizations. Consequently, the Dutch armed forces must manage many different actors simultaneously; among others, government officials, staff members of nongovernmental organizations (NGOs), tribal leaders, and informal power brokers. All have their often unspoken opinions about religion, culture, ethics, constitution, and society. That makes the operational situation multidimensional, nebulous, and dynamic. With each new development and every next step, Dutch officers must decide on their way forward. Can they construct a consistent and workable picture of the operational situation? Can they stay connected with all local stakeholders? Can they accomplish good governance to achieve the objective of the provincial reconstruction team?

Elahi (2009) defines governance as “the processes and structures that guide political and socio-economic relationships” (p. 1170). Military operations involving good governance are complex. After all, there are multiple ways to look at a versatile situation involving uncertainties. The perspective and interpretation can vary with the person, discipline, interests, and time. Various perspectives and interpretations can lead to other decisions. Other decisions can, in turn, lead to different actions. The choice for specific activities self-evidently influences the outcome of a military mission. That is why awareness of possible perspectives and interpretations and the competence to deal with them adequately in the decision-making process are of great interest to officers.

Nevertheless, recent research by Jansen (2019) shows that officer cadets struggle with precisely that issue. Officer cadets find it difficult to cope with situations that involve multiple perspectives and uncertainties. Consequently, as Hornstra (2021) previously advised, officer education should benefit more from the learning theory that is most suitable for learning how to handle those multidimensional and fuzzy situations. That learning theory is constructivism.

Constructivism as a learning theory states that learners actively construct their own knowledge. Socioconstructivism underscores the social element in this learning process: learners coconstruct knowledge with their peers and teachers (Harasim, 2017). As a result, constructivism takes a fundamentally different position than the other major learning theories: behaviorism and cognitivism. In brief, behaviorism views learning as establishing the right stimulus-response reactions in learners. Cognitivism, on the other hand, regards learning as the processing of information in the mind of the learners (Harasim, 2017).

Constructivism is based on a world view open to various perspectives and interpretations (Ertmer & Newby, 2013). This world view has considerable consequences

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for the role of the learner. Rather than passively receiving information, learners must construct their own viewpoints based on the multiple perspectives and interpretations presented to them or found by them (Bower, 2017). In the view of constructivism, the role of the teacher changes as well. Rather than the traditional transferring of information from teacher to learners, teachers need to establish the conditions for learners to construct knowledge themselves (Bruner, 1990). Accordingly, here we consider, as Ertmer et al. (2013) suggest, constructivist learning is a process in which learners actively and socially construct knowledge by testing and applying ideas in solving real-world problems.

Constructivism has been around for many years. Moreover, educators have applied constructivist learning principles to adult education and online learning for almost as many years. In what way does the design of online constructivist officer education contribute to our understanding of education in general and in the military context in particular?

For education in general, incorporating constructivist learning principles in instructional design remains intricate. Constructivism is an ambiguous concept by nature. Constructivism includes many different theoretical views and interpretations (Harasim, 2017; Phillips, 1995). Because of this, many educators are unsure on what specific theoretical basis they should start designing constructivist education. Over the years, many claimed that constructivism as a learning theory does not automatically result in instructional design (Karagiorgi & Symeou, 2005; Mayer, 2009; Savery & Duffy, 1995; Tam, 2000). Educators may thus experience difficulties translating the learning theory of constructivism into actual instructional design.

For military education, the value of constructivist learning is ever more acknowledged (Bannan et al., 2020; Ellis et al., 2021; Sookermany, 2017). After all, a singular worldview, with its lack of different perspectives and interpretations, does not do justice to the complex circumstances of a modern military mission. Nevertheless, at a military academy, such a singular world view can still dominate the educational approach (Jansen, 2019). To prepare officer cadets for their future job in which they have to cope with multiple world views with inconsistencies and uncertainties, Hornstra (2021) recommends incorporating constructivist learning principles at a military academy where applicable. However, he points out that in the military context, educators must figure how to design instruction based on that ambiguous concept of constructivism.

Additionally, due to the advantages of online learning, the usage of online education is increasing. This transition from offline to online education has in many places been catalyzed by the current COVID-19 pandemic. From a practical point of view, online (i.e., location-independent) education eliminates travel costs, facilitates scheduling, and is risk-free concerning COVID-19. From early 2020, distance learning has become more common in the U.S. Army (Kenyon, 2020). Concerning education in the Netherlands, a similar development has taken place (Van der Spoel et al., 2020).

In short, there is a need for constructivist education for officer cadets and officers. Educators may face challenges in designing such constructivist education, as there is an increasing emphasis on online education. This leaves us the general question of how we can provide adequate online constructivist officer education. To this end, we sought answers to two specific questions in this article. First, what is a suitable instructional design to enable online constructivist learning? Second, how can we use such instructional design to create an online constructivist course for officers?

The U.S. Department of the Army (2017) recommends using the insights of learning sciences to implement innovative instructional methods. Bannan et al. (2020) recently made the same recommendation in this journal. Regarding innovative instructional practices, what can the military learn from other organizations with a similarly high level of professionalism? Like officers, physicians must meet high standards of professionalism (Kirk, 2017). Therefore, the instructional design used at an academic medical center could be promising to explore for military use. In other words, what can the military learn from an academic medical center about online constructivist learning?

In the following sections, we briefly discuss the role of constructivism in medical education. We then describe the instructional design of online constructivist courses of an educational program for physicians in training. Lastly, we apply that instructional design to create the online constructivist Good Governance introduction course (Good GOV course) for officers working at the Civil-Military Interaction Command of the Royal Netherlands Army.

Online Constructivist Course for Physicians in Training

For many years, constructivism played an essential role in medical education (Dennick, 2016). After all, medical disciplines typically produce various perspectives and interpretations on medical situations (Elshamy, 2017). Common instructional methods in medical education, such as portfolio development, have emerged from constructivist learning principles (Mukhalalati & Taylor, 2019).

