



## **A Systems Engineering Approach to Mentorship Program for Online Military and Veteran Engineering Students**

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# **A Systems Engineering Approach to Mentorship Program for Online Military and Veteran Engineering Students**

## **Abstract**

Although online education has seen tremendous growth over the past decade, the lack of frequent and meaningful interactions between students and faculty has often been cited as one of the main obstacles for quality online educational experience and improving student learning outcomes. In the mean time, the flexibility and personalized learning opportunities offered by online modality are especially appealing to military students, but they have to overcome barriers in the online environment that are unique to their professional and private lives. In this work-in-progress paper, we will demonstrate the necessity of, and present a systems engineering approach to, developing an online mentorship program at one of the nation's leading online universities where about 60% of students are either veterans, members of the military or military dependents. The impact on students, especially active duty and veteran students will be reported later when assessment data is collected and analyzed.

## **Introduction**

Online education is experiencing an explosive growth over the past decade. According to the latest report from the Education Department's National Center for Education Statistics [1], the number and proportion of college and university students taking classes online grew solidly by 5.7% in 2017, even as overall post-secondary enrollments fell by 0.5%. Despite the tremendous growth, online education still faces significant challenges. Among them, the lack of frequent and meaningful interaction between students and faculty members has often been cited as the main obstacle for increasing the quality of online educational experience and improving student outcomes and satisfaction.

The flexibility and personalized learning opportunities offered by online modality are especially appealing to military students. The Education Department, using latest available statistics [2], found that 18% of military undergraduates took all of their courses online, compared with 12% of their nonmilitary peers. Among military graduate students, 41% attended fully online compared to 19% of nonmilitary graduate students. As one of the leading online universities in the country, Embry-Riddle Aeronautical University serves a vast student population in active duty service members and veterans. In the engineering and engineering technology programs of the Worldwide campus, active military and veterans account for 50% and 20% of enrollment, respectively. In addition to the difficulties facing traditional and other non-traditional students,

military students have to endure confusions and overcome barriers in the online environment that are unique to their professional and private lives. Helping this demographic earn college degrees and establish career paths not only has significant educational ramifications, but also serves a noble social cause for the country.

Among many touted solutions, mentoring has been shown to be a powerful method to overcome some of the major obstacles in online education and broader education community. Studies show that undergraduate students who are mentored tend to have higher GPAs, higher retention rates, and more units completed per semester as compared to their un-mentored colleagues [3].

It is in this background that the College of Aeronautics at Embry Riddle Aeronautical University has developed and launched a mentorship program aimed at helping online engineering and engineering technology students, in particular military and veterans succeed not only within, but also beyond the academic programs.

### **Mentorship and Online Mentoring**

Mentoring has established itself as an effective strategy in addressing key issues and problems currently facing colleges and universities [4]. Mentorship is a relationship between a mentor and a mentee for informal transmission of knowledge, social capital, and the psychosocial support perceived by the recipient as relevant to work, career, or professional development [5]. In higher education, mentorship is often credited for providing an example and guide to the world in and beyond the student's educational journey, enhancing student's affinity to the program, College, and University, and enabling a greater persistence toward graduation goals [6]–[8]. Due to the prevalence and diversity of formal and informal mentoring programs and practices at postsecondary institutions, relevant theories and frameworks for effective mentoring have been developed and tested over the years. Crisp, Baker, Griffin, *et al.* [9] provide an updated synthesis of the undergraduate mentoring scholarship to address four specific questions: *a)* to identify and understand how empirical knowledge and theory have advanced; *b)* to identify and provide clarity about the characteristics that serve to meaningfully distinguish mentoring relationships and programmatic efforts; *c)* to integrate theory and research in a way that could provide tentative hypotheses regarding the relationship between the various characteristics and outcomes of mentoring; and *d)* to offer evidence-based practices for the administration of formal mentoring programs.

There is an important distinction between academic advisor and mentor. An advisor is responsible for providing information on degree requirements and guidance for students to complete a degree plan. A mentor, on the other hand is a positive role model who can guide and motivate student professionally. A mentor can provide resources and tools that will stimulate engagement in discussions about intellectual issues that will increase student's aspiration to achieve a higher level.

