

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./DUE DATE NSF 23-510		<input type="checkbox"/> Special Exception to Deadline Date Policy 01/18/2023		FOR NSF USE ONLY NSF PROPOSAL NUMBER	
FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.) DUE - IUSE- Engaged Student Learning: Level I				2315560	
DATE RECEIVED 01/18/2023	NUMBER OF COPIES 1	DIVISION ASSIGNED 11040000 DUE	FUND CODE 1998	UEI (Unique Entity Identifier) U5MMBAC9XAM5	FILE LOCATION
EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN) 590936101		SHOW PREVIOUS AWARD NO. IF THIS IS <input type="checkbox"/> A RENEWAL <input type="checkbox"/> AN ACCOMPLISHMENT-BASED RENEWAL		IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> IF YES, LIST ACRONYM(S)	
NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE EMBRY-RIDDLE AERONAUTICAL UNIVERSITY, INC.				ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE 1 AEROSPACE BLVD DAYTONA BEACH,FL 32114-3910 US	
AWARDEE ORGANIZATION CODE (IF KNOWN) 0014795000					
NAME OF PRIMARY PLACE OF PERF Embry-Riddle Aeronautical University				ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE 1 AEROSPACE BLVD DAYTONA BEACH,FL 32114-3910 US	
IS AWARDEE ORGANIZATION (Check All That Apply)		<input type="checkbox"/> SMALL BUSINESS <input type="checkbox"/> MINORITY BUSINESS <input type="checkbox"/> FOR-PROFIT ORGANIZATION <input type="checkbox"/> WOMAN-OWNED BUSINESS		<input type="checkbox"/> IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE	
TITLE OF PROPOSED PROJECT Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions					
REQUESTED AMOUNT \$ 382,578	PROPOSED DURATION (1-60 MONTHS) 36 months	REQUESTED STARTING DATE 08/01/2023		SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE	
THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW					
<input type="checkbox"/> BEGINNING INVESTIGATOR <input type="checkbox"/> DISCLOSURE OF LOBBYING ACTIVITIES <input type="checkbox"/> PROPRIETARY & PRIVILEGED INFORMATION <input type="checkbox"/> HISTORIC PLACES <input type="checkbox"/> VERTEBRATE ANIMALS IACUC App. Date _____ PHS Animal Welfare Assurance Number _____ <input checked="" type="checkbox"/> TYPE OF PROPOSAL <u>Research</u>					
<input checked="" type="checkbox"/> HUMAN SUBJECTS Human Subjects Assurance Number _____ Exemption Subsection <u>approved</u> or IRB App. Date <u>01/03/2023</u> <input type="checkbox"/> FUNDING OF INT'L BRANCH CAMPUS OF U.S IHE <input type="checkbox"/> FUNDING OF FOREIGN ORGANIZATION OR FOREIGN INDIVIDUAL <input checked="" type="checkbox"/> INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED <u>CA</u> <input checked="" type="checkbox"/> COLLABORATIVE STATUS <u>Non-Collaborative</u>					
PI/PD DEPARTMENT		PI/PD POSTAL ADDRESS 1 Aerospace Boulevard			
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CERTIFICATION PAGE**Certification for Authorized Organizational Representative (or Equivalent)**

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), flood hazard insurance (when applicable), responsible conduct of research, and organizational support as set forth in the NSF Proposal & Award Policies & Procedures Guide (PAPPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, §1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of PAPPG Chapter IXA; and that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organizations expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organizations conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

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Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

- (1) community in which that area is located participates in the national flood insurance program; and
- (2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

- (1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
- (2) for other NSF grants when more than \$25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)

(This certification is not applicable to conference proposals.)

By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Chapter IX.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research.

The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

Certification Regarding Organizational Support

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Dual Use Research of Concern

By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

Certification Regarding the Meeting Organizer's Written Policy or Code-of-Conduct that Addresses Sexual Harassment, Other Forms of Harassment, and Sexual Assault

(This certification is only applicable to travel proposals.)

By electronically signing the Cover Sheet, the AOR is certifying that prior to the proposer's participation in the meeting, the proposer will assure that the meeting organizer has a written policy or code-of-conduct that addresses sexual harassment, other forms of harassment, and sexual assault, and that includes clear and accessible means of reporting violations of the policy or code-of-conduct. The policy or code-of-conduct must address the method for making a complaint as well as how any complaints received during the meeting will be resolved. The proposer is not required to submit the meeting organizer's policy or code-of-conduct for review by NSF.

Certification Regarding Family Leave Status (or equivalent)

(This certification is only applicable to career-life balance supplemental funding requests)

By electronically signing the certification pages, the Authorized Organizational Representative hereby certifies that the request for a technician (or equivalent) is because the (PI/co-PI/senior personnel/ NSF Graduate Research Fellow/postdoctoral researcher/graduate student) is, or will be, on family leave status (or equivalent) from the organization in accordance with the organization's policies. The Authorized Organizational Representative also affirms that the organization is able to fill the position for which funding is being requested, in an appropriate timeframe.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME Rachel Heinz Randall	Electronic Signature	Jan 18 2023 02:50 PM
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Division of Undergraduate Education
Project Data Form

Project Information

Name of Principal Investigator/Project Director: **Robert W Deters**

Name of Primary Organization: **Embry-Riddle Aeronautical University**

SAM Legal Business Name: **EMBRY-RIDDLE AERONAUTICAL UNIVERSITY, INC.**

Program Information

Program-track to which the proposal is submitted: **IUSE- Engaged Student Learning: Level I**

Category: **Not applicable for the selected program**

Prime Organization Information

Highest Degree: **Master's (M)**

Institution Type: **Private (PRIV)**

Project Data

Discipline: **STEM**

Subdiscipline:

Primary Academic Focus Level: **Both Divisions of Undergraduate (BO)**

Private Sector Participation: **No. The proposed project will not have private sector participation.**

Audience(s):

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

Strategic Area:

Project Feature(s):

- 1.
- 2.
- 3.

4.

5.

Estimated Number of Individuals Involved

Estimated number of individuals who will be directly affected by the activities of the project during its operation:

PreK-12 Students: **0**

PreK-12 Teachers: **0**

Undergraduate Students: **400**

Graduate Students: **9**

Postdoctoral Fellows: **0**

Higher Education Faculty: **10**

Other Organizations

Other Organizations involved in the project's operation:

1.

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Project Summary

Overview:

In this submission for the Engaged Student Learning Track, we propose modifications to the previously established Research Scholars program (NSF IUSE, #2021221) for development, testing, and use of curricular innovations to engage STEM students and improve learning. The envisioned changes are grounded in data and experiences from the initial phase and include the creation of an undergraduate STEM research minor, provision of travel and research grants for student researchers, and inclusion of graduate students as near-peer mentors for undergraduate researchers. The study goals feature broadening undergraduate research implementation; improving student perspectives; and promoting STEM career pathways. Objectives from the initial program will also be reinforced to support learning and transferable skills. This longitudinal mixed-methods study will emphasize the observation of STEM attitudes, while implementing a long-term data collection plan aimed at STEM persistence, as well as development of research and transferable skills. The project will support undergraduate research in a globally distributed online learning environment. While the initial phase of the project focused narrowly on undergraduate research within a single degree program, the updated approach will be fully available to all 16,000 ERAU-Worldwide students and will address some of the administrative and student barriers to engaging in the course-based undergraduate research experience.

Intellectual Merit:

Student impacts of traditional undergraduate research is well-studied, with a plethora of benefits for students, faculty, institutions, and beyond. However, the translation of STEM undergraduate research to the online environment is relatively new, though it is gaining in momentum, partly due to necessity from the COVID-19 pandemic. Data collected in this project will allow us to evaluate the effectiveness of the modified framework for undergraduate research for students enrolled in fully online STEM degree programs. This study will measure participation rates in undergraduate research and the impact of the experiences on STEM identity, attitudes, and career ambitions. We will also monitor STEM degree persistence of students who engage in the STEM research minor and compare persistence rates to the whole population for those degrees, while tracking progressive achievement of transferable skills development and research learning outcomes, as students complete the research minor.

Broader Impacts:

This proposed project further builds community and identity through two key approaches. First, research-active students will participate in credit-bearing undergraduate research through a cohort-style course rather than an independent study. Second, the near-peer mentoring will connect undergraduate students, graduate students, and research-active faculty. This proposed Phase 2 expands undergraduate research support, assists with developing a globally competitive STEM workforce, and strives to change the expectation of what is possible for distance students, breaking stereotypes about online education. Participation is anticipated to grow by at least 50-percent through the inclusion of additional educational disciplines, graduate students, and further resources intended to support engagement, mentorship, and outreach.

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Appendix Items:		

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions

Introduction

There is a growing gap between supply and demand for STEM professionals. The U.S. Bureau of Labor Statistics predicts 10.8% growth in STEM employment from 2021 to 2031 (*Employment in STEM Occupations*, n.d.). In 2020, 44% of undergraduate students in the U.S. completed coursework exclusively online (National Center for Education Statistics, 2022). While this number was driven by the COVID-19 pandemic, online degree programs are expected to continue to attract students. However, STEM degree program persistence has been problematic, with researchers exploring hygiene and motivating factors that influence persistence (Pedraza & Chen, 2022). Multiple studies have shown disparities in learner outcomes (e.g., persistence, graduation rate, and GPA) based on demographic variables including economic status, gender, and race/ethnicity (Clark, 2014; Heilbronner, 2014; Ohland et al., 2011). In the online learning environment, persistence is also problematic (Bawa, 2016). The course modality may influence demographics of the class, with Hispanic and black STEM majors less likely to enroll online and female STEM majors more likely to enroll online (Wladis et al., 2015).

Undergraduate research is a high impact practice that offers gains in disciplinary knowledge and skills (Howitt et al., 2022; Stanford et al., 2017), persistence (Estrada et al., 2017; Shuster et al., 2019), STEM identity and attitudes (Arnold et al., 2019; Betz et al., 2021; Linn et al., 2015), transferable skills (Balke et al., 2021; Hajdarpasic et al., 2015), and career ambition (Carpi et al., 2017), with particular impact for minority students (Carpi et al., 2017; Estrada et al., 2017; Shuster et al., 2019). While there are some unique challenges to making undergraduate research accessible to online students, this team has established a framework of support (Research Scholars Program) for research efforts of Embry-Riddle Aeronautical University (ERAU) students completing STEM degrees exclusively online. The framework included mentoring, workshops, and curricular opportunities (Faulconer, Terwilliger, et al., 2022).

In this submission for the Engaged Student Learning Track, we propose modifications to the Research Scholars program for development, testing, and use of curricular innovations to engage STEM students and improve learning. These modifications are grounded in data and experiences from the pilot and include the creation of a STEM research minor, provision of travel and research grants for student researchers, and inclusion of graduate students as near-peer mentors for undergraduate researchers. The study goals are to 1) broaden the implementation of undergraduate research, an effective instructional practice, 2) improve student perspectives (STEM attitude), and 3) promote STEM career pathways (STEM identity and career ambitions).

Intellectual Merit

This proposed project will support undergraduate research, a high-impact practice, in a globally distributed online learning environment. While the framework of support has already been developed, the challenges and barriers identified in the previous work have informed the modified approach presented here. This revised framework of support will broaden impact to all Worldwide Campus students and can be transferred to other institutions offering similar exclusively online STEM degree programs. While the previous project focused narrowly on undergraduate research within a single degree program (though mentoring and workshops were available to all Worldwide students), the approach presented here will be fully available to all Worldwide students (approximately 16,000 students) and will address some of the administrative and student barriers to engaging in the course-based undergraduate research experience.

Student impacts of traditional undergraduate research is well-studied, with a plethora of benefits for students, faculty, institutions, and beyond. However, the translation of STEM undergraduate research to the online environment is relatively new, though it is gaining in momentum, partly due to necessity from the COVID-19 pandemic (Chandrasekaran, 2020; DeChenne-Peters et al., 2022; Hung & Proctor, 2021;

Wang et al., 2020). However, very little research is available on a framework of support for undergraduate research for online students, with papers instead focusing on single research experiences (e.g., CUREs). Additionally, currently, the researchers are unaware of any institution that offers a STEM research minor exclusively online.

Data collected in this project will allow us to evaluate the effectiveness of the modified framework for undergraduate research for students enrolled in fully online STEM degree programs. This study will measure participation rates in undergraduate research and the impact of the experiences on STEM identity, attitudes, and career ambitions (using a voluntary survey that also collects basic demographics and background descriptors). While not a direct goal of the project, we will monitor STEM degree persistence of students who engage in the STEM research minor and compare persistence rates to the whole population for those degrees. Furthermore, we will track progressive achievement of transferable skills development (by way of general education competencies) and research learning outcomes as students complete the research minor. However, because of the timeline for students to complete major and minor programs of study, conclusions from this aspect of data collection are beyond the time frame of this project and thus is not included as study goals. However, when complete data is available, this data will be disseminated, with credit to this funding program.

The Revised Research Scholars Program

There is strong interest in undergraduate research among the students completing their STEM degrees exclusively online (Faulconer, Griffith, et al., 2020) and in undergraduate research supervision and mentorship among the faculty teaching in this learning environment (Faulconer, Dixon, et al., 2020). The most significant faculty barriers in the 2020 study were having prepared, motivated students and deficient student research skills, which are barriers clearly addressed through the Research Scholars Program. The current Research Scholars program provides scaffolding in four areas: Early Experiences, Bridge to Research, Undergraduate Research, and Culmination. The pilot of the Research Scholars program provided evidence of efficacy related to the workshops and the mentoring program. Since its launch in August 2021, the program has supported 31 research mentees, 18 of whom have entered the active research phase, resulting in 3 conference posters (completed), 1 conference presentation (approved), and 1 research publication. More outputs are anticipated in the very near future. Additionally, the program has offered 11 student-focused research workshops on topics ranging from “how to join faculty research” to “academic vs. industry research.” Attendance has been light, ranging from 2–7 students, but those who attended were highly engaged. This could be a factor of time pressures for synchronous attendance, particularly in light of global distribution. Recordings are available online to all students enrolled in the Research Scholars program’s Canvas page. There are currently 202 active users within this Canvas page. The Spring 2023 Program Update posted as an announcement on the page gained 161 page views in the last 10 days.

However, in administering the pilot Research Scholars Program, there have been barriers that we would like to address. One administrative hurdle has been workload allocation when expanding the research mentoring program to accommodate demand. This has been exacerbated by hesitance from administrators to support cross-college effort for faculty engaging in the research mentoring program. (The mentoring program is housed in the College of Arts and Sciences. Faculty from other Worldwide Colleges have thus far been unable to serve as mentors and have it count towards their negotiated workload.) Another administrative hurdle has been the revenue differences when substituting an independent study for an elective course in a degree program. From the student side, the predicted barriers to engaging in research – time and research costs – bore out in students engaged in the Research Scholars Program. Additionally, some students who wished to participate in the research independent study course were unable to either because their degree program did not have elective options or because they were too far along and did not have appropriate elective credits left. Due to the term structure of the Worldwide campus, every course credit hour must be paid for individually; there is no full-time flat tuition rate. Students are hesitant to pay

for credit hours that are not required by their degree programs. Course substitutions are exceedingly challenging due to equivalency concerns relevant to accreditation. Therefore, five students were unable to receive course credit for their research, three of which never became research active as a result. We propose specific actions to address these barriers and hurdles and to further provide support and recognition for undergraduate research efforts (Table 1).

Table 1: Proposed Phase 2 of the Research Scholars Program

	Key Components	Actions
Early Experiences	Introduction to Research Course (RSCH 202) Research Skills Workshops	<ul style="list-style-type: none"> Align research learning outcomes in RSCH 202 with RSCH 395 Offer 8 new workshops each academic year of the project
Bridge to Research	Research Mentoring VECTOR Research Skills Workshops STEM Research Minor Program	<ul style="list-style-type: none"> Hire graduate students as near-peer undergraduate research mentors Expand VECTOR resources Develop a minor program of study, including development of an upper-level research ethics course
Active Undergraduate Research	Research Mentoring VECTOR Research Skills Workshops CURE – Culminating Research Experience (RSCH 395) Travel and Research Grants	<ul style="list-style-type: none"> Redevelop RSCH 395 as a capstone (culminating experience) Administer travel and research grant program for undergraduate students
Culmination	Research Mentoring VECTOR Research Skills Workshops Undergraduate Research Certificate	<ul style="list-style-type: none"> Administer Distinguished Undergraduate Researcher Award Career Pathways Industry Coordination

Project Goals and Objectives

The study goals are to 1) broaden the implementation of undergraduate research for online STEM students, 2) improve student perspectives (STEM attitude), and 3) promote STEM career pathways (STEM identity and career ambitions). The benefits of undergraduate research to students are broad and this study will likely see benefits to degree persistence, and development of transferable and research-specific skills. However, these cannot be evaluated in the timeline of this project, so they are not included as goals, but instead stated later as long-term research questions. From the stated goals, the discrete objectives of this 3-year project are to administer a Research Scholars Program that will:

1. Increase undergraduate research participation in students completing STEM degrees exclusively online at ERAU (measured as participation rate prior to implementation of the Research Scholars program and compared to Phase 1 of the pilot of the Research Scholars Program).
2. Lead to impactful student research outputs (reported as internal and external conference participation, manuscript submission for peer-reviewed publication, and innovative dissemination strategies).
3. Positively influence STEM attitudes (evidenced through self-reported student perspectives in early and late phase research engagement and compared to non-research active students in STEM degree programs).
4. Support STEM career pathways (evidenced through self-reported STEM identity and career ambitions in early and late phase research engagement and compared to non-research active students in STEM degree programs).