The learning principles of constructivism are thus commonplace in medical education. For that reason, we examined a specific educational program for physicians in training at the Academy for Postgraduate Medical Education of the Maastricht University Medical Centre+ (Maastricht UMC+) in the Netherlands. In this educational program, in which two educational researchers (SH and WvM) are involved, physicians in training learn generic (i.e., nonmedical) competencies. Good physicians are not only medical experts; they also need to have generic competencies associated with roles such as scholar and manager (Frank, 2004).

For example, in the multicultural healthcare course in this educational program, physicians in training learn to view end-of-life care from various views to make well-founded medical treatment decisions for individual patients. Such a course is about collaborating with others, exploring multiple perspectives and interpretations, developing individual points of view, and learning to solve authentic problems in meaningful contexts. According to the insights of Ertmer and Newby (2013), a course such as this multicultural health-care course contains the characteristics of constructivist education. Additionally, due to COVID-19, the mentioned educational program saw a significant increase in the use of online education. The necessity to design online constructivist courses for the physicians in training led to the flexibility-activity framework of Collis and Moonen (2001). In the following sections, we elaborate upon applying this instructional design model at the Maastricht UMC+.

Educationalists of the Maastricht UMC+ used the flexibility-activity framework of Collis and Moonen (2001) to design online constructivist courses. The instructional design of Collis and Moonen (2001) is a web-based pedagogical framework with two parameters: flexibility and activity. They assess learning environments by the degree of flexibility regarding location, time, and content. They also categorized learning environments by the goal of the activity. Participants can either acquire knowledge or contribute knowledge. Collis and Moonen (2001) consider education a learning cycle with three phases: before, during, and after a focal event. To meet the learning needs, the degree of flexibility and contribution varies per phase.

Within the educational program for physicians in training, the practice of the three phases is as follows. In the before phase, the participants prepare themselves at their own pace and in their own way for the focal event. In this phase, flexibility is high, and the participants mainly acquire knowledge. Typical activities in the before phase include looking for relevant literature and other sources, exploring theories and models, and discussing.

During the focal event, the flexibility strongly diminishes. At a set point in time, the participants learn predetermined knowledge and complete preplanned assignments. The focal event starts with the participants acquiring knowledge, but the emphasis shifts to contributing knowledge. For participants, this often means attending a lecture or watching an instructional video, followed by working together on real-life cases.

In the after phase, the participants work on follow-up activities. The flexibility increases considerably. In this phase, the emphasis is still on contributing knowledge. At their own pace and in their own way, the participants focus on learning activities such as studying additional materials, discussing with each other, continuing working together on real-life cases, and reflecting on the learning process and learning results.

The flexibility-activity framework of Collis and Moonen (2001) clearly offers an instructional design method that can be used for online constructivist style classes. This framework encourages active and flexible learning where the teacher is a monitor and guide to the learning process.

The research on the effectiveness of these newly designed online constructivist courses has yet to start. However, the two involved researchers (SH and WvM) feel that the experiences of the teachers and participants are encouraging. We observed that the teachers see the desired competence development in the participants. Furthermore, after finishing a course, the participants evaluate the learning process and results informally and qualitatively in a positive way. And finally, we see that the participants rate the newly designed courses as good to very good.

These experiences with the framework of Collis and Moonen (2001) at the Maastricht UMC+ seem to indicate that this instructional design model may also be a good candidate for the design of an online constructivist course for officers.

The Design of an Online Constructivist Course for Officers

In the Civil-Military Interaction Command of the Royal Netherlands Army, there is a need for a Good GOV course, especially for (but not limited to) civil-military cooperation (CIMIC) functional specialists. Due to multidimensional military operational settings and the necessity of location-independent education, this introduction course must be constructivist by nature and online. That is why we applied the flexibility-activity framework of Collis and Moonen (2001) examined above to create the online constructivist Good GOV course.

The learning objectives of the Good GOV course are to get a general overview of the NATO CIMIC doctrine (NATO, 2018), to gain insight into the theoretical framework of good governance of this NATO doctrine, and to learn to apply the element of good governance of the doctrine to actual military situations. Three researchers (SH, PN, and JH) designed this course according to the three-phase flexibility-activity framework of Collis and Moonen (2001). In the following sections, we detail the before phase, the focal event, and the after phase of the Good GOV course. All learning activities will take place in a protected online learning environment.

Before Phase (Preparation for Class)

In the before phase, the focus is on flexibility and knowledge acquirement. The flexibility concerns location, time, and content. The participants search for literature about civil-military interaction (CMI), CIMIC, governance, and good governance. They refer to self-found online publications, where they explain why these publications are good sources on the subject. Subsequently, we provide references to online publications, among others, Allied Joint Publication 3.19, *Allied Joint Doctrine for Civil-Military Cooperation* (NATO, 2018). Participants look up, think about, and discuss definitions, assumptions, principles, theories, and models concerning CMI, CIMIC, governance, and good governance. Herein, analysis methodologies such as PMESII (political, military, economic, social, information, infrastructure) and ASCOPE (areas, structures, capabilities, organizations, people, events) play a crucial

Table 1
The Before Phase of the Flexibility-Activity Framework of Collis and Moonen (2001) Applied to the Good GOV Course

Phase	Learning activities of participants	Questions and assignments
Before phase	1. Searching for literature 2. Referring to self-found online publications 3. Studying self-found literature 4. Explaining the quality of self-found literature 5. Studying requiered literature	a. Add a reference to a new source on good governance and substantiate why you think this reference is of added value. b. What is the interpretation of NATO regarding good governance? What do you think of this interpretation? Argue why you think this interpretation is too broad or too narrow. What elements could you add to this interpretation? If necessary, use information from your references. c. What are the strengths of the PMESII model? What are the weaknesses of the PMESII model? And what about the ASCOPE model? What are its strengths and weaknesses? Which model do you prefer? Explain your preference.

role. This way, the participants get to know different perspectives and form their own opinions. In Table 1, we list the learning activities of the participants. We also include some questions and assignments typical of the before phase.