With the growth of online education, mentoring starts to take the same platform and relies on many of the same infrastructures. There have been numerous reports on online mentoring practice. For example, in [10], the effectiveness of a one-year online mentoring program for girls in STEM is studied. Mentee and mentor communicate with one another and with other program participants via email, online chat, and forums. The treatment-group participants show greater

levels of desirable short-term and long-term developments. In [11], the authors present distributed mentoring, an online mentoring style inspired by the theory of distributed cognition. Seven key attributes that distinguish distributed mentoring from traditional, offline forms of mentoring are identified: aggregation, accretion, acceleration, abundance, availability, asynchronicity, and affect. Dhorne, Deflandre, Bernaert, *et al.* [12] show how mentoring is used to motivate learners to improve MOOCs course completion rates. The paper presents the approach to enhance coaching efficiency together with new teaching pedagogy. In [13], [14], Nuankaew and Temdee propose an online mentoring model that identifies mentor and mentee based on compatible different attributes.

However, online mentoring theories or frameworks are still in the early stage of development. The commonly used tools for online mentoring are email and weekly meetings between mentors and mentees. While acknowledging that the development of online mentorship Program has been a much more complex enterprise than a face-to-face equivalent program, Reali, Tancredi, and Mizukami argue that it still “promoted the establishment of professional and affective bonds among the participants, the broadening of professional knowledge, the mastery of online adult education technologies, and the participants’ professional growth” [15].

### **Online Mentorship Program: A Systems Engineering Approach**

In this paper, we will treat developing mentorship program as a process that harnesses systems engineering doctrines. As per INCOSE definition, the systems approach is defined as a means of identifying and understanding complex problems and opportunities, synthesizing possible alternatives, analyzing and selecting the best alternative, implementing and approving a solution, and deploying, using and sustaining engineered system solutions.

**Identify stakeholders** The success of the systems engineering approach relies on active participation of stakeholders in the entire systems development life-cycle. Therefore, the first step in the mentorship program development process starts with identification of stakeholders, which we have shown in Table 1.

**Define needs and requirements** Identifying and understanding the stakeholders’ needs are essential to developing functional system, and in our case, mentorship program. This process will deter issues involving process improvement that could occur when total program is not kept in mind in achieving the purpose and/or goals.

Because military and veteran students are a key group of stakeholders, to build effective mentoring we need to recognize the unique circumstances in their professional lives that may cause additional disruptions in their online education. Some of the major challenges that these students face include:

- Deployment and re-assignments. There are many cases that students have been relocated (even oversea or the area with limited access to internet) during their terms of study.
- Budget allowance for the active duty and veterans is constantly changing. This change will limit the number of courses they can take.

Stakeholder	Passive/Active Stakeholder?	Stakeholder Role/Description	Outcomes and Benefits
Mentor	Active	Leadership. He or She should play a role of trusted advisor and be able to share/transfer experience, knowledge, and wisdom. Be a model and set goals and objective	Establish a trusted relationship with open communication that will help mentee toward achieving his/her goals
Mentee	Active	Commitment to active participation. He or she should take their responsibilities seriously and participate in assigned/agreed activities	Develop a roadmap for success. Create channels to receive and provide feedbacks and recommendations
ERAU COA	Active	Sponsor the program. Make it part of curriculum	A supported partnership program (pipeline) between faculty (mentor) and students (mentee) that will increase students take rate and get students through the entire pipeline
ERAU Facilitators	Passive	Create interactive intranet site and make it visible to all students. Provide and support required means on communication	Ease of communication and participation through pipeline; mentor/mentee communication
Active Duty	Active/passive	Support student in their financial issue and allow them to register in courses	Allocate (availability) appropriate fund for those who are pursuing a successful degree. Also, let student participate in their degree programs
Veteran	Active	Allocate and/or request for approved funding	Available funding towards completion of their degree programs
Family (Mentee)	Passive	Support (spiritually and financially) and release some time for study	Ease of mind and backup support to continue their journey

Table 1: Mentorship Program Stakeholders

- Life change caused by duty in war zone. Injured active duty members may not be able to continue to work.

A successful mentorship program requires defined and vetted problem statements. There are specific difficulties, such as physical distances, working on silo, or lack of interrelationship, that may be addressed by adding targeted services in the mentorship program. However, we have decided, based on inputs from stakeholders, that in current stage the mentoring initiative should focus on keeping students on track towards degree completion and more specifically, creating support structures to improve student take rate, retention rate, and graduation rate.