The Framework of Phase 2

Early Experiences. The Introduction to Research Methods (RSCH 202; 3 credit hours) course is required for many degree programs offered exclusively online through the Worldwide Campus, including in the Bachelor of Science in Engineering Technology (as a technical core course) and the Bachelor of Science in Unmanned Systems Applications (as a technical core course). This methods course introduces students to research, building key skills including defining a research problem, drafting a hypothesis, problem solving, quantitative and qualitative methods, literature reviews, data analysis, and communication of results. The culminating activity in the course is the submission of a literature review and research methodology, including a data analysis plan. Because this course walks students systematically through the research planning processes, it is a logical starting point to bridge into an authentic undergraduate research experience. In Phase 2 of the Research Scholars Program, we will align research learning outcomes between RSCH 202 and RSCH 395. This will allow us to evaluate progressive skills mastery through research engagement and ensure consistency of expectations across the research courses.

Advertised through RSCH 202 and through other means like mass emails and social media, students can be introduced to undergraduate research through the Research Skills Workshop Series. While students can matriculate into the Research Scholars program at any point in the academic year, we want to ensure that we offer introductory topics for these events at regular intervals to appeal to those who are research-curious. The goal is to offer at least 8 workshops each academic year of this project. Previous introductory topics have included the student research experience, writing a research proposal, and formulating your research vision. Ideas for future introductory workshop topics include current research opportunities at ERAU Worldwide, meet the mentors, creating your research path, research roles in a distributed team, and researcher identity. These address common student barriers (Faulconer, George, et al., 2022a). These workshops are available to all Worldwide students, regardless of participation in the Research Scholars program and includes the graduate student population, though the target audience are undergraduates. Beyond skills development, these workshops provide valuable networking opportunities across the institution and within industry, such as Carl Russell (Aerospace Engineer at NASA Ames Research Center).

Bridge to Research. One of the barriers students faced in the Phase 1 pilot of the Research Scholars program was inclusion of a credit-bearing research experience in their degree program. Curricular timing was identified in the research literature as a potential barrier (Wayment & Dickson, 2008), but the first phase did not do enough to adequately navigate this barrier. To address this hurdle, we propose the development of a STEM Research Minor program. The program coordinator can work with the student and advisor to establish an appropriate path for the student so that the student can be prepared to be research-active at an ideal time in their progress towards their major.

The STEM Research Minor would be a 15-credit hour minor. The core courses would be RSCH 202, a data analysis course (course name and number vary by degree program), and RSCH 395. Additionally, students could choose from one lower-level elective (Critical Thinking in Contemporary Problems, Collaborative Writing and Presenting, or Technical Report Writing) and one upper-level elective (Data Visualization, Research Ethics, or Group and Team Behavior). Course substitutions would be considered on a case-by-case basis, particularly if any courses are being offered as CUREs or otherwise provide support for the development of key research skills. Two minor course redevelopments (RSCH 202 and RSCH 395) and one course development (Research Ethics) are needed to finalize the minor program. The Research Ethics course will provide an in-depth examination of responsible research conduct, using a case study approach to promote critical thinking and develop skills in identifying and resolving ethical conflicts that may be encountered in various types of research. Topics will start with research planning and conduct (e.g., human subjects and research with animals), data ethics (e.g., bias, data privacy, data aggregation, and data visualization), publication ethics (e.g., COPE, conflict of interest, copyright, and predatory publishers), and beyond (e.g., entrepreneurship and commercialization). The course will include

guest lectures, group discussions, and engagement with authentic research projects under the guidance of the instructor.

The coordinator of the Minor can also ensure students have been assigned a research mentor upon entering the program. Research mentoring program is housed through the CoAS COMPASS mentoring program. The program has been highly praised by mentors as well as mentees (Faulconer, George, et al., 2022b). A research mentor has long-term engagement with the student focused on broadening their perspectives and horizons relevant to research. The mentor's primary role is to provide advice and information. Therefore, mentors have research experience but not necessarily within the field of the student's research. Mentoring topics can include preparing for research, potential research projects, funding options, research skill development needs, and key internal resources like VECTOR's Virtual Communication Lab. Research mentors are trained in mentoring best practices including scaffolding expectations (Shanahan et al., 2015), using active mentoring practices (Davis & Jones, 2017) and mediated action approach (Palmer et al., 2015), providing emotion and intellectual support (Johnson, 2015; Shanahan et al., 2015), and increasing student ownership of research over time (Johnson, 2015; Shanahan et al., 2015). In Phase 1, 100% of mentors fully completed the training program. The primary deliverable of the training is a student-facing mentoring philosophy statement, which mentors use in their initial conversation with students.

There have been a few barriers associated with faculty workload in the mentoring program. One mechanism to navigate this barrier is to use a cohort mentoring approach that connects graduate students to undergraduate researchers as near-peer mentors, with a faculty mentor overseeing the cohort. It is unlikely for a single mentor to fulfill diverse mentoring needs (DeCastro et al., 2013). Shared mentoring, or community mentoring, is a promising approach for supporting STEM undergraduate research, particularly because of the team focus (Kobulnicky & Dale, 2016; Tenenbaum et al., 2014). Aligned with the heart of this proposal, near-peer mentoring has been shown to bolster sense of belonging and STEM identity as well as self-efficacy, factors that are important for STEM persistence (Trujillo et al., 2015). Peer mentoring is already supported through the larger COMPASS program so graduate student near-peer mentors will engage in the same 8-hour training used in the program, an online peer mentoring course offered through Eduology that offers students an Online Student Leader certificate upon completion. This faculty-supported near-peer cohort approach will further create a collegial and supportive student research community.

In bridging to research, existing VECTOR resources are important, but there is room to grow these resources to support online STEM students. The following resources will be developed to support students in the research-curious phase: Scientific Arguments (Claim – Evidence – Reasoning), Narrative in STEM Communication, Funding Student Research, Conceptual Frameworks, and Reading & Citing Existing Research.

Undergraduate Research. When students are ready to enter the research-active phase, whether enrolled in the STEM research minor or not, they can engage in the RSCH 395 course. Through this project, this course will be modified slightly to address administrative and faculty barriers. Independent study courses have a 1:1 faculty to student ratio that reduces revenue. Furthermore, independent study courses are not considered in faculty workload and are compensated with a small stipend that does not always reflect the time investment. To this end, we propose adjusting to a culminating experience (capstone) format, where the course would be included in faculty workload and would not negatively impact the institution's revenue stream in the way an independent study does. Beyond the paperwork to make this change, only minor changes to the course template are needed to accommodate a cohort approach. A student benefit to this change lies in the formation of a cohort, offering the students a community and an expanded network of research-active peers.

One consideration in this approach is that the instructor would be in a mentoring role rather than a subject matter expert as, particularly in the early stages, there would not be enough students engaged in the same areas of research at the same time to form disciplinary cohorts. To this end, research supervision will still need to be provided to students for appropriate disciplinary skills development and oversight of the research. We propose coordinating this service activity through the appropriate academic departments using a small stipend to incentivize faculty time, though research outputs and other benefits may also offer an incentive for the time and energy invested in this activity in support of undergraduate research. Undergraduate mentorship and undergraduate research supervision are recognized as faculty contribution in the area of college-level service and acknowledged as significant activities that provides notable benefits to ERAU students.

While students are research-active, they will continue to engage with their research mentor. Mentoring topics at this phase include their research progress in their research as well as other supportive topics. Mentors can discuss research dissemination options, including both conference presentation and publication. Internally, students can publish through the peer-reviewed journal *Beyond*, or through external peer-reviewed venues like the *Journal of Young Investigators* or disciplinary journals. Mentors can also encourage students to utilize VECTOR's Virtual Communication Lab where they can receive one-on-one feedback on their research deliverables including practice sessions for oral and poster presentations. Students who utilize at least 5 supports through the VCL earn a certificate of completion. Mentors can also promote the relevant Research Skills Workshops.

Research skills workshops, in addition to addressing early experiences and the bridge to research, will cover topics appropriate for research-active students. Topics for the time frame of this project include Impact Challenge, Innovated Dissemination Strategies, Ethical Data Analysis, Compelling Abstracts, Discovery Day Practice Session, and Submitting to Beyond. All workshops will be open to all interested students, not just those in the Research Scholars program or engaged in the STEM research minor.

Being research-active requires time and resources in collecting, analyzing, and disseminating. Students will be encouraged to present at the annual ERAU Research Symposium and ERAU Discovery Day events, both of which offer virtual participation and presentation options for Worldwide students. Some students who have participated in Phase 1 of the Research Scholars program wanted to participate in person. Unfortunately, the Worldwide campus does not offer a funding line to support conference travel costs associated with undergraduate research. Furthermore, students may wish to network beyond ERAU faculty and students, engaging with an external conference event, either disciplinary or undergraduate research focused like the National Conference on Undergraduate Research. To help support the costs of research and research-related travel, we would like to propose the formation and administration of a Research Scholars Grant program similar to small scale grants students at many traditional campuses can access. The research grants would be up to \$2,500 and travel grants would be up to \$1,500. For the duration of the grant, the research team would administer the grant. After the lifetime of the grant, the program would be administered by the leadership of the Research Scholars Program (as appointed by administration).

Culmination. Once students have completed their research-active phase, there is continued support for students through relevant workshops. Topics appropriate for this phase that will be offered in the duration of this project include Entrepreneurial Research, How to Apply to Graduate School, Careers Related to Research, Landing Prestigious Research Awards, and Marketing Your Research Experience.

Students who have completed specific research-related tasks are eligible for an Undergraduate Research Certificate, receiving a digital certificate of completion, recognition at two or more ERAU events, recognition on the Research Scholars website, and a pin worn with graduation regalia. The criteria for Phase 2 will remain unchanged, requiring completion of faculty-supervised research that demonstrates

proficient or satisfactory mastery of all research learning outcomes, dissemination of original research through internal or external conference presentation or through peer-reviewed publication, participation in four or more Research Skills Workshops, and provision of a letter of recommendation from their research mentor.

To further incentivize high-quality research, for each year of the project the Distinguished Undergraduate Researcher Award will be earned by two students: one for conference participation and one for publication. Any student who has participated in a conference or been accepted for publication is eligible. Students can be self-nominated or nominated by any faculty member or fellow student. The award will come with a modest stipend of \$200. This aligns with recognition as a motivator. Furthermore, an Undergraduate Research Mentor of the Year Award will be provided each year of the project based on student nominations (with no stipend). This award program will be administered by the research team during the lifetime of the project and will be managed by the Research Scholars leadership beyond the life of this project.

For this project, an advisory board, consisting of members recruited from industry, government, and academia, will be created. The intent is to identify important research motivations and topics, capture contextual viewpoints, and make recommendations for future research-related educational programming, from each respective area. The board will aid the research team with determining the Distinguished Undergraduate Researcher Awards and Undergraduate Research Mentor of the Year Awards. Additionally, members of the advisory board will help connect ERAU-Worldwide Research Scholars to other research opportunities and resources, while also potentially serving as mentors to the student participants. The initial group will be composed of five members who will work to identify important engagement and recruitment actions, while considering methods to ensure sustainment and future support of the group. Members for the initial group will be identified during the first quarter of year 1.

ERAU-Worldwide has a demonstrated ability to coordinate the formation and sustainment of committees, groups, and working groups. These functional groups have historically been created to gain insight, perspective, and further understanding of a topic, emerging technology, or field. Their composition, scope, and length of term are typically based on the specific need predicated their formation (e.g., in support of accreditation requirements; curricula review; workforce development; and topical stakeholder engagement). Examples include the Worldwide Campus' Industry Advisory Board, the School of Engineering's Engineering Advisory Board, the Unmanned Aircraft System Stakeholder Group, and the M.S. in Airworthiness Engineering Program Advisory Board.

Methodology

In this project, our goal is to continue to improve the Research Scholars program to best support the high-impact practice of undergraduate research for students completing their degrees exclusively online. Specifically, we aim increase participation in undergraduate research in this student population, with the benefits of improving student perspectives and promoting STEM career pathways.

Study Population

The proposed Research Scholars Program will be available to all ERAU Worldwide undergraduate students, including the workshops, mentoring, and the STEM Research Minor program. Additionally, workshops and mentoring will be available to graduate students. Specifically, mentoring will be available to graduate students both as mentees and for participation as a near-peer mentor to undergraduate students.

In academic year 2021-2022, over 20,000 students enrolled at ERAU-Worldwide with 76% of them as undergraduates. Active military students accounted for 53% of the population and 19% were veterans. In

terms of gender, 83% of students were male and 17% were female. For ethnicity, 53% were white, 9% black, 5% Asian, and 17% were Hispanic/Latino.

Data Collection

Specific research questions (RQs) are presented in Table 2. We will also collect data to address long term research questions (LTRQs) aimed at STEM degree persistence, development of transferable skills, and mastery of research learning outcomes. Because of the timeline, only anecdotal and preliminary data can be disseminated during the lifetime of this project.

Table 2: Research Questions and Data Sources

Research Question	Institutional Data	Semi-Structured Interviews	Surveys
RQ1: What aspects of the Research Scholars (RS) program increase participation in undergraduate research?	X	X	X
RQ2: How does participation in undergraduate research differ among sub-groups of online students?	X		X
RQ3: How do aspects of the RS program affect STEM attitudes of online STEM students?		X	X
RQ4: How do aspects of the RS program affect STEM identity of online STEM students?		X	X
RQ5: How do aspects of the RS program affect STEM career ambitions?			X
LTRQ1: How do aspects of the RS program affect STEM degree persistence?	X	X	
LTRQ2: How do aspects of the RS program affect development of transferable skills?	X	X	
LTRQ3: How do aspects of the RS program affect the development of research skills in online students?	X	X	

To address RQ1, we will use institutional data regarding participation in mentoring, workshops, and enrollment in the STEM Research Minor to understand current undergraduate research participation among Worldwide students. Additionally, the research interest survey previously administered by the research team will be replicated to determine if improvements in the awareness of and participation in undergraduate research across the Worldwide campus can be measured and to determine if the Research Scholars program might have removed potential barriers to participation, as evidenced by a shift in the predominant perceived barriers. Interviews will further explore aspects of the research interest survey, with specific questions to be informed by the results of the replication of the survey. This data will also allow us to evaluate undergraduate research participation among sub-groups of the online student population based on demographic and other descriptive characteristics such as age, gender, military affiliation, first time in college status, first-generation in college status, and ethnicity (RQ2).

To address RQ3, RQ4, and RQ5, we will identify new participants in the Research Scholars program to recruit for survey participation, with the survey including the STEM Identity Scale (Dou et al., 2019), STEM Attitudes Survey (Guzey et al., 2014), and STEM Career Ambitions (Carpie et al., 2017). Both the

STEM Identity Scale and STEM Attitudes Survey have demonstrated construct validity are being used with current educational research studies. Later, students from this pool who have engaged in mentoring, attended workshops, and/or been research-active under faculty supervision will be recruited to repeat the survey to measure differences. Additionally, interviews can help collect nuanced perspectives and experiences related to STEM perspectives and career ambitions.

Preliminary data related to STEM degree persistence (LTRQ1) will be collected from Institutional Research based on the students' declared degree programs. Interviews of active Research Scholars students can also explore intended STEM degree persistence and how research engagement may have been an influence.

Preliminary data related to development and mastery of transferable skills (LTRQ2) and research skills (LTRQ3) in online students engaged in research will be explored through learning management system (LMS) data. Undergraduate research can help students develop transferable skills embodied by ERAU's General Education competencies (critical thinking, quantitative reasoning, information literacy, communication, scientific literacy, and collaborative learning). Specific course activities in RSCH 395 will be used as direct measures and voluntary End of Course Evaluation data from the course (institutional data) will be used as an indirect measure. Anecdotal evidence in this area can be collected through interviews that explore how workshops, mentoring, and supervised research experiences each contributed to skills development. With the alignment of research learning outcomes between RSCH 202 and RSCH 395, individual student progress towards mastery can be mapped. Though it is not likely that many students will engage in both the updated RSCH 202 and the RSCH 395 course within the timeline of this study, we will track this data for long-term evaluation of the program.