Focal Event (Class)

During the focal event, we reduce the flexibility in time and content. In addition, the focus shifts from knowledge acquirement to knowledge contribution. Again, we refer to online publications such as "Good Governance & CIMIC. A CCOE Fact Sheet" (Civil-Military Cooperation Centre of Excellence, n.d.). The participants look up, think about, and discuss the usability and practical relevance of different analysis methodologies for military operations. The participants also reflect on their role and responsibility in military missions. Then, two experts in civil-military cooperation both give a live lecture about CIMIC, CMI, governance, and good governance. These experts also provide feedback on the results of the previous assignments.

Table 2
The Focal Event of the Flexibility-Activity Framework of Collis and Moonen (2001) Applied to the Good GOV Course

Phase	Learning activities of participants	Questions and assignments
Focal event	1. Studying required literature 2. Discussing required literature 3. Reflecting on their own role and responsibility 4. Attending required lectures 5. Applying guidelines and models to real-life cases 6. Clarifying their own role and responsibility	a. Select a current crisis area together with another participant. Perform analysis with the ASCOPE model. You can leave unknown elements open or fill them in fictitiously. b. What are crucial success factors to accomplish good governance in a mission area? How do you respond to this during a mission? c. Based on your expertise, what contribution can you make here to good governance?

The questions and assignments during the focal event are less flexible regarding the content. The participants need to work with provided references to online sources. The emphasis is increasingly on knowledge contribution; that is, applying guidelines and models to actual operational situations, and further, clarifying their role and responsibility. Again, the participants learn different perspectives and form their opinions. However, this time they act on their views too. In Table 2, we describe the learning activities of the participants. We mention some questions and assignments typical of the focal event as well.

After Phase (Completion of Class)

In the after phase, the focus is again on flexibility (location, time, and content) and knowledge contribution. The participants apply their new knowledge, skills, and attitude to real-life cases. Herein, they must detail their approach and role concerning good governance in a military operational setting. Furthermore, the participants collaborate and give each other feedback. The final assignment is about reflection. In this assignment, the participants describe an authentic case from military practice, their approach before the Good GOV course, and their approach afterward. The difference between

Table 3
The After Phase of the Flexibility-Activity Framework of Collis and Moonen (2001) Applied to the Good GOV Course

Phase	Learning activities of participants	Questions and assignments
After phase	1. Applying new knowledge, skills, and attitude to real-life cases 2. Detailing their own approach and role 3. Collaborating with peers 4. Giving feedback on contributions of peers 5. Describing an authentic case, and reflecting on their own approach before the course, and their approach afterward 6. Providing feedback on reflection to peers	Describe a military operational setting from your experience concerning good governance. In this reflective assignment, explain how you would have done it before and how you would do it now, and explain the difference (maximum 1000 words).

their approach before and after the course makes the individual learning output explicit and visible. Regarding the final assignment, each participant provides extensive feedback on the work of at least one other participant. In Table 3, we describe the learning activities of the participants. We also mention an assignment typical of the after phase.

Discussion

We designed an online constructivist learning environment about the military knowledge domain of good governance using an instructional design already practiced in the medical field. The design of the Good GOV course is based on the three phases of the flexibility-activity framework of Collis and Moonen (2001). Under the guidance of a teacher and in collaboration with other participants, all the participants must construct their view on reality and take their position, based upon many perspectives, interpretations, and uncertainties, and solve real-life problems.

The actual design of the Good GOV course was the necessary first step. The stages that must follow are the technical implementation, running, and evaluation of the effectiveness of this course. In the following sections, we share some thoughts about evaluating military education.

We suggest using the four levels of evaluation model of Kirkpatrick and Kirkpatrick (1994) to evaluate military education. First, at level 1, we evaluate the participants' experience with a course. At level 2, we evaluate the participants' performance within the educational setting. Further, at level 3, we evaluate the participants' performance in the military operational setting. Finally, at level 4, we evaluate the extent to which the course contributes to the objectives of the military operation.

The evaluation of education is often limited to level 1 (e.g., did the participants appreciate and value the intervention) and level 2 (e.g., did they succeed in showing the desired performance in class). Although it is relevant to include these two levels of evaluation, it is essential to transcend these lower levels. In the end, it matters the most whether the participants can apply the new knowledge, skills, and attitude in an authentic setting (level 3) and whether a military operation benefits from that (level 4). The evaluation of military education, including the Good GOV course, should cover all four levels of evaluation of Kirkpatrick and Kirkpatrick (1994).

Conclusions and Recommendations

Online constructivist officer education is an advantageous instructional strategy to prepare officer cadets and officers for their demanding jobs. The design of the Good GOV course, as an example of online constructivist officer education, shows how the military can employ an instructional design commonly used in another field to improve military education. Further exploration and research are required to answer the question of how military education can reap the benefits of learning sciences and take advantage of the learning experiences of other professions and organizations.

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A Combined Project Management and Operations Management Course

Integrating the Two Disciplines to Better Teach Officers and Officer Candidates

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Abstract

Military officers must be skilled managers of the day-to-day operations they lead. Officers will also lead projects as part of their military duties. Although project management and operations management are separate business/management disciplines, we propose integrating the two areas. Traditionally, project managers are concerned with delivering a unique solution on schedule, within budget, and within quality and performance specifications. Operations managers concern themselves with effectively and efficiently converting inputs into products or services that meet quality and performance specifications to deliver to customers continually. We argue that discussing these disciplines in isolation is a disservice.

Both project management (PM) and operations management (OM) knowledge and skills are highly desired by the U.S. Air Force and the U.S. Space Force. As part of the graduation requirements for the U.S. Air Force Academy (USAFA) management majors, students must take either an introductory PM course or an OM course. Requiring officer candidates to take both courses is considered excessively difficult given all their other academic and military requirements, despite recognizing that exposure to both disciplines is optimal. To this end, the management department at USAFA directed a search for a course that would expose learners to both disciplines. A literature review revealed little that combines OM and other management disciplines (Pal & Busing, 2008) and even less that combines PM and OM. Many OM textbooks have a chapter on PM, but most PM textbooks do not address OM at all (Maylor et al., 2008).