Table 2 shows the student headcounts for the three engineering and engineering technology programs that will be the main beneficiary of the mentorship effort. It is clear that the newly launched ABET-accredited B.S. in Engineering houses the majority of the students. While strong freshman and sophomore classes are often a good indicator of a healthy program, they also present a huge challenge for retention.

Academic Standing \ Degree Program	AS Engineering	BS Engineering	BS Eng. Tech.
Freshman	270	569	12
Sophomore	40	235	48
Junior	10	66	137
Senior	N/A	20	150
Total	320	924	358

Table 2: Student Headcounts

Historically, the undergraduate retention rates at ERAU have been low especially among active duty and veteran students. One key indicator for retention is the take rate. As shown in Table 3, the take rate for students who entered engineering program as freshmen and continued in BSE/BSET degrees between Fall 2016 and Spring 2019 ranged between 2.99 to 5.55 courses per year. There is clearly an upward trend for take rate as students move from underclassmen to upperclassmen. However, the available data from the university shows the take rate for active duty and veteran students, the largest demographic at ERAU, averaged only between 2.6 to 3.82 courses per year. Although the rate goes up when students move to upper class, it still remains low for military freshman and sophomore, and is lower than that of their civilian counterparts.

The University and College have made improving student take a priority in the strategic goal of student success. The mentoring team also believes raising take rate benefits all stakeholders of the program. For students, it means keeping them on pace towards degree completion; for department, it means healthy pipeline for program continuity; for school, it means good retention and graduation rates. The disparity between under- and upperclassmen however, indicates that

Academic Standing \ Degree Program	AS Engineering	BS Engineering	BS Eng. Tech.
Freshman	2.57	3.08	3.17
Sophomore	4.23	5.36	3.98
Junior	9.30	8.23	5.55
Senior	N/A	12.25	7.83
Average	2.99	7.23	3.83

Table 3: Student Take Rate

mentoring effort should be skewed towards freshmen and sophomores for improving take rate purpose, and focus on life long learning and career development for juniors and seniors.

**Mentorship Program Design and Implementations.** Mentoring program is developed in collaboration with administrative staff, academic support staff and leadership team. To better serve and relate to military beneficiaries, the department has hired specifically a full-time faculty with service background who will be the lead mentor for active duty and veteran mentees. The design, development and implementation stage of the project consists of the following phases.

- Phase 1: Program Development
  - Explore methods to reach students
  - Develop website and video
  - Develop virtual career fair
  - Lessons learned
- Phase 2: Launch
  - Launch website and go live
  - Register mentees
  - Assign mentees to mentors
- Phase 3: Monitor and Evaluate
  - Build mentor/mentee relationship
  - Monitor progress; monthly/quarterly reports
  - Evaluate and improve

In Phase 2, the performance of students at freshmen and sophomore level will be reviewed at least once a year. The students with below expectation take rate will be identified and registered into

mentorship program and assigned to a mentor.

Students in the mentorship program have access to the following resources:

- Faculty/staff mentoring teams regarding their academic and personal goals
- A learning community where they can interact with a cohort of their peers sharing similar academic and non-academic experiences
- Preferred access to tutoring from COA's Virtual Center for Communication (VECTOR)
- Personal assistance in developing a portfolio of evidence to demonstrate that they have accrued top skills desired by potential employees
- Participation in networking events with industry professionals and ERAU alumni

## Conclusion

In this work-in-progress paper, we present an online mentoring program that is developed based on systems engineering doctrines. The program is aimed at assisting constituents pursuing online engineering and technology degrees, especially active military and veterans who comprise a significant portion of ERAU student body. With the support structures in place, the mentoring program's success will be mainly measured, at the current stage, by student take rate. In the mean time, we will observe the following key factors to assess the program status after its launch:

- Sustain a steady mentor-mentee relationship. This means focusing on one or more of the following characteristics: resilience self-organization, and hierarchy.
- Focus on the mentor and mentee's needs—two-way communication. Mentor should look to improve the mentee's prospects while respecting the his/her personal life circumstances and perspective.
- Pursue and use help and support from facilitators and program staff.

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