This study will be reviewed by ERAU's Institutional Review Board. The project will proceed in a manner aligned with research participant protection, including informed consent, privacy, and data confidentiality.

Data Analysis

A mixed-methods approach will be employed to provide robust evidence for the various potential effects of the RS program on participants. Institutional data will be analyzed through descriptive quantitative statistics. In particular, correlative measures will be calculated to identify effects of the RS program on: student participation in undergraduate research (RQ1), STEM degree persistence (LTRQ1), development of transferable skills development (LTRQ2), and research skills (LTRQ3). Semi-Structured Interviews will be analyzed through open coding of student responses. Codes will be compared and consolidated to provide qualitative evidence for potential effects of the RS program, especially related to STEM attitudes (RQ3) and STEM identify (RQ4). Surveys will be quantitatively analyzed according to their associated metrics. Note that each of the established surveys (Attitudes, Identity, Career Ambitions) provide quantitative data toward a research question (RQ3, RQ4, and RQ5, respectively).

Dissemination Plan

As part of this project, we propose traditional and strategic dissemination activities. We plan to engage in conferences, presenting our preliminary data related to research interest and participation by exclusively online STEM students, as well as the influence on STEM perspectives and STEM career pathways. A conference that would be appropriate is the 2024 Transforming STEM Higher Education conference, hosted by the American Association of Colleges and Universities in Fall each year.

We also plan to engage an academic audience regarding the overall Research Scholars program, including its refinement over time based on barriers and subsequent course corrections. A conference that would be appropriate is the 2025 Florida Statewide Symposium on Best Practices in Undergraduate Research, hosted by the Florida Undergraduate Research Association. Results will also be presented at the invited

NSF session at the annual ASEE conference. Specific details related to the mentoring offered through the Research Scholars program would be well suited for the 2025 University of New Mexico's Mentoring Conference.

We plan to replicate the research interest study, this time to explore impact of Research Scholars program, which would fit the scope of journals including *Journal of Experiential Education* (readership of over 87,000) or *International Review of Research in Open and Distributed Learning* (impact factor 2.770, open access). The results of participation rates, STEM perspectives and career pathways would fit the scope of journals including *Computers and Education* (impact factor 11.182) or *Internet and Higher Education* (impact factor 8.591).

We will also engage in strategic dissemination measures. We will prepare a Research Summary Document to provide an overview of completed and ongoing research resulting from the Research Scholars program, clearly presenting key findings and primary themes with a graphical abstract. This will be a publicly available document through Scholarly Commons, ERAU's open access digital repository. The outcomes from this work will also be advertised on a public-facing page for the Research Scholars program on ERAU's website. This page will include the Research Summary Document, Research Mentor profiles, and links to student research products, among other things.

Research Scholars Program Effectiveness Evaluation

This project will proceed over a 3-year study period (Table 3). Over this time, formative and summative evaluation of aspects of the program will be performed to ensure project goals are met (Table 4). Formal external evaluation of this project will occur as annual reports. Informal external evaluation will be ongoing, with semiannual feedback from the advisory board to the research team, including input on progress, barriers, and accomplishments. Feedback from the advisory board will be incorporated into the team activities and deliverables. This external review will ensure that our deliverables are high-quality and broadly applicable, as it is our goal to make the outcomes and program design publicly available for other practitioners and administrators at other institutions to review. Specifically, the board will review and advise on:

- Data, analysis, and interpretations of data
- Completion of project goals and objectives
- Program effectiveness, measured as achievement of benchmarks (Table 4)
- Dissemination plan
- Final deliverables

Table 3: Timeline for Development and Analysis of Phase 2 of Research Scholars Program

Tasks	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Align research learning outcomes in RSCH 202 and RSCH 395	X											
Redevelop RSCH 395 as a Culminating Experience (curriculum change form & instructional design)		X	X									
Establish near-peer cohort of graduate student mentors	X	X										
Expand VECTOR Resources	X	X	X									

Develop STEM Research Minor	X X X		
Develop upper-level research ethics course	X X X		
Conference dissemination of preliminary data	X	X X	
Conference dissemination of the Research Scholars program		X	X X
Research Summary Document and manuscript preparation			X X X X
Formal external evaluation		X X	X X
Establish and administer undergraduate research grant program	X X X X	X X X X	X X X X
Establish and administer Undergraduate Research Award	X X X X	X X X X	X X X X
Develop & offer Research Scholars workshop series	X X X X	X X X X	X X X X
Administer the COMPASS Research Mentoring Program	X X X X	X X X X	X X X X
Establish and administer Advisory Board	X X X X	X X X X	X X X X

Table 4: Research Scholars Program Evaluation Metrics

Measure	Benchmark
<i>Objective 1: Undergraduate Research Participation by Online STEM Students</i>	
Mentoring: Participation rate	45 mentees (50% over Phase 1)
Mentoring: Satisfaction with Mentor	90% report a positive mentoring experience
Research: Participation rate	30 students (50% over Phase 1)
Research: Satisfaction with Research Supervisor	90% report a positive experience
Workshops: Participation rate	Average attendance of 10 students
Workshops: Satisfaction	90% report a positive experience
<i>Objective 2: Student Research Productivity</i>	
Publication of peer-reviewed scholarly work	70% will submit a manuscript as a co-author by graduation
Presentation at a conference	70% will present by graduation
Innovative dissemination strategies	30% will use innovative dissemination methods
Secure internal funding for research	40% will secure internal funding
Achievement of the Undergraduate Research Certificate	50% will earn the award at graduation
Achievement of the Distinguished Undergraduate Researcher Award	Two students will earn the award each year of the project
<i>Objective 3: STEM Attitudes</i>	

Improved STEM attitudes: individual	70% will have an improved STEM identity between early and late phase research engagement
Improved STEM attitudes: program	Research-active students will have improved STEM identity compared to non-research active students at approximately the same degree progress
<i>Objective 4: STEM Career Pathways</i>	
Improved STEM identity: individual	70% will have an improved STEM identity between early and late phase research engagement
Improved STEM identity: program	Research-active students will have improved STEM identity compared to non-research active students at approximately the same degree progress
Improved STEM career ambitions: individual	70% will demonstrate improvement between early and late phase research engagement
Improved STEM career ambitions: program	Research-active students will have improved STEM career ambitions compared to non-research active students at approximately the same degree progress
<i>Program</i>	
Research minor	30 students
Mentoring	45 mentees and 9 graduate near-peer mentors
Workshops	Average attendance of 10 students
Conference dissemination	2 oral presentations at conferences provided
Manuscript dissemination	2 research manuscripts submitted for peer review
Research summary document	Document posted on Scholarly Commons
Public-facing website	Website linked on ERAU's website

Broader Impacts

Improved STEM Education

Online STEM programs face persistence problems, and the STEM career pipeline needs prepared graduates. Among many other benefits, undergraduate research has been shown to positively impact disciplinary knowledge, persistence, retention, and STEM identity particularly for minority students (Betz et al., 2021; Carpi et al., 2017; Howitt et al., 2022; Shuster et al., 2019). The Research Scholars program supported through this project brings the high-impact practice of undergraduate research to STEM students completing their degrees exclusively online and offers students a community, allowing them to develop a strong self-identity in STEM in what can be daunting fields to enter. In Phase 1 of the Research Scholars program, more than 200 undergraduate STEM students were engaged with and joined the collaborative group space setup for the project within the Canvas LMS.

This proposed project further builds community and identity through two key approaches. First, research-active students will participate in credit-bearing undergraduate research through a cohort-style course rather than an independent study. Second, the near-peer mentoring will connect undergraduate students, graduate students, and research-active faculty. The research literature and the outcomes of the pilot of the Research Scholars program demonstrate there are clear benefits to students and faculty. This proposed Phase 2 of the Research Scholars program will expand undergraduate research support, addressing key realized barriers, and will result in even greater participation. We will observe STEM attitudes, with a long-term data collection plan aimed at STEM degree persistence as well as development of research and transferable skills. Participation is anticipated to grow, by at least 50-percent (e.g., 300 total students engaged across various mediums and resources), through the inclusion of additional educational disciplines, graduate students, and further resources intended to support engagement, mentorship, and outreach.

By supporting undergraduate research, this project also enhances the research capacity of the institution. During Phase 1, the researchers produced four manuscripts (Faulconer, Terwilliger, et al., 2022; Deters et al., 2022; Faulconer, George, et al., 2022a; Faulconer, George, et al., 2022b), three abstracts, 11 research skills workshops (14 by end of Phase 1), and two internal presentations: Recruitment and Topical Development townhall in 2021 and a College of Aeronautics Stay Current Discussion in 2022. These materials supported the dissemination of research observations, results, and recommendations, as well as further developing networking, resource development, and programmatic recruitment of students and faculty.

Globally Competitive STEM Workforce

ERAU-Worldwide students are distributed globally. With a focus on career pathways through STEM identity and career ambitions, this project helps develop a globally competitive STEM workforce.

Potential to be Transformative

The core team for the project proposed here were the key individuals in Phase 1 of the Research Scholars program. Despite hurdles and barriers, the team achieved key outcomes and identified a path to move the program forward. Key individuals have been added to this proposed project to address project needs and existing skill sets.

We believe positive results here can change the expectation of what is possible for distance students, breaking stereotypes about online education. Because this framework could be adopted by other institutions, we have designed our dissemination efforts to reach both administrators and practitioners. The results of the Phase 1 research have been used to further refine the student's research learning and development experience, while subsequent observations and findings from Phase 2 will be used to create sharable recommendations and resources, such as articles, presentations and briefings, and guidance materials, in furtherance of instrumental research skills. Feedback and observations from student participation in Phase 1 have already exhibited the positive influence from participation in the program, including increased awareness and proficiency with research development, experience growth, and the formation of a research portfolio with distributable materials. Phase 2 can capitalize on this foundation to include a larger student base; further engagement, and support from within the graduate student population; and additional perspective, mentorship, and resources from the advisory board.

Project Personnel and Roles

Robert Deters, PI, (Ph.D. Aerospace Engineering) is an Associate Professor and Program Coordinator for the B.S. Engineering Technology degree. He is an active researcher with recent publications on topics including propeller aeroacoustics testing, propeller-induced flow effects, and propulsion elements for multirotor unmanned aerial vehicles. For this project, Dr. Deters will lead the project through the

following roles: 1) Research Scholars Workshop Co-Coordinator, 2) Research Scholars Travel & Research Grant Program Co-Coordinator, 3) Distinguished Undergraduate Researcher of the Year Award Co-Coordinator, and 4) Advisory Board Coordinator. Dr. Deters will actively support all dissemination efforts, including conference presentations and manuscript preparation. Dr. Deters will manage grant supervision and project administration efforts including budget management, interim reporting, and external evaluation.

Emily Faulconer, Co-PI, (Ph.D. Environmental Engineering Sciences) is an Associate Professor in the Math, Science, & Technology Department at Embry-Riddle Aeronautical University, Worldwide Campus. Her research has focused on the scholarship of teaching and learning, specifically online education and undergraduate research. Dr. Faulconer will lead the project through the following roles 1) Research Minor Coordinator, 2) Research Scholars Workshop Co-Coordinator, 3) Research Scholars Travel & Research Grant Program Co-Coordinator, and 4) Distinguished Undergraduate Researcher of the Year Award Co-Coordinator. Dr. Faulconer will also co-manage human subjects and data collection efforts. Dr. Faulconer will actively support all dissemination efforts, including conference presentations and manuscript preparation.

Brent Terwilliger, Co-PI, (Ph.D. Business Administration) is an Associate Professor of Aeronautics for the College of Aviation at Embry-Riddle Aeronautical University, Worldwide Campus. He is an active researcher with many recent publications in unmanned systems application and development, training, and operation. Dr. Terwilliger will lead the project through the following roles: 1) Research Scholars Workshop Co-Coordinator, 2) Research Mentor Coordinator, 3) Research Scholars Travel & Research Grant Program Co-Coordinator, and 4) Distinguished Undergraduate Researcher of the Year Award Co-Coordinator. Dr. Terwilliger will also co-manage human subjects and data collection efforts. Dr. Terwilliger will actively support all dissemination efforts, including conference presentations and manuscript preparation.

Darryl Chamberlain, Co-PI (Ph.D. Mathematics and Statistics) is an Assistant Professor in the Math, Science, & Technology Department at Embry-Riddle Aeronautical University, Worldwide Campus. He engages in action research through technology, designing theoretically and experimentally driven open-source educational materials to enhance student learning. Dr. Chamberlain will lead the project through the following roles: 1) Data Analyst 2) Research Scholars Workshop Co-Coordinator, 3) Research Scholars Travel & Research Grant Program Co-Coordinator, and 4) Distinguished Undergraduate Researcher of the Year Award Co-Coordinator.

Donna Roberts, Research Associate, (Ph.D. Psychology) is a Professor and Associate Dean for Faculty for the College of Arts and Sciences, Worldwide Campus. Dr. Roberts will support this project through leading the course design efforts, including aligning research learning outcomes between RSCH 202 and RSCH 395, refreshing RSCH 395 as a culminating experience, and developing the upper-level research ethics course.

Results from Prior NSF Support

NSF DUE -IUSE (Proposal #2021221): *Undergraduate Research in a Fully Online Engineering Program: Effects on Retention, Performance, STEM attitudes, and Identity.* PI: **E. Faulconer**, Co-PIs: **B. Terwilliger** and **R. Deters**. \$295,966 for 10/1/2020 – 9/30/2023. **Intellectual merit:** The key deliverable is a framework that can be transferred and scaled to other degree programs. Another key contribution of this study is the data generated regarding the student impacts of participating in this high-impact practice in an online environment, which can be disseminated for a broad audience through manuscript publication. High-impact practices in online educational settings is a relatively new area of research. This study collects multiple types of data on approximately 15 B.S. Engineering Technology students in the pilot study. This data set can allow us to identify the frameworks that best support undergraduate research

for distance students. To date, this project has produced 2 conference presentations (Faulconer, Deters, et al., 2021; Deters et al., 2022) with 2 invited talks pending, 2 research manuscript under review (Faulconer, George, et al., 2022a; Faulconer, George, et al., 2022b) and 1 in progress, and 1 strategic dissemination artifact (Faulconer, Terwilliger, et al. 2022). **Broader impacts:** Many traditional engineering programs offer undergraduate research opportunities, with varying levels of support. Using the knowledge gained in this study, we can develop a framework that can be used by other institutions to support undergraduate research in STEM degrees. The plan will highlight actions that are most likely to improve student learning, persistence, retention, and perspectives. This project will provide a framework for enhancing access to research experiences within the growing body of students enrolled in fully online STEM degree programs. We believe positive results here can change the expectation of what is possible for distance students, breaking stereotypes about online education.