Since nothing was readily available to develop a combined course, we needed to conduct further research in the management body of knowledge. In addition, we needed to generate new constructs and create a combined course in-house.

In researching the course construct, we found literature stressing the importance of integrating both knowledge areas. For example, Maylor et al. (2018) decried the absence of integration but did not address how to integrate them. We found no literature that addresses how to integrate the knowledge areas, so we created our own construct (see Table). We chose appropriate PM and OM topics and generated integration points (connection column in Table). We designed a course describing the benefit and efficacy of integrating both topics.

Military Need for PM and OM Knowledge

Ongoing military modernization requires soldiers to constantly change tactics, techniques, and procedures to optimize combat effectiveness (Topolski et al., 2010). Knowledge of OM is essential for leaders to make these changes successfully. Leaders with knowledge of OM processes and tools can more easily integrate the new capabilities for effective and efficient military operations.

Numerous military officers become maintenance officers (maintenance operations managers) every year. The military's aging fleets require increased attention, and operational units still demand high availability. To match scarce resources with increased demand, these officers must be well-versed in operations topics like continuous process improvement and operations scheduling techniques. Additive manufacturing (or 3D printing) may help with the availability of rare spare parts, but the officer leading the project to incorporate this new method for meeting requirements would benefit from PM knowledge.

When warfighters identify a new requirement in military operations, the military requires officers with PM knowledge to successfully execute a project to meet the new requirement. Whether operators need a new weapon system or simply a change in their operations, PM knowledge, processes, and tools are vital to delivering a unique solution on schedule and within budget that meets quality and performance specifications. As shown in the Table, when the operations side identifies a continuous process improvement project or a product development project, personnel must know the basics of program management to develop that solution.

Every year, numerous military officers become acquisition professionals. They often become project managers who must lead their organization with ever-increasing requirements and constrained resources while committing to a timeline. The officers must thoroughly understand project management topics like proper scoping, communicating, budgeting, scheduling, executing, monitoring, and controlling. As shown in the Table, when the project management side builds and tests prototypes or preliminary units, PM personnel must know operational processes and capabil-

Table
Connections for Integration

Connections Observed in Diagram of Processes		
Origin	**Connection**	**Insertion Point**
Business Development to/from OM Planning [4]		
Business Development*	*Cost Benefit Analysis*	*Financial Feasibility*
Business Development	*Location and Plant Capacity*	*Capacity Planning*
PM Planning to/from OM Facilitating [3]		
Risk Mgt	Initial Risk Analysis	Scope Statement
Continuous Improvement [2]	New Project?	Project Initiation
PM Planning to/from OM Facilitating [2]		
Risk Mgt	*Ongoing Risk Analysis*	*Risk Mgt*
PM Execution to/from OM Planning [6]		
Capacity Planning	*Plant Capability*	*Conception Definition*
Product Design	*Design for Manufacturability*	*Concept Definition*
Product Design	*Design for Manufacturability*	*Analysis and Design*
Build and Test	*Prototype on Production Equipment*	*Process Selection*
Build and Test	*Run at Rate on Production Equipment*	*Capacity Planning*
*Italics indicates a bidirectional connection		

ities to ensure the solution meets the operational requirements. OM knowledge is critical in this situation.

Even more critical than OM or PM knowledge alone is the integration of the fundamentals of OM and PM. We envision a more significant organizational advantage with officers who understand how processes like ongoing risk analysis and design for manufacturability (to mention a few) are connected in the project and operational management effort. Leaders and project managers who understand how PM and OM are integrated and when coordination is needed between the two disciplines can better contribute to organizational success.

Literature Review

Since this research effort is a project, we followed PM processes. *A Guide to the Project Management Body of Knowledge* (*PMBOK Guide*; Project Management Institute, 2017) points out that project planning processes allow us to focus our thoughts by creating a scope definition and scope control. We narrowed the scope to the steps needed to research the intersection of PM and OM, produced a 40-lesson course, and published the research.

The PMBOK Guide (2017) describes how the project planning process helps with discovery. Focusing on the process that breaks down the deliverables, we identified the research and thought progression needed to achieve them. Finally, we used an iterative process that allowed flexibility to refine summary tasks while meeting the completion date milestones to meet deadlines for course implementation.

The literature review was a natural consequence of the discovery phase. The initial review focused on existing PM and OM textbooks. A significant discovery was that there are no combined PM and OM textbooks; readings for the course would require at least two sources to address both topics. The review of journal articles revealed numerous authors who stressed the need for integrating OM teaching with other relevant subjects (Lovejoy, 1998; Maylor et al., 2018; Morgan et al., 2008). Sobek et al. (1998) describe how the Japanese industries achieved success by integrating product design, manufacturing processes, and other business functions. Also, textbooks such as *Operations Management in the Supply Chain* (Schroeder & Goldstein, 2021) emphasize cross-functional material and the importance of integrating decisions across business functions. Multiple additional articles allude to advantages of teaching PM and OM in a more integrated manner (Goffin, 1998, Pal & Busing, 2008). However, none of the articles offered recommendations on how to integrate the disciplines.

Project metrics should facilitate successful operations. We demonstrate the need for project managers to have PM and OM knowledge and skills with the following example. A project was "successfully" completed (i.e., met its goals), but the operation that necessitated the project experienced avoidable issues. Maylor et al. (2018) write about the disconnect between PM and OM at Terminal 5 of the London Heathrow

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Airport, which lost thousands of pieces of luggage in the opening months of service. The authors describe the PM side as "extremely successful" regarding the cost and timing of the deliverables. The problems occurred in transitioning the physical deliverables to ongoing airport terminal operations. The critical lesson learned in this instance was that the project success metrics should have included "effective start-up and sustainment of operations" (Maylor et al., 2018, p. 1276). Razak et al. (2020) discuss other failed projects due to inappropriate knowledge and coordination between PM and OM personnel. This further stresses the importance of a project manager who understands issues that may arise in the OM phase.