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Wang, C., Bauer, M., Burmeister, A. R., Hanauer, D. I., & Graham, M. J. (2020). College student meaning making and interest maintenance during COVID-19: From course-based undergraduate research experiences (CUREs) to science learning being off-campus and online. *Frontiers in Education*, 5, 251. <https://doi.org/10.3389/feduc.2020.590738>

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NSF BIOGRAPHICAL SKETCH

NAME: Deters, Robert

POSITION TITLE & INSTITUTION: Associate Professor, Embry-Riddle Aeronautical University

(a) PROFESSIONAL PREPARATION -(see PAPPG Chapter II.C.2.f.(a))

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if applicable)	YEAR YYYY
West Virginia University	Morgantown, WV	Aerospace Engineering	BS	2000
West Virginia University	Morgantown, WV	Mechanical Engineering	BS	2000
University of Illinois at Urbana-Champaign	Urbana, IL	Aeronautical and Astronautical Engineering	MS	2003
University of Illinois at Urbana-Champaign	Urbana, IL	Aerospace Engineering	PHD	2014
University of Illinois at Urbana-Champaign	Urbana, IL		Postdoctoral Fellow	2014 - 2014

(b) APPOINTMENTS -(see PAPPG Chapter II.C.2.f.(b))

- 2020 - present Associate Professor, Embry-Riddle Aeronautical University, Daytona Beach, FL
 2015 - present Program Coordinator, B.S. in Engineering Technology, Embry-Riddle Aeronautical University, Daytona Beach, FL
 2014 - 2020 Assistant Professor, Embry-Riddle Aeronautical University, Daytona Beach, FL

(c) PRODUCTS -(see PAPPG Chapter II.C.2.f.(c))**Products Most Closely Related to the Proposed Project**

1. Deters, R., Terwilliger, B., Faulconer, E., George, K. Building Undergraduate Research in a Fully Online Engineering Program. 2022 ASEE Annual Conference & Exposition; ; c2022. Available from: <https://peer.asee.org/42093>
2. Deters, R., Coppola, J., Coppola, R. Impact of moving an international aviation design competition to a virtual environment: challenges, benefits, and lessons learned (Evaluation). 2022 ASEE Annual Conference & Exposition; ; c2022. Available from: <https://peer.asee.org/41278>
3. Faulconer, E., Terwilliger, B., Deters, R., George, K. Is a Framework of Support Enough? Undergraduate Research for Online STEM Students. Journal of College Science Teaching 51(3). 2022. Available from: <https://commons.erau.edu/publication/1682>
4. Deters R, Terwilliger B, Kleinke S, Coppola R, Coppola J. Ten Years of the Real World Design Challenge. 2018 AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference; ; c2018. Available from: <https://arc.aiaa.org/doi/10.2514/6.2018-0050>

Other Significant Products, Whether or Not Related to the Proposed Project

1. Ananda G, Selig M, Deters R. Experiments of Propeller-Induced Flow Effects on a Low-Reynolds-Number Wing. AIAA Journal. 2018 August; 56(8):3279-3294. Available from: <https://arc.aiaa.org/doi/10.2514/1.J056667> DOI: 10.2514/1.J056667

2. Dantsker O, Caccamo M, Deters R, Selig M. Performance Testing of APC Electric Fixed-Blade UAV Propellers. AIAA AVIATION 2022 Forum. AIAA AVIATION 2022 Forum; ; Chicago, IL & Virtual. Reston, Virginia: American Institute of Aeronautics and Astronautics; c2022. Available from: <https://arc.aiaa.org/doi/10.2514/6.2022-4020> DOI: 10.2514/6.2022-4020
3. Maier, N., Narsipur, S., Deters, R.. Parametric Performance Study of the Aerodynamics and Aeroacoustics of Small Propellers in Static Conditions. AIAA AVIATION 2021 FORUM; 2021; American Institute of Aeronautics and Astronautics; c2021. Available from: <http://dx.doi.org/10.2514/6.2021-2223>
4. Deters, R.W., Ananda, G.K., Selig, M.S. Slipstream Measurements of Small-Scale Propellers at Low Reynolds Numbers. 33rd AIAA Applied Aerodynamics Conference; 2015; c2015. Available from: <https://doi.org/10.2514%2F6.2015-2265>
5. Deters, R.W., Ananda, G.K., Selig, M.S. Reynolds Number Effects on the Performance of Small-Scale Propellers. 32nd AIAA Applied Aerodynamics Conference; 2014; c2014. Available from: <http://dx.doi.org/10.2514/6.2014-2151>

(d) SYNERGISTIC ACTIVITIES -(see PAPPG Chapter II.C.2.f.(d))

1. Technical lead for the Real World Design Challenge, a high school STEM competition in the field of aviation and engineering (2015-present)
2. Faculty advisor for AIAA student branch at ERAU-Worldwide

NSF BIOGRAPHICAL SKETCH

NAME: Faulconer, Emily

POSITION TITLE & INSTITUTION: Associate Professor, Embry-Riddle Aeronautical University

(a) PROFESSIONAL PREPARATION -(see PAPPG Chapter II.C.2.f.(a))

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if applicable)	YEAR YYYY
Virginia Commonwealth University	Richmond, VA	Forensic Science	BS	2004
University of Florida	Gainesville, FL	Environmental Engineering Sciences	DPHIL	2012

(b) APPOINTMENTS -(see PAPPG Chapter II.C.2.f.(b))

- 2021 - present Associate Professor, Embry-Riddle Aeronautical University, Daytona Beach, FL
 2012 - 2021 Assistant Professor, Embry-Riddle Aeronautical University, Daytona Beach, FL
 2008 - 2012 Graduate Teaching Assistant, University of Florida, Gainesville, FL
 2006 - 2008 Adjunct Instructor, Tidewater Community College, Suffolk, VA

(c) PRODUCTS -(see PAPPG Chapter II.C.2.f.(c))**Products Most Closely Related to the Proposed Project**

1. Faulconer E, Griffith J, Gruss A. The impact of positive feedback on student outcomes and perceptions. *Assessment & Evaluation in Higher Education*. 2021 April 18; 47(2):259-268. Available from: <https://www.tandfonline.com/doi/full/10.1080/02602938.2021.1910140> DOI: 10.1080/02602938.2021.1910140
2. Faulconer E. eService-Learning: A Decade of Research in Undergraduate Online Service-learning. *American Journal of Distance Education*. 2020 December 07; 35(2):100-117. Available from: <https://www.tandfonline.com/doi/full/10.1080/08923647.2020.1849941> DOI: 10.1080/08923647.2020.1849941
3. Comparing Online and Traditional Student Engagement and Perceptions of Undergraduate Research. *Scholarship and Practice of Undergraduate Research*. 2020. Available from: <https://doi.org/10.18833/spur/3/3/1>
4. Perspectives on undergraduate research mentorship: a comparative analysis between online and traditional faculty. *Online Journal of Distance Learning Administration*. . Available from: https://www.westga.edu/~distance/ojdl/summer232/faulconer_dixon_griffith_faulconer232.htm

Other Significant Products, Whether or Not Related to the Proposed Project

1. Faulconer E, Bolch C, Wood B. Cognitive load in asynchronous discussions of an online undergraduate STEM course. *Journal of Research in Innovative Teaching & Learning*. 2022 November 15; :-. Available from: <https://www.emerald.com/insight/content/doi/10.1108/JRIT-02-2022-0010/full/html> DOI: 10.1108/JRIT-02-2022-0010
2. Does Instructor Quality Affect Student Grades in a College Statistics Course?. *Online Journal of Distance Learning Administration*. 2021. Available from: https://www.westga.edu/~distance/ojdl/spring241/griffith_faulconer_mcmasters241.html

3. Faulconer E, Wood B, Griffith J. Infusing Humanities in STEM Education: Student Opinions of Disciplinary Connections in an Introductory Chemistry Course. *Journal of Science Education and Technology*. 2020 March 20; 29(3):340-345. Available from: <http://link.springer.com/10.1007/s10956-020-09819-7> DOI: 10.1007/s10956-020-09819-7
4. Faulconer E, Griffith J. Identifying Sources of Anxiety in an Introductory Online Undergraduate Chemistry Course. *Journal of Science Education and Technology*. 2021 September 23; 31(1):143-151. Available from: <https://link.springer.com/10.1007/s10956-021-09937-w> DOI: 10.1007/s10956-021-09937-w
5. Faulconer E, Kam C. Service-Learning in Undergraduate General Chemistry: A Review. *Journal of Experiential Education*. 2022 April 04; :105382592210921-. Available from: <http://journals.sagepub.com/doi/10.1177/10538259221092141> DOI: 10.1177/10538259221092141

(d) SYNERGISTIC ACTIVITIES -(see PAPPG Chapter II.C.2.f.(d))

1. Certified scorer for the Critical Thinking VALUE rubric (American Association of Colleges & Universities), 2020 - 2021.
2. Participated in the Spring 2022 virtual Faculty Learning Community on Diversity, Equity, and Inclusion and the Fall 2020 virtual Faculty Learning Community on Teaching Philosophy.
3. Editorial published in Journal of College Science Teaching titled "Is a Framework of Support Enough? Undergraduate Research for Online STEM Students", published in 2022, Volume 51, Issue 3.
4. Co-coordinated Research Scholars Workshops to support undergraduate research, with 2022 topics covering how to join faculty research, finding a faculty research supervisor, the student research experience, academic vs. industry research, building into graduate school, promoting research on your resume, and writing a research proposal.
5. Deters, R., Terwilliger, B., Faulconer, E., & George, K. (June 2022) "Building Undergraduate Research in a Fully Online Engineering Program" American Society for Engineering Education Annual Conference & Exposition, Minneapolis, MN

Effective 10/04/2021**NSF BIOGRAPHICAL SKETCH****OMB-3145-0058**

NAME: Terwilliger, Brent Andrew

POSITION TITLE & INSTITUTION: : Associate Professor, Embry-Riddle Aeronautical University

A. PROFESSIONAL PREPARATION - (see [PAPPG Chapter II.C.2.f.\(i\)\(a\)](#))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Embry-Riddle Aeronautical University	Daytona Beach, FL	Aerospace Studies	BS	2000
Embry-Riddle Aeronautical University	Daytona Beach, FL	Aeronautical Science	MS	2005
Northcentral University	Prescott Valley, AZ	Business Administration	PHD	2012

B. APPOINTMENTS - (see [PAPPG Chapter II.C.2.f.\(i\)\(b\)](#))

From - To	Position Title, Organization and Location
2018 - present	Associate Professor, Embry-Riddle Aeronautical University, Daytona Beach, FL
2018 - 2020	Associate Dean for Research, College of Aeronautics, Embry-Riddle Aeronautical University, Daytona Beach, FL
2018 - 2019	Program Chair, MS in Unmanned and Autonomous Systems Engineering, College of Aeronautics, Embry-Riddle Aeronautical University, Daytona Beach, FL
2013 – 2017, 2019-present	Program Coordinator/Chair, MS in Unmanned Systems, College of Aeronautics, Embry-Riddle Aeronautical University, Daytona Beach, FL
2013	Associate Program Chair, MS in Aeronautics, College of Aeronautics, Embry-Riddle Aeronautical University, Daytona Beach, FL
2012 - 2018	Assistant Professor, College of Aeronautics, Embry-Riddle Aeronautical University, Daytona Beach, FL

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

1. Wallace, R.J., Terwilliger, B.A., Winter, S.R., Rice, S., Kiernan, K.M.; Burgess, S.S., Anderson, C.L., De Abreu, A., Arboleda, G., & Gomez, L. (2022, August 1). Small Unmanned Aircraft System (sUAS) Traffic Analysis (A11L.UAS.91): Initial Annual Report. Report prepared for the U.S. Department of Transportation, Federal Aviation Administration, Office of Aviation Research.
2. Booz Allen Hamilton, Embry-Riddle Aeronautical University, Hogan Lovells, Kimley Horn and Associates, Novel Engineering, Toltz, King, Duvall, Anderson, and Associates, Vanesse Hangen Brustlin, Inc. (2019). Task B: Engaging stakeholders in unmanned aircraft systems (UAS; report no. ACRP 03-42: Airports and UAS). Prepared for the Transportation Research Board, Airport Cooperative Research Program [B.Terwilliger, Co-PI and contributing author].
3. Deters, R., Terwilliger, B., Kleinke, S., Coppola, R., & Coppola, J. (2017). Ten years of the Real World Design Challenge (paper no. 2792639). Proceedings of the 2018 AIAA Science and Technology Forum and Exposition (SciTech). Reston, VA: American Institute of Aeronautics and Astronautics. doi:10.2514/6.2018-0050
4. Terwilliger, B. (2017). Examining critical elements to support development and delivery of sUAS flight training [expanded content]. International Journal of Unmanned Systems Engineering, 5(1), 54-74. doi: 10.14323/ijuseng.2017.4
5. Faulconer, E., Terwilliger, B., Deters, R., & George, K. (2022) Is a Framework of Support Enough? Undergraduate Research for Online STEM Students. Journal of College Science Teaching 51(3). <https://commons.erau.edu/publication/1682>

Other Significant Products, Whether or Not Related to the Proposed Project

1. Deters, R., Terwilliger, B., Faulconer, E., & George, K. (2022). Building undergraduate research in a fully online engineering program. Paper presented at 2022 ASEE Annual Conference & Exposition, Minneapolis, MN.
2. Rosser, J.C., Vignesh, V., Terwilliger, B.A., & Parker, B.C. (2018). Surgical and medical applications of drones: A comprehensive review. *Journal of the Society of Laparoscopic Surgeons*, 22(2), 1-27. doi: 10.4293/JSL.2018.00018
3. Balog, C., Terwilliger, B., Vincenzi, D., & Ison, D. (2016). Examining human factors challenges of sustainable small unmanned aircraft (sUAS) system operations. In P. Savage-Knepshield, & J. Chen (Eds.), *Advances in Human Factors in Robots and Unmanned Systems. Proceedings of the AHFE 2016 International Conference on Human Factors in Robots and Unmanned Systems*, 499 (pp. 61-74). New York, NY: Springer International Publishing. doi: 10.1007/978-3-319-41959-6
4. Terwilliger, B., Vincenzi, D., & Ison, D. (2015). Unmanned aerial systems: Collaborative innovation to support emergency response. *Journal of Unmanned Vehicle Systems*, 3(2), 31-34. doi: 10.1139/juvs-2015-0004
5. Terwilliger, B., Vincenzi, D., Ison, D., Witcher, K., Thirtyacre, D., & Khalid, A. (2015). Influencing factors for use of unmanned aerial systems in support of aviation accident and emergency response. *Journal of Automation and Control Engineering*, 3(3), 246-252. doi: 10.12720/joace.3.3.246-252

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

1. Engaged and fostered collaborative research and development activities among a diverse population, including 9-12 STEM high school students, non-traditional working professional undergraduate students, graduate students, doctoral candidates, and postdoctoral colleagues
2. Provided subject matter expertise review for the evaluation of funding requests, proposed presentation and academic papers, and refereed publication materials
3. Provided service to the international aviation/aerospace, engineering, and robotic systems communities, as a member of technology assessment and policy monitoring committees, including those related to uncrewed/unmanned systems, emerging technologies, and academic curricula design, development, and delivery
4. Prepared, delivered, and revised academic degree materials (e.g., program and course designs, curriculum maps, skills development activities, student assessment materials, career and workforce development strategies, innovative student engagement approaches, and academic support materials) through a variety of formats and modalities within the online education space
5. Developed, distributed, and sustained materials supporting career development and employment to assist uncrewed/unmanned system professionals to establish, reinforce, and apply critical knowledge, skills, and abilities contributing towards achieving success in field

NSF BIOGRAPHICAL SKETCH

NAME: Chamberlain, Darryl

ORCID: 0000-0001-9724-3225

POSITION TITLE & INSTITUTION: Assistant Professor, Embry-Riddle Aeronautical University

(a) PROFESSIONAL PREPARATION -(see PAPPG Chapter II.C.2.f.(a))

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if applicable)	YEAR YYYY
University of Florida	Gainesville, Florida	Mathematics	BS	2010
Georgia State University	Atlanta, Georgia	Mathematics and Statistics	PHD	2017

(b) APPOINTMENTS -(see PAPPG Chapter II.C.2.f.(b))

- 2021 - present Assistant Professor, Embry-Riddle Aeronautical University, Department of Mathematics, Science, & Technology, Daytona Beach, FL
- 2017 - 2021 Assistant Teaching Professor, University of Florida, Mathematics, Gainesville, FL

(c) PRODUCTS -(see PAPPG Chapter II.C.2.f.(c))**Products Most Closely Related to the Proposed Project**

- Chamberlain D, Grady A, Keeran S, Knudson K, Manly I, Shabazz M, Stone C, York A. Transitioning to an Active Learning Environment for Calculus at the University of Florida. PRIMUS. 2020 June 04; 31(3-5):517-531. Available from: <https://www.tandfonline.com/doi/full/10.1080/10511970.2020.1769235> DOI: 10.1080/10511970.2020.1769235
- Faulconer E, Chamberlain D, Wood B. A Case Study of Community of Inquiry Presences and Cognitive Load in Asynchronous Online STEM Courses. Online Learning. 2022 September 01; 26(3):-. Available from: <https://olj.onlinelearningconsortium.org/index.php/olj/article/view/3386> DOI: 10.24059/olj.v26i3.3386

Other Significant Products, Whether or Not Related to the Proposed Project

- Stalvey H, Burns-Childers A, Chamberlain D, Kemp A, Meadows L, Vidakovic D. Students' understanding of the concepts involved in one-sample hypothesis testing. The Journal of Mathematical Behavior. 2019 March; 53:42-64. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S073231231730216X> DOI: 10.1016/j.jmathb.2018.03.011
- Chamberlain D, Jeter R. Creating Diagnostic Assessments. Journal of Assessment in Higher Education. 2020 April 02; 1(1):30-49. Available from: <https://journals.flvc.org/assessment/article/view/116892> DOI: 10.32473/jahe.v1i1.116892
- Stalvey H, Burns-Childers A, Chamberlain D, Kemp A, Meadows L, Vidakovic D. Students' understanding of the concepts involved in one-sample hypothesis testing. The Journal of Mathematical Behavior. 2019 March; 53:42-64. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S073231231730216X> DOI: 10.1016/j.jmathb.2018.03.011
- Chamberlain D, Vidakovic D. Cognitive trajectory of proof by contradiction for transition-to-

proof students. The Journal of Mathematical Behavior. 2021 June; 62:100849-. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0732312321000109> DOI: 10.1016/j.jmathb.2021.100849

(d) SYNERGISTIC ACTIVITIES -(see PAPPG Chapter II.C.2.f.(d))

1. Chair for Mathematics Association of America Committee on Technology in Mathematics Education.
2. Development of open-source online homework system utilizing Ximera (NSF Award #1245433). Questions are generated dynamically utilizing SageMath and Python. Content created for traditional College Algebra course.
3. Co-PI - Community of Inquiry and Cognitive Load in Online STEM: Persistence, Performance, and Perspectives (2021--2024). NSF IUSE grant. PI: Dr. E. Faulconer. Co-PI: Dr. B. Wood.
4. PI - Developing Autonomous, Targeted Feedback in Precalculus (2021--2022). Embry-Riddle Aeronautical University Faculty SEED Grant.
5. Co-PI - Examining and addressing the content knowledge development needs of Florida's aspiring and newly-qualified mathematics teachers (2020-2021). College Research Incentive Fund (Internal Grant). PI: Dr. C. Paolucci. Co-PI: C. Redding.