Organizations realize the importance of projects within their operations and know they need to take better advantage of PM knowledge and skills (Ravinder & Kollikkathara, 2017). Most undergraduate students in business are only exposed to PM education in the singular chapter of their introductory OM course (Maylor et al., 2008). Ravinder and Kollikkathara (2017) remind us that OM courses often need to pay more attention to the human skills required to be a successful project manager. Nixon et al. (2012) write explicitly about how the shortcomings in PM education impact employees' skills and knowledge. Schilling and Hill (1998) stress the importance of organizations' effectiveness in product development projects and the efficacy of the operations designed to deliver the product to the customer. Finally, Maylor et al. (2008) describe how the volume of operations work, accomplished as a project deliverable, is significant and continuously growing; OM personnel must know how to plan, execute, evaluate, and complete these projects for maximum benefit to the operation and the organization.

Approach

Construct for Connections and Integration

To create an integrated PM and OM course, we had to develop a construct that clarified the connections between the two disciplines. We found literature regarding integrating the disciplines based on learning outcomes (Borrego & Newswander, 2010; Mathews & Jones, 2008; Svanström et al., 2008). We also found literature that elaborated on the efficacy of integrating a marketing course with a course in operations management by coordinating learning objectives, sequence of topics covered, and project assignments (Darian & Coopersmith, 2001; Pal & Busing, 2008).

We wanted to go beyond just sequencing the material. To that end, we connected the two disciplines and identified the critical relationships by more closely examining the integrated processes. We started with the diagrams of the Pocket PM Project Planning and Project Execution processes (Dudley, 2005). We then created an OM construct that combined most of the topics in the introduction to OM textbooks.

By organizing the OM topics into OM planning, OM execution, and OM facilitating processes, we were able to visualize natural coordinating points or intersections between the two disciplines, and we were able to find logical input-output relationships between them. The key that allowed us to start integrating the disciplines was identifying the greatest density of connections.

The connectivity between OM and PM processes is more evident when the project deliverables include establishing an ongoing operation. For example, projects leading to establishing a manufacturing line or opening a store, restaurant, or other ongoing operation have closer connections between the PM and OM processes. A military example would be the establishment of a new allied training squadron to support the sale of a new weapon system overseas. The stand-alone project that creates a one-of-a-kind deliverable is less critically intertwined with OM.

As previously stated, the key to beginning the integration of the disciplines was identifying where the greatest density of connections occurred. We reviewed the interconnections by inspecting the two sets of processes. As a result, we found connections to OM—beginning with business development and continuing in the PM planning phase—and ending with a greater density of interconnectivity in the PM execution phase (see Table).

We noted that the active interactions between the OM processes and business development are completed before the start of the project. This insight further emphasized that the greatest connectivity density between PM and OM is in interactions between the OM planning phase and the PM execution phase. It became apparent that PM execution is the primary input to OM planning. Sheremata (2000) alludes to this conclusion in his writing about problem-solving cycles in project development that entailed introducing cross-functional knowledge from other teams, including OM.

When examining projects that lead to ongoing operations, we sometimes found that the profit derived from the manufactured goods, or the ongoing operations far exceeded the project's cost. In these situations, the need for the project's success is more important than the project's cost may initially indicate. In reviewing the literature, we often observed the importance of the success of the product launched at the end of the project (Maylor et al., 2018). This observation contributed to the realization that the triad of cost, quality, and timing may not be the main criteria for success and that product/operation success must be considered. Morris (2013) concludes that the value of a project's true worth may be based on its ability to deliver results at the start of ongoing operations.

Course Design

The outcome of our research was to create an integrated PM and OM course at USAFA, which we describe below. We focus on the premise that everything we do for a military organization should provide an improved good or service already offered or plan and execute a new good or service to improve the mission. In the course we developed for our officer candidates, we emphasize the need to learn various concepts, processes, and tools to enhance the organization's projects and operations functions in a combined and integrated manner. The course offers opportunities for application and assessment through exercises, activities, exams, case studies, and a final project. After completing this course, no matter what job and organization an officer candidate receives, they will be able to analyze how the organization works and how to improve it. The challenge to the soon-to-be graduates is to use the concepts learned in this course during their military careers. Exposing students to both disciplines, especially in an integrated framework, enhances the probability of application of the skills and knowledge acquired in the course regardless of the officer's career field.

The purpose of the course vision is to develop future leaders who understand the benefits and application of OM and PM principles and use them in an integrated manner to improve their organization's processes. We achieve this by imparting an understanding of how OM and PM are integrated through their commonalities through the study of planning, process, quality, and analytical methods, all using real-world examples.

The course goals are described below:

1. Understand the planning and process side of operations and project management. Develop critical thinking skills necessary to analyze complex systems. Develop strategies for continuous improvement to achieve organizational goals.
2. Understand the quality side of operations and project management. Identify factors and root causes for problems and risks. Develop and recommend potential improvements.
3. Understand the analytical side of operations and project management. Develop methods of reliably assessing current operations. Verify improvements of process changes.
4. Participate in a workgroup scenario as a productive team member.

For the sequence of material, we choose to introduce topics as closely as possible to our framework connecting PM and OM topics that helped us create the Table. For the course's first lesson, we discuss the unique nature of an integrated PM and OM course. We introduce the officer candidates to the connections observed in the Connections for Integration Table (see Table). In the beginning block of the course, we include fundamental project planning and execution topics and choose to dedicate the first quarter of the course to teaching and assessing essential PM topics (see Appendix).