Other Personnel Biographical Information

Data Not Available

**SUMMARY
PROPOSAL BUDGET**

YEAR 1

		FOR NSF USE ONLY		
		PROPOSAL NO.		DURATION (months)
		2315560		Proposed Granted
		AWARD NO.		
ORGANIZATION Embry-Riddle Aeronautical University				
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Robert Deters				
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)		NSF Funded Person-months		Funds Requested By proposer
		CAL	ACAD	Funds granted by NSF (if different)
1. Robert Deters - Principal Inv		2.0		21,071
2. Darryl Chamberlain		1.25		9,892
3. Emily Faulconer		1.25		11,584
4. Brent Terwilliger		2.0		22,338
5.				
6. () OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)		0.0		0
7. (4) TOTAL SENIOR PERSONNEL (1 - 6)		6.5		64,885
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)				
1. (0) POST DOCTORAL SCHOLARS		0.0		0
2. (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)		1.0		13,138
3. (3) GRADUATE STUDENTS				3,000
4. (3) UNDERGRADUATE STUDENTS				1,900
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0
6. (0) OTHER				0
TOTAL SALARIES AND WAGES (A + B)				82,923
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				16,166
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				99,089
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)				
TOTAL EQUIPMENT				0
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				1,303
2. INTERNATIONAL				0
F. PARTICIPANT SUPPORT COSTS				
1. STIPENDS \$ 0				
2. TRAVEL 6,000				
3. SUBSISTENCE 0				
4. OTHER 10,400				
TOTAL NUMBER OF PARTICIPANTS (12)		TOTAL PARTICIPANT COSTS		16,400
G. OTHER DIRECT COSTS				
1. MATERIALS AND SUPPLIES				0
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0
3. CONSULTANT SERVICES				0
4. COMPUTER SERVICES				0
5. SUBAWARDS				0
6. OTHER				2,300
TOTAL OTHER DIRECT COSTS				2,300
H. TOTAL DIRECT COSTS (A THROUGH G)				119,092
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) MTDC (Rate: 23.0, Base:102691.0)				
TOTAL INDIRECT COSTS (F&A)				23,619
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				142,711
K. FEE				0
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				142,711
M. COST SHARING PROPOSED LEVEL \$ 0		AGREED LEVEL IF DIFFERENT \$		
PI/PD NAME Robert Deters		FOR NSF USE ONLY		
		INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* Rachel Heinz Randall		Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

**SUMMARY
PROPOSAL BUDGET**

YEAR 2

		FOR NSF USE ONLY		
		PROPOSAL NO.		DURATION (months)
		2315560		Proposed Granted
		AWARD NO.		
ORGANIZATION Embry-Riddle Aeronautical University				
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Robert Deters				
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)		NSF Funded Person-months		Funds Requested By proposer
		CAL	ACAD	Funds granted by NSF (if different)
1. Robert Deters - Principal Inv		2.0		21,703
2. Darryl Chamberlain		1.25		10,188
3. Emily Faulconer		1.0		9,773
4. Brent Terwilliger		1.25		14,667
5.				
6. () OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)		0.0		0
7. (4) TOTAL SENIOR PERSONNEL (1 - 6)		5.5		56,331
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)				
1. (0) POST DOCTORAL SCHOLARS		0.0		0
2. (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)		1.0		13,532
3. (3) GRADUATE STUDENTS				3,000
4. (3) UNDERGRADUATE STUDENTS				1,900
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0
6. (0) OTHER				0
TOTAL SALARIES AND WAGES (A + B)				74,763
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				11,159
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				85,922
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)				
TOTAL EQUIPMENT				0
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				4,495
2. INTERNATIONAL				4,091
F. PARTICIPANT SUPPORT COSTS				
1. STIPENDS \$ 0				
2. TRAVEL 6,000				
3. SUBSISTENCE 0				
4. OTHER 10,400				
TOTAL NUMBER OF PARTICIPANTS (12)		TOTAL PARTICIPANT COSTS		16,400
G. OTHER DIRECT COSTS				
1. MATERIALS AND SUPPLIES				0
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0
3. CONSULTANT SERVICES				0
4. COMPUTER SERVICES				0
5. SUBAWARDS				0
6. OTHER				300
TOTAL OTHER DIRECT COSTS				300
H. TOTAL DIRECT COSTS (A THROUGH G)				111,208
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) MTDC (Rate: 23.0, Base:94808.0)				
TOTAL INDIRECT COSTS (F&A)				21,806
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				133,014
K. FEE				0
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				133,014
M. COST SHARING PROPOSED LEVEL \$ 0		AGREED LEVEL IF DIFFERENT \$		
PI/PD NAME Robert Deters		FOR NSF USE ONLY		
		INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* Rachel Heinz Randall		Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

**SUMMARY
PROPOSAL BUDGET**

YEAR 3

		FOR NSF USE ONLY		
		PROPOSAL NO.		DURATION (months)
		2315560		Proposed Granted
		AWARD NO.		
ORGANIZATION Embry-Riddle Aeronautical University				
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Robert Deters				
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)		NSF Funded Person-months		Funds Requested By proposer
		CAL	ACAD	Funds granted by NSF (if different)
1. Robert Deters - Principal Inv		2.0		22,354
2. Darryl Chamberlain		1.25		10,494
3. Emily Faulconer		1.0		10,066
4. Brent Terwilliger		1.25		15,107
5.				
6. () OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)		0.0		0
7. (4) TOTAL SENIOR PERSONNEL (1 - 6)		5.5		58,021
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)				
1. (0) POST DOCTORAL SCHOLARS		0.0		0
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)		0.0		0
3. (3) GRADUATE STUDENTS				3,000
4. (3) UNDERGRADUATE STUDENTS				1,900
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0
6. (0) OTHER				0
TOTAL SALARIES AND WAGES (A + B)				62,921
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				7,228
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				70,149
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)				
TOTAL EQUIPMENT				0
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				3,090
2. INTERNATIONAL				0
F. PARTICIPANT SUPPORT COSTS				
1. STIPENDS \$ 0				
2. TRAVEL 6,000				
3. SUBSISTENCE 0				
4. OTHER 10,400				
TOTAL NUMBER OF PARTICIPANTS (12)		TOTAL PARTICIPANT COSTS		16,400
G. OTHER DIRECT COSTS				
1. MATERIALS AND SUPPLIES				0
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0
3. CONSULTANT SERVICES				0
4. COMPUTER SERVICES				0
5. SUBAWARDS				0
6. OTHER				300
TOTAL OTHER DIRECT COSTS				300
H. TOTAL DIRECT COSTS (A THROUGH G)				89,939
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) MTDC (Rate: 23.0, Base:73539.0)				
TOTAL INDIRECT COSTS (F&A)				16,914
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				106,853
K. FEE				0
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				106,853
M. COST SHARING PROPOSED LEVEL \$ 0		AGREED LEVEL IF DIFFERENT \$		
PI/PD NAME Robert Deters		FOR NSF USE ONLY		
		INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* Rachel Heinz Randall		Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

**SUMMARY
PROPOSAL BUDGET**

				Cumulative				
				FOR NSF USE ONLY				
ORGANIZATION Embry-Riddle Aeronautical University				PROPOSAL NO. 2315560		DURATION (months)		
						Proposed	Granted	
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Robert Deters						AWARD NO.		
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months			Funds Requested By proposer	Funds granted by NSF (if different)
				CAL	ACAD	SUMR		
1. Robert Deters - Principal Inv				6.0			65,128	
2. Darryl Chamberlain				3.75			30,574	
3. Emily Faulconer				3.25			31,423	
4. Brent Terwilliger				4.5			52,112	
5.								
6. () OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)								
7. (4) TOTAL SENIOR PERSONNEL (1 - 6)				17.5			179,237	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)								
1. (0) POST DOCTORAL SCHOLARS				0.0			0	
2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				2.0			26,670	
3. (9) GRADUATE STUDENTS							9,000	
4. (9) UNDERGRADUATE STUDENTS							5,700	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)							0	
6. (0) OTHER							0	
TOTAL SALARIES AND WAGES (A + B)							220,607	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							34,553	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							255,160	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)								
							0	
TOTAL EQUIPMENT							0	
E. TRAVEL				1. DOMESTIC (INCL. U.S. POSSESSIONS)			8,888	
				2. INTERNATIONAL			4,091	
F. PARTICIPANT SUPPORT COSTS								
1. STIPENDS \$ 0								
2. TRAVEL 18,000								
3. SUBSISTENCE 0								
4. OTHER 31,200								
TOTAL NUMBER OF PARTICIPANTS (36)				TOTAL PARTICIPANT COSTS			49,200	
G. OTHER DIRECT COSTS								
1. MATERIALS AND SUPPLIES							0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION							0	
3. CONSULTANT SERVICES							0	
4. COMPUTER SERVICES							0	
5. SUBAWARDS							0	
6. OTHER							2,900	
TOTAL OTHER DIRECT COSTS							2,900	
H. TOTAL DIRECT COSTS (A THROUGH G)							320,239	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)								
TOTAL INDIRECT COSTS (F&A)							62,339	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							382,578	
K. FEE							0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							382,578	
M. COST SHARING PROPOSED LEVEL \$ 0				AGREED LEVEL IF DIFFERENT \$				
PI/PD NAME Robert Deters				FOR NSF USE ONLY				
				INDIRECT COST RATE VERIFICATION				
ORG. REP. NAME* Rachel Heinz Randall				Date Checked	Date Of Rate Sheet		Initials - ORG	

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Embry-Riddle Aeronautical University (ERAU) Budget Justification

A. Senior Personnel

Robert Deters, PI, (Ph.D. Aerospace Engineering) is an Associate Professor and Program Coordinator for the B.S. Engineering Technology degree. He is an active researcher with recent publications on topics including propeller aeroacoustics testing, propeller-induced flow effects, and propulsion elements for multirotor unmanned aerial vehicles. Support for ERAU Principal Investigator (PI), Dr. Deters is requested at 0.5 SM & 0.5 AY months of supplemental compensation and 1 AY months effort in each year of the project. For this project, Dr. Deters will lead the project through the following roles: 1) Research Scholars Workshop Co-Coordinator, 2) Research Scholars Travel & Research Grant Program Co-Coordinator, 3) Distinguished Undergraduate Researcher of the Year Award Co-Coordinator, and 4) Advisory Board Coordinator. Dr. Deters will actively support all dissemination efforts, including conference presentations and manuscript preparation. Dr. Deters will manage grant supervision and project administration efforts including budget management, interim reporting, and external evaluation.

Darryl Chamberlain, Co-PI (Ph.D. Mathematics and Statistics) is an Assistant Professor in the Math, Science, & Technology Department at Embry-Riddle Aeronautical University, Worldwide Campus. He engages in action research through technology, designing theoretically and experimentally driven open-source educational materials to enhance student learning. Support for ERAU Co-Investigator (Co-PI), Dr. Chamberlain is requested at 0.75 AY and 0.5 SM supplemental compensation each year of the project. Dr. Chamberlain will lead the project through the following roles: 1) Data Analyst 2) Research Scholars Workshop Co-Coordinator, 3) Research Scholars Travel & Research Grant Program Co-Coordinator, and 4) Distinguished Undergraduate Researcher of the Year Award Co-Coordinator.

Emily Faulconer, Co-PI, (Ph.D. Environmental Engineering Sciences) is an Associate Professor in the Math, Science, & Technology Department at Embry-Riddle Aeronautical University, Worldwide Campus. Her research has focused on the scholarship of teaching and learning, specifically online education and undergraduate research. Support for ERAU Co-Investigator (Co-PI), Dr. Faulconer is requested at 1.0 AY month effort and 0.25 AY months of supplemental compensation in Year 1, and 1.0 AY months of supplemental compensation in Years 2-3 of the project. Dr. Faulconer will lead the project through the following roles 1) Research Minor Coordinator, 2) Research Scholars Workshop Co-Coordinator, 3) Research Scholars Travel & Research Grant Program Co-Coordinator, and 4) Distinguished Undergraduate Researcher of the Year Award Co-Coordinator. Dr. Faulconer will also co-manage human subjects and data collection efforts. Dr. Faulconer will actively support all dissemination efforts, including conference presentations and manuscript preparation.

Brent Terwilliger, Co-PI, (Ph.D. Business Administration) is an Associate Professor of Aeronautics for the College of Aviation at Embry-Riddle Aeronautical University, Worldwide Campus. He is an active researcher with many recent publications in unmanned systems application and development, training, and operation. Support for ERAU Co-Investigator (Co-

PI), Dr. Terwilliger is requested at 1.0 AY month effort and 0.75 AY & 0.25 SM of supplemental compensation effort in Year 1, and 1 AY months & 0.25 SM of supplemental compensation in Years 2-3 of the project. Dr. Terwilliger will lead the project through the following roles: 1) Research Scholars Workshop Co-Coordinator, 2) Research Mentor Coordinator, 3) Research Scholars Travel & Research Grant Program Co-Coordinator, and 4) Distinguished Undergraduate Researcher of the Year Award Co-Coordinator. Dr. Terwilliger will also co-manage human subjects and data collection efforts. Dr. Terwilliger will actively support all dissemination efforts, including conference presentations and manuscript preparation.

The proposed salary for Dr. Emily Faulconer for Year 1, in combination with other current NSF support NSF Project #2044302, exceeds the two-month limit for senior personnel. The proposed level of commitment for this proposal is appropriate for the scope of work and is required in order to fulfill the objectives of this project within the proposed time frame.

Salary costs are based on the individual's Institutional Base Salary. A 3% cost of living increase has been applied annually to the Institutional Base Salary.

B. Other Personnel

Other Professionals: Support for ERAU Research Associate, Donna Roberts Ph.D., is requested at 1.0 AY months effort for Years 1-2. Dr. Roberts (Ph.D. Psychology) is a Professor and Associate Dean for Faculty for the College of Arts and Sciences, Worldwide Campus. Dr. Roberts will support this project through leading the course design efforts, including aligning research learning outcomes between RSCH 202 and RSCH 395, refreshing RSCH 395 as a culminating experience, and developing the upper-level research ethics course.

Near-peer Graduate Student Stipends: Support for Near-peer Graduate Students and is requested annually. The Near-peer graduate student stipend for three (3) students per summer (nine total) at ERAU is \$3,000 per year, leading to a total of \$9,000 for the project. The graduate students will assist the PI in achieving the science goals by carrying out the tasks listed in the proposal.

Undergraduate Research Mentors: Support for four (4) mentor summer stipends is requested each year of the project. It is expected that the mentors will work Summer (8 weeks) leading to a total of \$1,900 per year. The total for the project is \$5,700. Their roles will be to continue to support their research mentees through summer by carrying out the tasks listed in the proposal.

C. Fringe Benefits \$34,553

Embry-Riddle Aeronautical University's federally negotiated fringe benefit rates have been applied to the salaries and wages in the budget. The 30.6% rate for full-time employees is applied to all academic and calendar year salaries, and the 8.3% rate is applied to part-time salaries, including summer effort. There are no fringe benefits on student stipends/wages. Actuals are applied at costing, and a detailed list is available upon request.

D. Equipment

None Requested.

E. Travel: Domestic & International (Canada)

Funds are requested for the cost of travel directly related to the project have been included in the proposal. Per ERAU policies, employees will use the Federal GSA CONUS rates for travel within the Continental U.S., and OCONUS rates determined by the US Department of State. The budget includes a research trip to the 2024 Florida Symposium, 2025 UNM's Mentoring Conference, travel within Daytona Beach, Florida to record research mentoring promotion video, and 2025 & 2026 ASEE Annual conference.

Destination	Purpose	Traveler(s)	Conference Fees	Airfare	Per Diem	Ground Transportation	Lodging/night	Days	Total
Travel within Florida	Year 1 2024 Florida Statewide Symposium	1	\$60	N/A	\$297	\$197	\$750	4	\$1,303
Daytona Beach, Florida	Year 2 Travel to record Research Mentoring Promotional Video	1	N/A	N/A	N/A	\$1,000	N/A	1	\$1,000
Albuquerque, NM	Year 2 2025 UNM's Mentoring Conference	1	\$600	\$455	\$414	\$1,300	\$726	7	\$3,495
Montreal, Quebec, Canada	Year 2 2025 ASEE Annual Conference	1	\$800	\$441	\$630	\$1,100	\$1,120	6	\$4,091
Charlotte, NC	Year 3 2026 ASEE Annual Conference	1	\$800	\$200	\$345	\$1,100	\$645	6	\$3,090

Total travel costs for Years 1-3 are \$12,979.

F. Participant Support Costs

Funds are requested to support the research and research-related travel of the undergraduate participants. The research grants would be up to \$2,500 per student with 4 awarded per year for a total of \$30,000. The travel grants would be up to \$1,500 per student with 4 awarded per year for a total of \$18,000. To incentivize completion of their research, students who disseminate their research can apply for the distinguished undergraduate research award. This award is \$200 per student with 2 awarded per year for a total of \$1,200. The total participant support cost is \$49,200.

No. of Participants	Travel Expenses	Event and/or Materials	Total
6	N/A	Distinguished undergraduate research awards. \$200 per participant	\$1,200
12	\$6,000 p/yr.	Travel Grant Program. \$1,200 per participant	\$18,000
12	N/A	Research Grant Program. \$2,500 per participant	\$30,000
Total Participant Costs			\$49,200

Per Uniform Guidance participant support costs are not subject to indirect costs (F&A).

G. Other Direct Costs

ERAU-Other: Online Student Leader Certification \$900

Funds are requested to cover the cost of the online peer mentoring course for the near-peer graduate students. There will be three (3) near-peer graduate students per year who take the course at a cost of \$100 per student. The total cost is \$900.

ERAU-Other: Survey Incentive/Amazon Gift Cards

Incentives for participation are calculated beginning in Year 1, based on interviewees and survey participants. Each interview participant will receive a \$5 Amazon e-card with a 400-participant goal, leading to a total of \$2,000.

H. Total Direct Costs: \$320,239

I. Indirect Costs: \$62,339

Embry-Riddle Aeronautical University's 23% Modified Total Direct Cost (MTDC), federally negotiated, the off-campus rate is applied to the proposal. This rate was negotiated with ERAU's Federal Cognizant Agency, the Department of Health and Human Services. The agreement is in effect from July 1, 2016, to June 30, 2023.

The distribution base for indirect costs is as defined in the Uniform Guidance, 2 CFR 200.68. It consists of all salaries and wages, fringe benefits, materials and supplies, services, travel, and up to the first \$25,000 of each subaward (regardless of the period of performance of the subawards under the award). Equipment, capital expenditures, charges for patient care, rental costs, tuition remission, scholarships and fellowships, participant support costs, and the portion of each subaward in excess of \$25,000 are excluded from the MTDC base. A copy of the agreement is available upon request.

Embry-Riddle Aeronautical University defines year as fiscal year, which is the consecutive 12-month period beginning July 1 and ending June 30, and a calendar year is the 12-month period starting January 1 and ending December 31.

J. Total Budget Request: \$382,578

PI/co-PI/Senior Personnel: Deters, Robert

PROJECT/PROPOSAL CURRENT SUPPORT

- Project/Proposal Title: NASA STTR Phase I T15.04-1048: Integrated High Lift Propulsor

Proposal/Award Number (if available):

Source of Support: NASA/Wayfarer Aircraft Research and Development Inc.

Primary Place of Performance: Embry-Riddle Aeronautical University

Project/Proposal Support Start Date (if available): 08/2022

Project/Proposal Support End Date (if available): 09/2023

Total Award Amount (including Indirect Costs): \$52,501

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2023	0.8

Overall Objectives: The objective of the project is to design the experiments and systems for the successful implementation and testing of the Integrated High Lift Propulsor system in the possible Phase II of the work.

Statement of Potential Overlap: None

- Project/Proposal Title: NSF STTR Phase I: Integrated High Lift Propulsor

Proposal/Award Number (if available): 2210226

Source of Support: NSF/Wayfarer Aircraft Research and Development Inc.

Primary Place of Performance: Embry-Riddle Aeronautical University

Project/Proposal Support Start Date (if available): 08/2022

Project/Proposal Support End Date (if available): 08/2023

Total Award Amount (including Indirect Costs): \$15,811

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
-------------	---

Year	Person-months per year committed
2023	1

Overall Objectives: The overall motivation of the proposed work is to develop the Integrated High Lift Propulsor to enable commercial adoption. Computations and wind-tunnel experiments will be conducted to understand the complex aerodynamics of the system to enable the tailoring of high-lift characteristics to achieve field performance targets while minimizing handling qualities, cruise performance, weight, and cost penalties. The lessons learned will facilitate a potential Phase 2 aimed at flight testing.

Statement of Potential Overlap: None

- Project/Proposal Title: Undergraduate Research in a Fully Online Engineering Program: Effects on Retention, Persistence, Performance, STEM attitudes and Identity

Proposal/Award Number (if available): 2021221

Source of Support: NSF

Primary Place of Performance: Embry-Riddle Aeronautical University

Project/Proposal Support Start Date (if available): 10/2020

Project/Proposal Support End Date (if available): 09/2023

Total Award Amount (including Indirect Costs): \$295,966

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2023	0.5

Overall Objectives: Develop an undergraduate research framework for the online engineering program at Embry-Riddle Aeronautical University

Statement of Potential Overlap: None

PROJECT/PROPOSAL PENDING SUPPORT

- Project/Proposal Title: Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions

Proposal/Award Number (if available):

Source of Support: NSF

Primary Place of Performance: Embry-Riddle Aeronautical University

Project/Proposal Support Start Date (if available): 10/2023

Project/Proposal Support End Date (if available): 09/2026

Total Award Amount (including Indirect Costs): \$382,578

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2024	2
2025	2
2026	2

Overall Objectives: 1.Increase undergraduate research participation in students completing STEM degrees exclusively online at ERAU 2.Lead to impactful student research outputs 3.Positively influence STEM attitudes 4.Support STEM career pathways

Statement of Potential Overlap: Proposal submission

2. Project/Proposal Title: Low Reynolds Number Propeller-Wing Interaction Dynamics and Performance Studies

Proposal/Award Number (if available):

Source of Support: Office of Naval Research

Primary Place of Performance: Embry-Riddle Aeronautical University

Project/Proposal Support Start Date (if available): 08/2023

Project/Proposal Support End Date (if available): 07/2026

Total Award Amount (including Indirect Costs): \$79,667

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2024	1
2025	1
2026	1

Overall Objectives: The objective of the project is to develop a systematic study of propeller-wing interactions using wind tunnel models. Analysis of propeller performance, wing aerodynamics, and slipstream characteristics will be used to identify key contributors to overall

system performance and be used to develop prediction strategies.

Statement of Potential Overlap: None

3. Project/Proposal Title: RET Site: Promoting Research for Outcome-driven Preparation of Educational Leaders: Supporting Educational Development of Underserved Communities in Interdisciplinary UAS Topics

Proposal/Award Number (if available):

Source of Support: NSF

Primary Place of Performance: Embry-Riddle Aeronautical University

Project/Proposal Support Start Date (if available): 06/2023

Project/Proposal Support End Date (if available): 05/2026

Total Award Amount (including Indirect Costs): \$599,462

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2023	2
2024	2
2025	2

Overall Objectives: The overall intent of Project PROPEL is to connect teams of interdisciplinary middle-school educators to UAS-related engineering and operational research topics, resources, and practitioners to serve as a catalyst for supporting motivating learning, inspiring creative problem-solving, and engaging with subject matter experts in their classrooms.

Statement of Potential Overlap: None

PI/co-PI/Senior Personnel: Faulconer, Emily

PROJECT/PROPOSAL CURRENT SUPPORT

1. Project/Proposal Title: Community of Inquiry and Cognitive Load in Online STEM: Persistence, Performance, and Perspectives

Proposal/Award Number (if available): 2044302

Source of Support: National Science Foundation

Primary Place of Performance: Embry-Riddle Aeronautical University

Project/Proposal Support Start Date (if available): 06/2021

Project/Proposal Support End Date (if available): 05/2024

Total Award Amount (including Indirect Costs): \$237,298

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2021	2
2022	2
2023	2

Overall Objectives: 1. Increase STEM course persistence.2. Increase academic performance in online STEM courses.3. Positively influence STEM attitudes, as evidenced through self-reported student perspectives.4. Decrease cognitive load in discussion activities.5. Improve Community of Inquiry presences, as evidenced through self-reported student perspectives and discussion transcript analysis.6. Be transferable to other online STEM courses.

Statement of Potential Overlap: No scope overlap. No budget overlap. Some potential person-months overlap should the pending I-USE proposal be funded.

2. Project/Proposal Title: Undergraduate Research in a Fully Online Engineering Program: Effects on Retention, Persistence, Performance, STEM attitudes and Identity

Proposal/Award Number (if available): 2021221

Source of Support: National Science Foundation

Primary Place of Performance: Embry-Riddle Aeronautical University

Project/Proposal Support Start Date (if available): 10/2020

Project/Proposal Support End Date (if available): 09/2023

Total Award Amount (including Indirect Costs): \$295,966

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2021	2
2022	1.5
2023	1.8

Overall Objectives: 1. increase engineering program persistence (take rate and withdrawal rate).2. improve student retention in engineering degreee program.3. increase academic performance of engineering students engaged in research.4. positively influence STEM identity and attitudes.5. improve key transferable skills, as evidenced by direct and indirect assessment ofgeneral education competencies of the institution.6. be transferable to other online degree programs.

Statement of Potential Overlap: No scope overlap. No budget overlap. Person-months overlap would depend on start date but would be minimal (<2 calendar months of consecutive effort).

PROJECT/PROPOSAL PENDING SUPPORT

1. Project/Proposal Title: Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions

Proposal/Award Number (if available):

Source of Support: National Science Foundation

Primary Place of Performance: Embry-Riddle Aeronautical University

Project/Proposal Support Start Date (if available): 10/2023

Project/Proposal Support End Date (if available): 09/2026

Total Award Amount (including Indirect Costs): \$382,578

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2023	0.25
2024	1

Year	Person-months per year committed
2025	1
2026	1

Overall Objectives: 1.Increase undergraduate research participation in students completing STEM degrees exclusively online at ERAU 2.Lead to impactful student research outputs 3.Positively influence STEM attitudes 4.Support STEM career pathways

Statement of Potential Overlap: No scope overlap. No budget overlap. Some potential person-months overlap with #2044302.

Effective 10/04/2021

NSF CURRENT AND PENDING SUPPORT

OMB-3145-0058

*PI/co-PI/Senior Personnel Name: Brent A. Terwilliger

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[\[1\]](#) Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[\[2\]](#)

[\[1\]](#) If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.

[\[2\]](#) The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1.*Project/Proposal Title : RET Site: Promoting Research for Outcome-driven Preparation of Educational Leaders: Supporting Educational Development of Underserved Communities in Interdisciplinary UAS Topics

*Status of Support : Current Pending Submission Planned Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : Embry-Riddle Aeronautical University

Project/Proposal Start Date (MM/YYYY) (if available) : 06/2023

Project/Proposal End Date (MM/YYYY) (if available) : 05/2026

*Total Award Amount (including Indirect Costs): \$ 599,462

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	2.00	4.	
2. 2024	2.00	5.	
3. 2025	2.00		

*Overall Objectives : The overall intent of Project PROPEL is to connect teams of interdisciplinary middle-school educators to UAS-related engineering and operational research topics, resources, and practitioners to serve as a catalyst for supporting motivating learning, inspiring creative problem-solving, and engaging with subject matter expert.

*Statement of Potential Overlap : Proposal submission.

Projects/Proposals

2.*Project/Proposal Title : Undergraduate Research in a Fully Online Engineering Program: Effects on Retention, Persistence, Performance, STEM attitudes and Identity

*Status of Support : Current Pending Submission Planned Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : Embry-Riddle Aeronautical University

Project/Proposal Start Date (MM/YYYY) (if available) : 10/2022

Project/Proposal End Date (MM/YYYY) (if available) : 09/2023

*Total Award Amount (including Indirect Costs): \$ 295,966

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	1.50	4.	
2. 2023	1.80	5.	
3.			

*Overall Objectives : Develop an undergraduate research framework for the online engineering program at Embry-Riddle Aeronautical University.

*Statement of Potential Overlap : No potential overlap.

Projects/Proposals

3.*Project/Proposal Title : Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions

*Status of Support : Current Pending Submission Planned Transfer of Support

Proposal/Award Number (if available):

*Source of Support: NSF

*Primary Place of Performance : Embry-Riddle Aeronautical University

Project/Proposal Start Date (MM/YYYY) (if available) :

Project/Proposal End Date (MM/YYYY) (if available) :

*Total Award Amount (including Indirect Costs): \$ 382,578

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.00	4.	
2. 2025	1.25	5.	
3. 2026	1.25		

*Overall Objectives : 1.Increase undergraduate research participation in students completing STEM degrees exclusively online at ERAU 2.Lead to impactful student research outputs 3.Positively influence STEM attitudes 4.Support STEM career pathways

*Statement of Potential Overlap : Proposal submission.

PI/co-PI/Senior Personnel: Chamberlain Jr., Darryl

PROJECT/PROPOSAL CURRENT SUPPORT

- Project/Proposal Title: Community of Inquiry and Cognitive Load in Online STEM: Persistence, Performance, and Perspectives

Proposal/Award Number (if available): 2044302

Source of Support: NSF IUSE:EDU

Primary Place of Performance: Embry-Riddle Aeronautical University -- Worldwide

Project/Proposal Support Start Date (if available): 06/2021

Project/Proposal Support End Date (if available): 05/2024

Total Award Amount (including Indirect Costs): \$237,298

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2021	0.5
2022	1
2023	1
2024	0.5

Overall Objectives: (1) Increase STEM course persistence. (2) Increase academic performance in online STEM courses. (3) Positively influence STEM attitudes. (4) Decrease cognitive load in discussion activities. (5) Improve Community of Inquiry presences in online STEM courses.

Statement of Potential Overlap: No overlap in scope nor budget. Total person-months across all projects is 2 for year 2023 and 1.75 for year 2024.

PROJECT/PROPOSAL PENDING SUPPORT

- Project/Proposal Title: Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions

Proposal/Award Number (if available):

Source of Support: NSF IUSE:EDU

Primary Place of Performance: Embry-Riddle Aeronautical University -- Worldwide

Project/Proposal Support Start Date (if available): 10/2023

Project/Proposal Support End Date (if available): 09/2026

Total Award Amount (including Indirect Costs): \$382,578

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2023	0.25
2024	1.25
2025	1.25
2026	1

Overall Objectives: (1) Increase undergraduate research participation in students completing STEM degrees exclusively online at ERAU. (2) Lead to impactful student research outputs. (3) Positively influence STEM attitudes. (4) Support STEM career pathways.

Statement of Potential Overlap: No overlap in scope nor budget. Total person-months across all projects is 2 for year 2023 and 1.75 for year 2024.

2. Project/Proposal Title: Collective Knowledge Progression and Proliferation in Asynchronous Calculus Discussion Boards

Proposal/Award Number (if available):

Source of Support: Internal University Grant

Primary Place of Performance: Embry-Riddle Aeronautical University -- Worldwide

Project/Proposal Support Start Date (if available): 02/2023

Project/Proposal Support End Date (if available): 06/2023

Total Award Amount (including Indirect Costs): \$6,000

Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project:

Year	Person-months per year committed
2023	0.5

Overall Objectives: (1) Formalize framework for analyzing knowledge development in online mathematics discussions. (2) Improve online mathematics discussion design and facilitation.

Statement of Potential Overlap: No overlap in scope nor budget. Total person hours across all

projects for year 2023 is 2.

Facilities, Equipment, and Other Resources

Embry-Riddle's Worldwide Campus offers access to various equipment, software, and resources. The following will be leveraged for this project:

Worldwide Campuses

The Worldwide campus has satellite locations at more than 130 locations around the world. These satellite campuses offer traditional classroom space for lectures and host a variety of events to engage distance students. In addition to face-to-face classes, events include seminars, workshops, and networking events. Satellite campus classrooms are equipped with the latest technology that allow interactions with faculty and students at other campus and home locations. With campuses in 33 states, ERAU Worldwide operates in accordance with the U.S. Department of Education State Authorization Regulations.

Audio Recording Studio

At Worldwide Headquarters in Daytona Beach, Florida there are two audio recording studio rooms. Both have computers, monitors, and Yeti Mic. Faculty and staff can reserve access to this resource, with support from the Instructional Design Department. This studio will be used for generating VECTOR resources for students.

Academic Technology Department

The Worldwide Campus' Academic Technology Department provides training and support to faculty and staff on Canvas, EagleVision, ePortfolios, My Media Delivery, Microsoft Forms, and other platforms as needed.