We split the remaining three-quarters of the course into the following three blocks: (1) operations planning, (2) operations execution, and (3) operations facilitating processes. We find it optimal to organize the topics of any introductory OM text into these three blocks. In these blocks, we often revisit the interconnectivity between PM and

OM that we identified when we integrated the processes (see Table). We highlight to the students every connection between the two disciplines (see Appendix).

Bradbeer and Porter (2017) discuss the importance of multimedia techniques in military education. We generate the officer candidates' critical thinking with multiple lessons and various media throughout the course. The students prepare a preliminary project planning document for adding new equipment to a small manufacturing organization in the PM block. We use an operations simulation exercise in the OM blocks to reinforce the digital text material. We challenge officer candidates to balance manufacturing contracts (demand) with the appropriate processes and throughputs (supply). We agree with Meinhart (2018) that we experience better student/instructor interactions when the students "take responsible ownership for their learning" (p. 83). The operations simulation exercise is ideal for this. In the competitive simulation, students make decisions for a clothing manufacturing business. Students willingly seek feedback from instructors to maximize their profit. Finally, using four case studies, we cause the students to exercise critical and creative thinking concerning capacity planning, quality control, inventory management, and lean analysis.

The combination of digital text, projects, simulation work, and case studies provides multiple methods of instruction for the students to learn. Williams (2020) states that instructors must enable students to connect with the learning, practice what they have learned, retrieve knowledge, and receive feedback from their instructors. All these forms of active learning are essential to "enhance classroom engagement of military learners," as described by Hamilton (2019, p. 3).

Lastly, since this is a course for officer candidates, we present military-specific examples of PM and OM to highlight the relevance of this material to the military experiences they can expect to encounter soon. The military topics we address in the course include the military acquisitions process, examples of risk management for special operations forces, military aircraft assembly/manufacturing, and Air Force continuous process improvement initiatives, as well as an introduction to the Military Logistics Agency and the United States Transportation Command.

Impact and Extensions

Developing a course that addresses PM and OM topics in isolation is a disservice to our officer candidates and our military. It is possible to create a course showing how interrelated the two disciplines are throughout business and military operations. Integrating PM and OM at the correct touchpoints is the solution to this dilemma. We want our officer candidates early in their business/management education to understand that operational results are not optimized by improving only OM and PM but also by integrating their linked applications to the mission. We demonstrate that project execution and operations planning have the greatest density of connections and that the linkage between these two disciplines is the product development process (PDP). We are careful not to overemphasize the PDP alone, as it could lead to suboptimization but rather to strive for a balance between the two main disciplines.

As we further improve the integrated teaching of OM and PM, we must continue investigating the PDP's role and importance. Research on the PDP may introduce and integrate even more disciplines, such as marketing, systems engineering, and design thinking. Cardinal et al. (2011) speak to the importance of project design concerning project performance. Verona (1999) points out that the PDP ties PM and OM processes together for product effectiveness. We are extending research into the PDP as an avenue to further contribute to PM and OM integration knowledge. We must be thoughtful and prudent in determining the best way to emphasize PDP in this critical officer candidate course.

Conclusion

This article states that PM and OM should be more closely aligned and integrated. At the management department of USAFA, we believe that military leaders should be exposed to both disciplines. Since more material was needed to teach a combined PM/OM course, we researched the management body of knowledge and generated a construct to build a course that combines them. Through this effort, we determined that more than just combining the disciplines was required: we needed to show the synergies of fully integrating the topics. We propose that officers who understand how both project management and operation management work—in an interconnected manner—are critical to achieving an organizational advantage in projects and operations.

To integrate the topics, we followed a process that started with visualizing the disciplines and identifying the critical interconnections. We concluded that the most connections occur between PM execution and OM planning and that understanding and managing these connections help realize the value of a project that enhances ongoing operations.

We built a course emphasizing the integrated nature of PM and OM and focusing on the interconnections. In class, we highlight the connections between PM and OM to show students when to move from PM to OM—or from OM to PM—during their operations or project management efforts. This helps the students choose the appropriate mix of processes, tools, and knowledge for working between the two disciplines to achieve success.

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Appendix

Schedule of Course Material

Lsn#	Topic
1	Course Introduction
2	Intro to Operations and Project Management/Strategy
3	Project Mgt #1 (Intro to Project Mgt/Customer Satisfaction and Triple Constraint/Initiating (Charter, Handoff, Scope Statement))
4	Project Mgt # 2(WBS/Planning/Planning Docs)
5	Project Mgt # 3 (Simulation/Scheduling/MS Project)
6	Project Mgt # 4 (Fast Tracking and Crashing a Project)
7	Project Mgt # 5 (Project Execution and M&C (Communication, Team, Leadership))
8	Project Mgt # 6 (Analysis of Variance (EVA))
9	Final Project Mgt Topics (Project Closure)
10	EXAM #1
11	OPS Mgt Planning - Product Design/Product Development Process (PM Connection)
12	OM Simulation
13	OM Simulation Discussions/Intro MRP spreadsheet
14	Process Selection (PM Connection)
15	Review of Forecasting
16	Capacity Planning (PM Connection)
17	Capacity Planning Case Study
18	Aggregate Planning
19	OM Simulation Discussion/Strat. (scorecard spreadsheet)
20	Final Ops Mgt Planning Topics

Appendix

Schedule of Course Material (continued)

Lsn#	Topic
21	EXAM # 2
22	Ops Mgt Execution-Managing Quality
23	OM Simulation Discussion/Capacity Mgt tabs on spreadsheet
24	Quality Control
25	Quality Control Case Study
26	Inventory Management
27	Inventory Management Case Study
28	Scheduling
29	Final Ops Mgt Execution Topics
30	EXAM # 3
31	Ops Mgt Facilitating Topics-Process Flow Analysis
32	Capstone Simulation Introduction/ Expectations for final project/Grading Rubric
33	Value/ Lean Analysis/Case Study
34	Continuous Process Improvement (PM Connection)
35	Supply Chain Management
36	Risk Mgt and Final Ops Mgt Facilitating Topics (PM Connection)
37	EXAM # 4
38	Guest Speaker
39	Capstone Simulation
40	End of Sim Discussion/ End of Course Wrap-Up/Course Feedback

The Army University Research Program

(January 2020 – December 2022)

Background

The Army University Research Program (AURP) is a learning sciences research program with the aim of improving education across the Army Learning Enterprise with innovative projects that address specific needs. The AURP was created by the vice provost of academic affairs (VPAA), Army University (ArmyU), in 2019 to support evidence-based innovation in the learning enterprise. It is an inclusive program: one needn't be a researcher by trade to contribute. Practitioners can be faculty/instructors, curriculum or faculty development staff, students, or research staff.