COAS Mentoring Program

The COAS-Worldwide mentoring program nurtures students through the higher education pipeline by providing a partnership between academic advising and faculty mentoring that promotes student connection with faculty, courses, and programs, with the goal of improving student retention.

Instructional Design and Development Department

The Worldwide Campus' Instructional Design and Development Department has primary responsibility for the production of high-quality asynchronous online courses. This department coordinates efforts of instructional designers, faculty developers, media specialists, contractors, external vendors, and other Worldwide staff.

This department also houses the Media Production and Instructional Technology team. The Media Production team provide guidance in producing quality media, including recording instructional and non-instructional videos, generating audio files, and production and manipulation of still imagery. The Instructional Technology team assists in selecting learning objects that enhance content and are accessible, multi-modal, multi-sensory, and pedagogically sound. They also design digital media assets and materials, including graphics, infographics, interactive presentations, animated videos, simulations, gamification, and reusable HTML5 content.

Institutional Review Board

This is a federally mandated body established under the Department of Health & Human Services to protect the rights and welfare of participants recruited to volunteer in research activities conducted under the auspices of ERAU. All ERAU research involving human participants is reviewed and approved by the IRB prior to initiation of the research. The IRB also oversees mandatory CITI training for researchers.

Rothwell Center for Teaching and Learning Excellence

Worldwide's CTLE mission is to foster and support all faculty in teaching excellence through a variety of educational experiences and resources such as workshops, consultations, and just-in-time support. CTLE researches and continuously improves to ensure they are a source and model of the most accurate and current strategies in teaching and learning.

Canvas

Canvas is a learning management system designed with the online teaching and learning experience in mind. The cloud-based system is viewable on any web browser, computer or mobile device, and supports engagement and collaboration through video, audio, integrated media recorder, and text. Canvas also offers a free mobile app.

Canvas Studio is a video-centric, interactive approach to e-learning, making video a conversation. Faculty and students can generate, store, and share video and audio. In-video commenting enables timely feedback and collaboration. Analytics provide actionable insights on video usage.

Remote Access & VPN

Faculty and staff can access office computers and network drives remotely using a Virtual Private Network (VPN). A VPN creates a secure connection from a public network (such as the Internet or a private network owned by a service provider) to some of ERAU's technology. ERAU's VPN software allows access to shared network drives, software with network licensing restrictions, and remote access to work computers when you are connected to the ERAUNet, EagleNet, and most off-campus networks.

Scholarly Commons

Scholarly Commons is an open-access digital repository of scholarly work of faculty, students, and staff at ERAU. Scholarly Commons collects, preserves, and displays research, scholarly, education, and creative works produced by the ERAU community. This facilitates global discovery of and access to ERAU's scholarly and creative output while providing a stable, long-term home for digital scholarship. Scholarly Commons also publishes and hosts:

- *Beyond: Undergraduate Research Journal*
- *International Journal of Aviation, Aeronautics, and Aerospace*
- *The Journal of Aviation/Aerospace Education & Research*

This system provides the platform for submission, peer review, and open-access online publication.

Zoom

Zoom is a unified communication platform that provides instant messaging, whiteboarding, voicemail, file transfer, and video conferencing. Zoom can be run on Windows operating systems as well as Apple and Android mobile devices.

Virtual Environment for Communication: Teaching, Outreach, and Research (VECTOR)

The mission of VECTOR is to support ERAU Worldwide students and faculty in teaching, learning, and research related to written, spoken, visual, and digital communication. The **Virtual Communication Lab** provides free tutoring support, workshops, and online resources for students.

Unfunded Collaborations

Dr. Ronnie Mack (Director of Undergraduate Research at the Daytona Beach Campus of ERAU) will contribute to this project through an unfunded collaboration, providing remote/virtual access to Discovery Day and Fall Research Symposium events for Worldwide students.

Meghan Velez, Assistant Director of VECTOR, will contribute to this project through an unfunded collaboration, supporting student communication skills in their research efforts through the Virtual

Communication Lab and developing key resources to support student research, with resources identified organically during the lifetime of the project.

James Hanamean (M.S. Atmospheric Sciences) is the Associate Department Chair and Assistant Professor of the Practice within the Department of Applied Sciences at Embry-Riddle Aeronautical University, Worldwide Campus. He currently leads the COAS mentoring program. His role in this project will be to do the large-scale administration of the research mentorship program, including managing the recruitment and training of faculty and near-peer mentors. He will also handle internal reporting related to research mentoring as an arm of the larger COMPASS mentoring program.

Data Management Plan

Data Generation

This project will collect student outcome data (assignment rubric scores, final course grades), survey data, and interview data. This data will also collect institutional data including demographics, enrollments, and withdrawals. The data to be used outside of the research team has been reviewed by the Institutional Review Board and deemed “accepted”. Informed consent will be collected and managed as per the approved IRB plan.

Student Outcome Data. The research team will collect data from the LMS regarding student performance on individual assignments (including scores on individual assignments as well as elements of the research rubrics applied to individual assignments) and final course grades. All student work will be de-identified through alphanumeric coding. Student outcome data will be collected for research purposes only.

Student Survey Data. Survey data will be collected through the end of course evaluations (indirect measure for transferable skills) as well as separately administered surveys (STEM attitudes and STEM identity) through Qualtrics. (deemed “exempt”, IRB Approval #23-068)

Student Interview Data. Interview data will be coded and stored electronically along with transcripts and audio files from interviews. Student interview data will be collected as the project proceeds, with interview protocol to be developed during the project and reviewed by IRB prior to implementation.

Institutional Data. Institutional data will be collected through the Institutional Research Department, to include take rate, withdrawal rate, enrollments, and declared major.

Data Management

During this project, all ownership rights for the data lie with ERAU (Embry-Riddle Aeronautical University). Data management and dissemination will align with ERAU policies governing copyright and dissemination of products.

Student outcome data, student survey data, and institutional data originate as digital data. The raw data will be stored within Excel files, with aggregate data (e.g., data tables and figures) being stored within text documents (.docx and .pdf) or presentation documents (.pptx) for both for internal use and external dissemination. Student interview data originates as digital data, stored as video files. Audio transcripts, stored as text files, may be prepared by the research team as deemed necessary for analysis.

All digital data will be managed centrally, archived on existing ERAU servers. Additionally, the digital data will be redundantly archived on the hard drives of the research team, using ERAU laptops with password-protected access. Digital data will be in a password-protected file on a password-protected computer. The collection of personal information will be limited to demographics and background descriptors (e.g., declared major). No personally identifying information will be shared outside of the research team, including in final reports or external dissemination through conferences or research manuscripts. Only members of the project team will have access to the raw research data collected for this study.

Data collection and management will be conducted by Robert Deters (PI), Emily Faulconer (co-PI), Brent Terwilliger (co-PI), and Darryl Chamberlain (co-PI). Access to the raw data will be permitted to the research team for one year after the project has ended, after which time all digital files (.xlsx, .docx, .pdf, .pptx, .mp4, etc.) will be deleted. However, the data is being collected as a foundation for future work; data may be requested for future research studies within this window, with IRB approval. At the conclusion of the project, the research team will identify which project materials are of probable long-term interest so that IRB approval for use of secondary data can be obtained within the window of data availability. There are no anticipated costs associated with storage and maintenance of the digital data for this duration.

Products Generation and Management

The aggregate data that results from this project will be made available as soon as possible, with preliminary results disseminated prior to the conclusion of the project and final result dissemination occurring at the completion of the project. As part of the dissemination plan, preliminary data will be presented at conferences, specifically targeting STEM education and online education. The presentation materials (oral presentation and/or research poster) will be prepared using appropriately aggregated and anonymized data.

As part of the dissemination plan, the results of the project will be submitted to peer-reviewed journals in the form of a research manuscript. Product generation and management will be conducted by Robert Deters (PI), Emily Faulconer (co-PI), Brent Terwilliger (co-PI), and Darryl Chamberlain (co-PI). Access to and duration of access to these products (conference materials and manuscripts) will be a factor of guidelines of the conference and journals. Costs of conference presentation are addressed in the budget for this project. The research team will select journals that do not have article processing charges or other fees for publishing.

List of Project Participants

Donna Roberts, Research Associate, (Ph.D. Psychology) is a Professor and Associate Dean for Faculty for the College of Arts and Sciences, Worldwide Campus. Dr. Roberts will support this project through leading the course design efforts, including aligning research learning outcomes between RSCH 202 and RSCH 395, refreshing RSCH 395 as a culminating experience, and developing the upper-level research ethics course.

Ronnie Mack, Collaborator, (Ed.D.) is the Director of Undergraduate Research for the Daytona Beach campus of ERAU. Dr. Mack will support this project through committing resources to have Worldwide students participate virtually in the Research Symposium and Discovery Day held on the Daytona Beach campus yearly.

Embry-Riddle Aeronautical University
Application for IRB Approval
EXEMPT Determination Form

Principal Investigator: Emily Faulconer

Other Investigators: Brent Terwilliger, Robert Deters, Darryl Chamberlain

Role: Faculty

Campus: Worldwide

College: Arts & Sciences

Project Title: Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions

Review Board Use Only

Initial Reviewer: Teri Gabriel **Date:** 01/03/2023 **Approval #:** 23-068

Determination: Exempt

Dr. Beth Blickensderfer Elizabeth L.
IRB Chair Signature: Blickensderfer

Digitally signed by Elizabeth L.
Blickensderfer
Date: 2023.01.03 11:35:48 -05'00'

Brief Description:

This study seeks to explore the influence of expanded curricular opportunities related to undergraduate research on student perspectives (STEM attitude) and STEM career pathways (STEM identity and career ambitions).

This study will be conducted using data from ERAU students. Surveys will be administered online via Qualtrics.

This research falls under the **EXEMPT** category as per 45 CFR 46.104:

- (2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met: (Applies to Subpart B [Pregnant Women, Human Fetuses and Neonates] and does not apply for Subpart C [Prisoners] except for research aimed at involving a broader subject population that only incidentally includes prisoners.)

Human Subject Protocol Application

Campus:	Worldwide	College:	COAS
Applicant:	Emily Faulconer	Degree Level:	Doctorate
ERAU ID:	2286283	ERAU Affiliation:	Faculty
Project Title:	Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions		
Principal Investigator:	Emily Faulconer		
Other Investigators:	Brent Terwilliger, Robert Deters, Darryl Chamberlain		
Submission Date:	12/16/2022		
Beginning Date:	08/01/2023		
Type of Project:	Survey		
Type of Funding Support:	National Science Foundation I-USe (proposal in progress, project will proceed pending funding)		

Questions

1. Background and Purpose: Briefly describe the background and purpose of the research. Include how the study contributes to existing knowledge; spell out acronyms the first time they are used; and use consistent terminology.

There is a growing gap between supply and demand for STEM professionals. Undergraduate research is a high impact practice that offers gains in disciplinary knowledge and skills (Howitt et al., 2022; Stanford et al., 2017), persistence (Estrada et al., 2017; Shuster et al., 2019), STEM identity and attitudes (Arnold et al., 2019; Betz et al., 2021; Linn et al., 2015), transferable skills (Balke et al., 2021; Hajdarpasic et al., 2015), and career ambition (Carpi et al., 2017), with particular impact for minority students (Carpi et al., 2017; Estrada et al., 2017; Shuster et al., 2019). While there are some unique challenges to making undergraduate research accessible to online students, this team has established a framework of support (Research Scholars Program) for research efforts of Embry-Riddle Aeronautical University (ERAU) students completing STEM degrees exclusively online. The framework included mentoring, workshops, and curricular opportunities (E. Faulconer, Terwilliger, et al., 2022). This study seeks to explore the influence of expanded curricular opportunities related to undergraduate research on student perspectives (STEM attitude) and STEM career pathways (STEM identity and career ambitions).

2. Design, Procedures and Methods: Describe the details of the procedure(s) to be used; how the data will be collected and/or what will be done to collect the needed data.

This study will be conducted using data from ERAU students. Surveys will be administered online via Qualtrics.

a. Will the activity be RECORDED?

No

b. LOCATION: Indicate where the activity will take place –

Online – indicate what online system will be used; Qualtrics, Google Forms, etc.

Qualtrics

3. Time: Include how much time will be asked of each participant. Include the amount of time it takes for each activity and the total time. The total amount of time must match what is written on the Informed Consent Form (ICF), but the ICF only need include the total amount of time. (Do NOT include the amount of time needed to read the ICF.)

It is anticipated that it will take approximately 4 minutes to complete the survey.

4. Measures and Data to be Collected: What measures and data will be collected in the study? How will the measures and/or data be collected?

The survey will collect data in four sections: 1) demographics, 2) STEM identity (Dou et al., 2019), 3) STEM attitudes (Guzey et al., 2014), and 4) STEM career ambitions (Carpi et al., 2017). The STEM Identity and STEM Attitudes instruments are used from the sources cited without modification. The STEM career ambitions questions in this survey were generated by the research team based on the results presented in Carpi et al, 2017.

5. Participant Population and Recruitment Procedures:

- a. Who will be recruited to be participants? Check ALL that apply:

Embry-Riddle Students

- b. Approximately how many participants do you hope to recruit?

200

- c. Explain how and where recruitment will be conducted? (Emails, mailings, sign-up sheets, social media, flyers, etc.)

Emails and announcements within the Research Scholars Canvas page.

6. Risks or Discomforts: Describe any potential risks to the dignity, rights, health or welfare of the human subjects and how these risks will be mitigated. Risks may be physical, psychological, social, legal, economic, to reputation, or others. All other possible options should be examined to minimize any risks to the participants.

The risks of participating in this study are no more than what is experienced in daily life. Participants do not have to answer any questions they are uncomfortable in answering.

7. Benefits: Assess the potential benefits to be gained by the participants as well as to others in general as a result of this project. If there are no benefits to the participants, state that 'While there are no benefits to the participants...' The benefits here must match what is written on the consent form; here they are written to the IRB reviewer on the consent form they are written directly to the participant.

While there are no direct benefits to participants in this study, results may help practitioners better understand the impact of undergraduate research opportunities for students completing their STEM degree programs exclusively online.

8. Informed Consent: Describe the procedure you will use to obtain informed consent of the subjects. How and where will you obtain consent? The first page of an electronic survey must be the consent document. See [**Obtaining Participant Consent**](#) for more information on Informed Consent requirements.

The Informed Consent will be presented to students as a preliminary page prior to starting the survey. The survey will contain a preliminary question that confirms consent by asking participants to indicate they have read the consent form and agree to participate by selecting "yes" on the survey. Those who do not consent will not continue to participate. No data will be collected for individuals who do not consent.

9. Confidentiality of Records/Data and Privacy: Will participant information be:

Confidential

- a. Justify the classification and describe the safeguards you will employ to protect participant privacy in securing, sharing, and maintaining data during the study.

All data will remain confidential. Individual information will be protected in all data resulting from this study. No personally-identifying information will be collected beyond name. All data will be reported in aggregate, with no individual identifiers. Participants will be assigned a number; the key code will be stored separately from the data. Information collected as part of this research will not be used or distributed for future research studies.

Confidential data is needed over anonymous data to allow test-retest to measure the impact of undergraduate research on students over time.

- b. Indicate what will happen to data collected from participants that choose to "opt out" during the research process.

No further data will be collected from participants who choose to opt out during the research process. Any previously collected data from participants who opt out will be destroyed in both hard drive and cloud locations.

c. Where and how long will participant data be kept? Include the plan for storage or destruction of data upon study completion. Stating that the data will be destroyed when the Capstone project is completed is NOT acceptable. A specific time period must be indicated. Example: Data will be destroyed three years after completion of the research.

Digital data will be in a password protected file on a password protected ERAU computer and destroyed 48 months after it is analyzed.

10. Economic Considerations/Incentives: Are participants going to be paid for their participation or are you providing any other type of incentive; including extra credit?

Yes

What will be the compensation or incentive –

Gift Card – Specify what kind of gift card, the amount of the gift card and where it can be used/redeemed

\$5 Amazon ecard

Describe your policy for dealing with participants who start but fail to complete the research.

If a participant begins the survey but does not complete it, as long as their email address is provided, they will still be compensated. (Without provision of their email address we do not have a way of identifying the participant.)

We would like to survey student perspectives related to undergraduate research. The survey is estimated to take approximately four (4) minutes for most respondents to complete. Participants will receive \$5 in Amazon e-cards.

The survey contains a series of 19 questions, starting with some demographic questions and then asking about your STEM attitudes, STEM identity, and career ambitions. The data collected from the survey will be stored on password-protected ERAU laptops (hard drive) and cloud storage for up to 24-months after data has been analyzed. After this period, all participant data will be deleted from all storage locations.

If you wish to change your consent after completing the survey, contact the researcher, Emily Faulconer, at emily.faulconer@erau.edu.

[Insert link to Qualtrics survey here]

Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions

Purpose of this Research: I am asking you to take part in survey research for the purpose of understanding the impact of participating in undergraduate research on students completing their STEM degrees exclusively online. During this study, you will be asked to complete a one-time confidential survey. The survey contains several demographic questions as well as a series of questions on your STEM attitudes, STEM identity, and career ambitions. It is expected to take four (4) minutes for most respondents to complete.

Risks or discomforts: The risks of participating in this study are no greater than what is experienced in daily life. Participants do not have to answer any questions they are uncomfortable in answering.

Benefits: While there are no direct benefits to you in this study, results may help practitioners better understand the impact of undergraduate research opportunities for students completing their STEM degree programs exclusively online.

Confidentiality of records: All data will remain confidential. Individual information will be protected in all data resulting from this study. No personally-identifying information will be collected beyond an email address. All data will be reported in aggregate, with no individual identifiers. You will be assigned a number; the key code will be stored separately from the data. Information collected as part of this research **will not be used or distributed** for future research studies.

Compensation: Participants are compensated with \$5 in Amazon e-cards.

Contact: If you have any questions or would like additional information about this study, please contact Emily Faulconer, faulcone@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email teri.gabriel@erau.edu.

Voluntary Participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used and collected information will be destroyed.

CONSENT. By checking AGREE below, I certify that I am a student enrolled in a STEM degree program at ERAU's Worldwide campus. I further verify that I understand the information on this form, that the researcher has answered any and all questions I have about this study, and I voluntarily agree to participate in the study.

If you do **not** wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Emily Faulconer (faulcone@erau.edu).

- AGREE
- DISAGREE

Preliminary Survey Question: By selecting “yes” below, you confirm that you are at least 18 years old, have read the Informed Consent form, someone has answered all of your questions, and you voluntarily agree to participate.

- Yes
- No

DEMOGRAPHICS & PERSONAL INFORMATION

1. What is your ERAU email address?
(open response)
2. What is your gender? This may be a sensitive question. Our purpose in asking is because previous studies have shown correlations between gender and online course persistence.
 - Female
 - Male
 - Non-binary
3. What is your age? This may be a sensitive question. Our purpose in asking is because previous studies have shown correlations between age range and online course persistence.
 - 18 – 24 years old
 - 25 – 34 years old
 - 35 – 44 years old
 - 45 – 54 years old
 - 55 – 64 years old
 - Over 65 years old
4. Do you consider yourself a member of an ethnic group? This may be a sensitive question. Our purpose in asking is because previous studies have shown a correlation between ethnicity and online course persistence.
 - Asian
 - Black or African American
 - Hawaiian or Pacific Islander
 - Hispanic, Latino, or Spanish
 - Indian
 - Middle Eastern or North African
 - Native American
 - White
 - Other race, ethnicity, or origin
 - Prefer not to say
5. What is your military affiliation with U.S. Armed Forces?
 - Current active duty
 - Current reserves or national guard
 - Veteran/retired
 - Never served in U.S. Armed Forces

6. I entered this University as a _____.
 - first-time student
 - transfer student
7. Did your parents or grandparents attend college?
 - Yes, at least one of my parents or grandparents attended college.
 - No, none of my parents or grandparents attended college.
 - I don't know

STEM Identity

8. For each of the following regarding **STEM (science, technology, engineering, and mathematics) interest**, indicate your level of agreement: (6 point LIKERT scale strongly disagree to strongly agree, anchored at poles ... 1 (strongly disagree) ... 2...3...4...5...6(strongly agree))
 - I am interested in learning more about STEM
 - Topics in STEM excite my curiosity
 - I enjoy learning about STEM
9. For each of the following regarding **STEM recognition**, indicate your level of agreement: (6 point LIKERT scale strongly disagree to strongly agree, anchored at poles ... 1 (strongly disagree) ... 2...3...4...5...6(strongly agree))
 - My STEM teacher sees me as a STEM person
 - My family sees me as a STEM person
 - Others ask me for help in STEM
 - My friends/classmates see me as a STEM person

STEM Attitudes

10. For each of the following regarding **personal and social implications of STEM**, indicate your level of agreement: (5 point LIKERT scale strongly disagree to strongly agree, anchored at poles ... 1 (strongly disagree) ... 2...3...4...5(strongly agree))
 - It is important to know **science** in order to get a good job
 - It is important to know **engineering** in order to get a good job
 - It is important to know **digital technologies** in order to get a good job
 - It is important to know **mathematics** in order to get a good job.
11. For each of the following regarding **social implications of STEM**, indicate your level of agreement: (5 point LIKERT scale strongly disagree to strongly agree, anchored at poles ... 1 (strongly disagree) ... 2...3...4...5(strongly agree))
 - Science, technology, engineering, and mathematics make our lives better.
 - Science, technology, engineering, and mathematics are very important in life.
 - Science, technology, engineering, and mathematics are good for the future of our country.
 - The benefits of science, technology, engineering, and mathematics are greater than any harmful effects they may have.

12. For each of the following regarding **personal implications of STEM**, indicate your level of agreement: (5 point Likert scale strongly disagree to strongly agree, anchored at poles ... 1 (strongly disagree) ... 2...3...4...5(strongly agree))

- Having a job that involves science, mathematics, engineering, or technology would help me to be successful in life.
- I would like to have a job that involves science, mathematics, engineering, or technology.
- To learn engineering, I have to be good at science and mathematics.
- When something new is discovered, I like to learn about it quickly.

13. For each of the following regarding **learning of engineering and the relationship to STEM**, indicate your level of agreement: (5 point Likert scale strongly disagree to strongly agree, anchored at poles ... 1 (strongly disagree) ...

- 2...3...4...5(strongly agree))
- I enjoy learning engineering.
 - I am good at engineering.
 - I am interested in taking more classes that involve engineering.
 - Learning engineering helps me learn science, mathematics, or technology.

14. For each of the following regarding **learning of science and the relationship to STEM**, indicate your level of agreement: (5 point Likert scale strongly disagree to strongly agree, anchored at poles ... 1 (strongly disagree) ... 2...3...4...5(strongly agree))

- I enjoy learning science.
- I am good at science.
- I am interested in taking more classes that involve science.
- Learning science helps me learn engineering, mathematics, or technology.

15. For each of the following regarding **learning of mathematics and the relationship to STEM**, indicate your level of agreement: (5 point Likert scale strongly disagree to strongly agree, anchored at poles ... 1 (strongly disagree) ...

- 2...3...4...5(strongly agree))
- I enjoy learning mathematics.
 - I am good at mathematics.
 - I am interested in taking more classes that involve mathematics.
 - Learning mathematics helps me learn science, engineering, or technology.

16. For each of the following regarding **learning and use of technology**, indicate your level of agreement: (5 point Likert scale strongly disagree to strongly agree, anchored at poles ... 1 (strongly disagree) ... 2...3...4...5(strongly agree))

- I enjoy learning to use technology.
- I am good at using technology.
- I am interested in taking more classes that involve technology.
- Using technology helps me learn science, engineering, or technology

STEM Career Ambitions

17. For each of the following regarding **STEM career ambitions**, indicate your level of agreement: (5 point Likert scale strongly agree to strongly disagree, anchored at poles ... 1 (strongly disagree) ... 2 ... 3...4...5 (strongly agree))

- Before engaging in undergraduate research, I intended to go to graduate school.
- Participating in undergraduate research strengthened my interest in graduate school.
- Before engaging in undergraduate research, I intended to pursue a STEM career.
- Participating in undergraduate research strengthened my interest in a STEM career.
- Undergraduate research increased my knowledge of STEM career options.
- Undergraduate research influenced my career path.

18. Before engaging in undergraduate research, what was your career interest?

19. After engaging in undergraduate research, what is your career interest?

January 9, 2023

To Whom It May Concern,

If the proposal submitted by Robert Deters, Emily Faulconer, Brent Terwilliger, and Darryl Chamberlain entitled “Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, and Career Ambitions” is selected for funding by the NSF, it is my intent to collaborate and/or commit resources to the provision of virtual participation in the Research Symposium and Discovery Day for the 3 year period covered in the proposal (AY 23-24, AY 24-25, and AY 25-26).

Respectfully,

Sincerely,

Ronnie Mack  Digitally signed by Ronnie Mack
Date: 2023.01.18 14:08:16
-05'00'

Ronnie Mack, EdD
Director of Undergraduate Research
Email: mackr7@erau.edu
Phone: 386 226 7526



1 Aerospace Blvd.
Daytona Beach, FL 32114-3900

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Deters, Robert W	Embry-Riddle Aeronautical University	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R				

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Selig, Michael S	University of Illinois at Urbana-Champaign	Aerospace Engineering
T	Dantsker, Or D	University of Illinois at Urbana-Champaign	Aerospace Engineering

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Selig, Michael S	University of Illinois at Urbana-Champaign	m-selig@illinois.edu	
A	Narsipur, Shreyas	Mississippi State University	snarsipur@ae.msstate.edu	
A	Caccamo, Marco	Technical University of Munich	mcaccamo@tum.de	
A	Terwilliger, Brent	Embry-Riddle Aeronautical University	terwillb@erau.edu	
A	Coppola, Ralph K	Real World Design Challenge	rkcoppola@yahoo.com	
A	Coppola, Jeffrey	Real World Design Challenge	jeffcoppola@gmail.com	
A	Faulconer, Emily	Embry-Riddle Aeronautical University	faulcone@erau.edu	
A	George, Kelly	Embry-Riddle Aeronautical University	georged8@erau.edu	
A	Jordan, William	North Carolina State University	wajordan@ncsu.edu	07/01/20
A	Maier, Nicholas	North Carolina State University	nmaier@ncsu.edu	07/01/21
C	Ward, Bryon	Wayfarer Aircraft Research and Development Inc.	byron@wardaerospace.com	
C	Collins, Kyle	Embry-Riddle Aeronautical University	COLLINK9@erau.edu	
C	Anderson, Richard	Embry-Riddle Aeronautical University	andersop@erau.edu	
C	Kleinke, Stefan	Embry-Riddle Aeronautical University	kleinkes@erau.edu	
C	Sanders, Brian	Embry-Riddle Aeronautical University	sanderb7@erau.edu	
C	Mancuso, Renato	Boston University	rmancuso@bu.edu	06/01/19
C	Burgess, Scott	Embry-Riddle Aeronautical University	burgesco@erau.edu	
C	Panesi, Marco	University of Illinois at Urbana-Champaign	mpanesi@illinois.edu	11/11/21
C	Bhalerao, Kaustubh	University of Illinois at Urbana-Champaign	bhalerao@illinois.edu	11/11/21
C	Ansell, Phillip J	University of Illinois at Urbana-Champaign	ansell1@illinois.edu	09/01/19

C	Woodard, Brian S	University of Illinois at Urbana-Champaign	bswoodrd@illinois.edu	09/01/19
C	Gao, Grace X	Stanford University	gracegao@stanford.edu	09/01/19

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
B	Cross, David S	Embry-Riddle Aeronautical University	International Journal of Aviation, Aeronautics, and Aerospace	01/31/21
E	Barari, Ghazal	Embry-Riddle Aeronautical University	International Journal of Aviation, Aeronautics, and Aerospace	01/31/21

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Faulconer, Emily K	Embry-Riddle Aeronautical University	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R	Chamberlain, Darryl	Business	CHAMBD17@erau.edu	
R	Keene, Karen	Business	KEENEK@erau.edu	

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Mazyck, David	Penn State	SEDTAPP
T			

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Griffith, John	Embry-Riddle Aeronautical University	griff2ec@erau.edu	
A	Bolch, Charlotte	Midwestern University	cbolch@midwestern.edu	11/01/22
A	Wood, Beverly	Embry-Riddle Aeronautical University	woodb14@erau.edu	
A	Chamberlain, Darryl	Embry-Riddle Aeronautical University	CHAMBD17@erau.edu	
A	Kam, Cheryl	Unaffiliated	kjycherly@gmail.com	09/01/22
A	Gruss, Amy	Kennesaw State University	agruss@kennesaw.edu	12/01/21
A	McMasters, Bobby	Embry-Riddle Aeronautical University	mcmas245@erau.edu	12/01/21
A	Faulconer, Laura	Unaffiliated	laura.faulconer@gmail.com	06/01/21
C	Wood, Beverly	Embry-Riddle Aeronautical University	woodb14@erau.edu	
C	Chamberlain, Darryl	Embry-Riddle Aeronautical University	CHAMBD17@erau.edu	
C	Deters, Robert	Embry-Riddle Aeronautical University	detersr1@erau.edu	
C	Terwilliger, Brent	Embry-Riddle Aeronautical University	terwillb@erau.edu	
C	George, Kelly	Embry-Riddle Aeronautical University	georgeg8@erau.edu	

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
B				
E				

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Terwilliger, B.	Embry-Riddle Aeronautical University	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Blyler, Diane	Northcentral University	
G	Bouvin, David	Northcentral University	
T	Trunkhill, Corey	Embry-Riddle Aeronautical University	
T	Stephenson, Ross	Embry-Riddle Aeronautical University	

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Shephard, Andrew	Sinclair Collunty College		04/24/22
A	Burgess, Scott	Embry-Riddle Aeronautical University		09/01/22
A	Solti, James	Embry-Riddle Aeronautical University		07/01/22
A	Kiernan, Kristine	Embry-Riddle Aeronautical University		09/01/22
A	Janke, Christian	Embry-Riddle Aeronautical University		07/01/22
C	Deters, Robert	Embry-Riddle Aeronautical University		01/03/23
C	Faulconer, Emily	Embry-Riddle Aeronautical University		01/03/23
C	George, Kelly	Embry-Riddle Aeronautical University		01/03/23
A	Norman, Narcirsha	National Science Foundation		05/30/20
C	Wallace, Ryan	Embry-Riddle Aeronautical University		09/01/22
A	Earnhardt, Matthew	Embry-Riddle Aeronautical University		03/30/20
A	Winter, Scott R.	Embry-Riddle Aeronautical University		09/01/22
A	Rice, Stephen	Embry-Riddle Aeronautical University		09/01/22
A	Anderson, Carolina L.	Embry-Riddle Aeronautical University		09/01/22
A	De Abreu, Armando	Wichita State University		09/01/22
A	Arboleda, Gerardo	Wichita State University		09/01/22

A	Gomez, Luis	Wichita State University		09/01/22
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Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
B	Cross, David S	Embry-Riddle Aeronautical University	International Journal of Aviation, Aeronautics, and Aerospace	01/31/21
B	Shephard, Andrew	Sinclair Community College	Journal of Unmanned Aerial Systems	04/24/22

Table 1

1 Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
Chamberlain Jr., Darryl, J	Embry-Riddle Aeronautical University - Worldwide	
Chamberlain Jr., Darryl, J	University of Florida	07/31/21

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Vidakovic, Draga	Georgia State University	Mathematics and Statistics

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Childers, Annie	University of Arkansas at Little Rock	Mathematics	
A	Cooley, Laurel	Brooklyn College	Mathematics	
A	Duncan, Benton	North Dakota State University	Mathematics	
C	Faulconer, Emily	Embry-Riddle Aeronautical University - Worldwide	Mathematics, Science, & Technology	
A	Grady, Amy	University of Florida	Mathematics	07/31/21
A	Jeter, Russell	Motus Nova		
A	Keene, Karen	Embry-Riddle Aeronautical University - Worldwide	Mathematics, Science, & Technology	
A	Keeran, Willard	University of Florida	Mathematics	07/31/21
A	Kemp, Aubrey	California State University, Bakersfield	Mathematics	
A	Knudson, Kevin	University of Florida	Mathematics	07/31/21
A	Manly, Ian	University of Florida	Mathematics	07/31/21
A	Martin, William	North Dakota State University	Mathematics	
A	Meadows, Leslie	Georgia State University	Mathematics and Statistics	03/01/19
C	Paolucci, Catherine	University of Florida	Teaching and Learning	
A	Reed, Zackery	Embry-Riddle Aeronautical University - Worldwide	Mathematics, Science, & Technology	

C	Redding, Christopher	University of Florida	Mathematics, Science, & Technology	
A	Shabazz, Melissa	University of Florida	Mathematics	07/31/21
A	Stalvey, Harrison	University of Colorado, Boulder	Mathematics	03/01/19
A	Stone, Corey	University of Florida	Mathematics	07/31/21
A	Vidakovic, Draga	Georgia State University	Mathematics and Statistics	
C	Wood, Beverly	Embry-Riddle Aeronautical University - Worldwide	Mathematics, Science, & Technology	
A	Yao, Yongwei	Georgia State University	Mathematics and Statistics	
A	York, Alexander	University of Florida	Mathematics	07/31/21

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date

List of Suggested Reviewers

Data Not Available

List of Reviewers Not to Include

Data Not Available