The AURP uses the Army Learning Coordination Council (ALCC) structure to drive solicitation, selection, and oversight of research projects. The administration of the program rests in the Institutional Research and Assessment Division (IRAD), VPAA, ArmyU. AURP activities are managed by the Learning Sciences Committee (LScC), which is a standing committee of the ALCC.

The strengths of AURP projects rest with the opportunity for topics to be proposed by anyone, and the research is done in a collaborative environment with investigators from organizations as varied as IRAD, the Center for the Profession and Leadership, the Army Research Institute, the U.S. Army Institute for Religious Leadership, the Sabalauski Air Assault School, U.S. Army Combat Capabilities Development Command-Soldier Center, the Sustainment Center of Excellence, and U.S. Northern Command Gender Advisors. This makes certain that products or policies developed through this process have had input from potential user groups and subject-matter experts.

Current AURP Projects and Status

Since its introduction at the November 2019 meeting of the LScC, the AURP has resulted in seven supported research projects. The Table provides an overview of these projects.

AURP Way Forward

As the AURP grows, additional programmed funding will be required for contracted research support and to transition products to the operational force. Every year, new, varied, and relevant research ideas are proposed to the LScC; we hope that collaborations and support through the LScC continue to grow, and the Army Learning Enterprise is able to produce better educated soldiers through these efforts.

Table

Overview of Current AURP Projects

Title (Year Begun)	Project Description
Survey of the Army Learning Enterprise (SALE) (2019)	The SALE provides an enterprise level overview of professional military education (PME) from the student perspective after they return to the operational force. The main aims are (1) to facilitate the collection of best practices, lessons learned, and techniques, tactics, and procedures from those who are excelling; and (2) to facilitate the identification and remediation of barriers to success.
Tacit Knowledge Transfer (2019)	Tacit knowledge refers to the knowledge, skills, and abilities an individual gains through experience that is often difficult to put into words or otherwise communicate. Understanding tacit knowledge and how it is transferred within the total force is critical to improve the military's agility, adaptability, and speed of responding to any challenges presented by adversaries.
Defining and Quantifying Rigor in Army PME (2020)	The term "academic rigor" is often used within Army doctrine and heard within command directives. However, there is not a common understanding of what is meant by "academic rigor" within PME. The aims of this project are to (1) create a common understanding in the context of PME of the term "academic rigor" and (2) develop tools to measure and evaluate the level of rigor in specific courses.
Applying Learning Science to Skill and Knowledge Acquisition (ALSSKA) (2020)	Academic research in learning and memory has validated several strategies to optimize the acquisition and retention of knowledge and skills. The aim of this project is to establish (1) learning outcomes associated with strategies for skill and knowledge acquisition; and (2) practices of value, lessons learned, and tactics, techniques, and procedures associated with the implementation of strategies.
Improving Self-Regulated Learning (SRL) Through Assessment and Feedback in a Distributed Learning Environment (2021)	For learning to be successful, students must be proficient in self-regulation skills including planning, goal setting, discipline, and focus. The aim of this project is to determine whether providing learner-centric assessments along with adaptive feedback and strategies for optimizing skills in self-regulation improves learning outcomes in a distributed learning environment. The key planned product of this project is an assessment and feedback tool leveraging adaptive learning technology to improve SRL skills.
Identifying Best Practices for Instructor Training for Virtual Learning (2022)	As the Army looks to modernize, Army instructors may increasingly be tasked to teach in a distributed learning environment. This will likely involve instructing online through platforms such as MS Teams or Blackboard. The aims of this project are (1) to identify best practices and challenges for virtual learning (VL) instructors and (2) to develop recommendations for VL instruction that can be used throughout the learning enterprise.
Assessing Affective Domain Growth in Soldiers (2022)	The affective domain is "the domain that examines a student's ability to internalize what is learned in the form of feelings and attitude" (TRADOC Regulation 350-70, 2017, p. 127). The aim of this project is to develop an affective domain assessment for use in Army training and education contexts. We propose utilizing existing, scientifically validated scales to help build an assessment of the affective domain to be used in Army training and education contexts.

Upcoming Conferences of Note

July 17–20, 2023: Anthology Together (Formerly Blackboard World Conference)

In Person, Nashville, TN

https://www2.anthology.com/together

Anthology Together is the destination for education professionals featuring keynotes by industry thought leaders, peer-driven discussions, best practices sharing, and a variety of networking opportunities. Learn from the best institutions and organizations in education on how they inspire and achieve greatness.

August 3–5, 2023: American Psychological Association Convention

Hybrid, Washington, D.C.

https://convention.apa.org/

The American Psychological Association (APA) convention is the world's largest gathering of psychologists, psychology students, and other mental and behavioral health professionals. This is an opportunity to discuss education and behavioral sciences specifically tailored to the military population with a wide variety of experts.

September 19, 2023 (Virtual) and October 3–6, 2023 (In Person): American Association for Adult and Continuing Education Conference (AAACE)

Hybrid, Lexington, KY

https://www.aaace.org/page/2023-conference

This is the annual conference of one of the nation's largest organizations for adult and continuing education. The American Association for Adult and Continuing Education (AAACE) is the publisher of three leading adult education journals: *Adult Education Quarterly*, *Adult Learning*, and the *Journal of Transformative Education*.

October 9–11, 2023: Association of the United States Army (AUSA) Annual Meeting

In Person, Washington, D.C.

https://meetings.ausa.org/annual/index.cfm

The Association of the United States Army (AUSA) Annual Meeting and Exposition is the largest landpower exposition and professional development forum in North America. The annual meeting is designed to deliver the Army's message by highlighting the capabilities of Army organizations and presenting a wide range of industry products and services. AUSA accomplishes this task throughout the entire event by providing informative and relevant presentations on the state of the Army, panel discussions, and seminars on pertinent military and national security subjects, and a variety of valuable networking events available to all that attend.

October 16–18, 2023: Association for Continuing Higher Education (ACHE)

In Person, Charleston, SC

https://www.acheinc.org/2023-annual-conference-

The Association for Continuing Higher Education (ACHE) is a dynamic network of diverse professionals who are dedicated to promoting excellence in continuing higher education and to sharing their expertise and experience with one another.

October 24–27, 2023: Institute for Credentialing Excellence (ICE) Exchange

In Person, Colorado Springs, CO

https://www.credentialingexcellence.org/ICE-Exchange/Save-the-Date

The ICE Exchange conference is the conference for the credentialing community. The name ICE Exchange reflects what is valued most by our annual conference attendees: the exchange of industry trends and best practice through live education and networking.

November 8–10, 2023: Council for Adult and Experiential Learning (CAEL) Conference

Hybrid, Baltimore, MD

https://www.cael.org/events/2023-cael-conference

The annual conference brings together over 500 participants to learn, network, and work together to make lifelong learning accessible to adults around the world. Attendees include college faculty and administrators, human resources professionals, workforce developers, and representatives from labor and government.

November 16–20, 2023: Professional and Organizational Development (POD) Network Conference

Hybrid, Seattle, WA

https://podnetwork.org/47th-annual-conference/

The POD Network conference focuses on the community of scholars and practitioners that advance the scholarship of teaching and learning through faculty development.

November 27–December 1, 2023: Interservice/Industry Training, Simulation & Education (I/ITSEC) Conference

In Person, Orlando, FL

https://www.iitsec.org/

This is the world's largest modeling, simulation, training, and education conference allowing participation in education paper presentations, and networking among government, industry, academia peers, and subject-matter experts.

Call for Papers

The *Journal of Military Learning* (*JML*) is a peer-reviewed, semiannual publication that supports efforts to improve education and training for the U.S. Army and the overall profession of arms.

We continually accept manuscripts for subsequent editions with editorial board evaluations held in April and October. The *JML* invites practitioners, researchers, academics, and military professionals to submit manuscripts that address the issues and challenges of adult education and training such as education technology, adult learning models and theory, distance learning, training development, and other subjects relevant to the field. Submissions related to competency-based learning will be given special consideration.

Submissions should be between 3,500 and 5,000 words and supported by research, evident through the citation of sources. Scholarship must conform to commonly accepted research standards such as described in *The Publication Manual of the American Psychological Association*, 7th edition.

Do you have a "best practice" to share on how to optimize learning outcomes for military learners? Please submit a one- to two-page summary of the practice to share with the military learning enterprise. Book reviews of published relevant works are also encouraged. Reviews should be between 500 to 800 words and provide a concise evaluation of the book.

Manuscripts should be submitted to usarmy.leavenworth.tradoc.mbx.armyu-journal-of-military-learning@army.mil by 1 April and 1 October for the October and April editions respectively. For additional information, call 913-684-2090 or send an email to the address above.

Author Submission Guidelines

Manuscripts should contain between 3,500 to 5,000 words in the body text. Submissions should be in Microsoft Word, double-spaced in Times New Roman, 12-point font.

Manuscripts will use editorial style outlined in *The Publication Manual of the American Psychological Association*, 7th edition. References must be manually typed. (The automatically generated references employed by Microsoft Word have proven to be extremely problematic during conversion into final layout format for publication, causing delays and additional rekeying of material.) Manuscripts that arrive with automated references will be returned to the authors for compliance with submission requirements. Bibliographies will not be used and should not be submitted with manuscripts.

Submissions must include a one-paragraph abstract and a biography not to exceed 175 words in length for each author. Such biographies might include significant positions or assignments, notes on civilian and military education together with degrees attained, and brief allusions to other qualifications that establish the bona fides of the author with regard to the subject discussed in the article. Do not submit manuscripts that have been published elsewhere or are under consideration for publication elsewhere.

Authors are encouraged to supply relevant artwork with their work (e.g., maps, charts, tables, and figures that support the major points of the manuscript. Illustrations may be submitted in the following formats: PowerPoint, Adobe Illustrator, SVG, EPS, PDF, PNG, JPEG, or TIFF. The author must specify the origin of any supporting material to be used and must obtain and submit with the article permission in writing authorizing use of copyrighted material. Provide a legend explaining all acronyms and abbreviations used in supplied artwork.

Photo imagery is discouraged but will be considered if it is germane to the article. Authors wanting to submit original photographs need to do so in JPEG format with a resolution of 300 DPI or higher. Each submitted photo must be accompanied by a caption identifying the date it was taken, the location, any unit or personnel in the photo, a description of the action, and a photo credit specifying who took the photo. Captions should generally be between 25 and 50 words.

The *Journal of Military Learning* (*JML*) will not consider for publication a manuscript failing to conform to the guidelines above.

The editors may suggest changes in the interest of clarity and economy of expression; such changes will be made in consultation with the author. The editors are the final arbiters of usage, grammar, style, and length of article.

As a U.S. government publication, the *JML* does not have copyright protection; published articles become public domain. As a result, other publications both in and out of the military have the prerogative of republishing manuscripts published in the *JML*.

Manuscripts should be submitted to usarmy.leavenworth.tradoc.mbx.armyu-journal-of-military-learning@army.mil by 1 April and 1 October for the October and April editions respectively. For additional information, call 913-684-2090 or send an email to the address above.