

List of Suggested Reviewers or Reviewers Not To Include (optional)

SUGGESTED REVIEWERS:

Not Listed

REVIEWERS NOT TO INCLUDE:

Not Listed

The following information regarding collaborators and other affiliations (COA) must be separately provided for each individual identified as senior project personnel. The COA information must be provided through use of this COA template.

Please complete this template (e.g., Excel, Google Sheets, LibreOffice), save as .xlsx or .xls, and upload directly as a Fastlane Collaborators and Other Affiliations single copy doc. Do not upload .pdf.

If there are more than 10 individuals designated as senior project personnel on the proposal, or if there are print preview issues, each completed template must be saved as a .txt file [select the Text (Tab Delimited) option] rather than as an .xlsx or .xls file. This format will still enable preservation of searchable text and avoid delays in processing and review of the proposal.

Please note that some information requested in prior versions of the PAPPG is no longer requested. **THIS IS PURPOSEFUL AND WE NO LONGER REQUIRE THIS INFORMATION TO BE REPORTED.** Certain relationships will be reported in other sections (i.e., the names of postdoctoral scholar sponsors should not be reported, however if the individual collaborated on research with their postdoctoral scholar sponsor, then they would be reported as a collaborator). The information in the tables is not required to be sorted, alphabetically or otherwise.

There are five separate categories of information which correspond to the five tables in the COA template:

COA template Table 1:

List the individual's last name, first name, middle initial, and organizational affiliation (including considered affiliation) in the last 12 months.

COA template Table 2:

List names as last name, first name, middle initial, for whom a personal, family, or business relationship would otherwise preclude their service as a reviewer.

COA template Table 3:

List names as last name, first name, middle initial, and provide organizational affiliations, if known, for the following:

- The individual's Ph.D. advisors; and
- All of the individual's Ph.D. thesis advisees.

COA template Table 4:

List names as last name, first name, middle initial, and provide organizational affiliations, if known, for the following:

- Co-authors on any book, article, report, abstract or paper with collaboration in the last 48 months (publication date may be later); and
- Collaborators on projects, such as funded grants, graduate research or others in the last 48 months.

COA template Table 5:

List editorial board, editor-in chief and co-editors with whom the individual interacts. An editor-in-chief must list the entire editorial board.

- Editorial Board: List name(s) of editor-in-chief and journal in the past 24 months; and
- Other co-Editors of journal or collections with whom the individual has directly interacted in the last 24 months.

The template has been developed to be fillable, however, the content and format requirements must not be altered by the user. This template must be saved in .xlsx or .xls format, and directly uploaded into FastLane as a Collaborators and Other Affiliations Single Copy Document. Using the .xlsx or .xls format will enable preservation of searchable text that otherwise would be lost. It is therefore imperative that this document be uploaded in .xlsx or .xls only. Uploading a document in any format other than .xlsx or .xls may delay the timely processing and review of the proposal.

This information is used to manage reviewer selection. See Exhibit II-2 for additional information on potential reviewer conflicts.

1 Note that graduate advisors are no longer required to be reported.

2 Editorial Board does not include Editorial Advisory Board, International Advisory Board, Scientific Editorial Board, or any other subcategory of Editorial Board. It is limited to those individuals who perform editing duties or manage the editing process (i.e., editor in chief).

List names as Last Name, First Name, Middle Initial. Additionally, provide email, organization, and department (optional) Fixed column widths keep this sheet one page wide; if you cut and paste text, set font size at 10pt or smaller, and To insert *n* blank rows, select *n* row numbers to move down, right click, and choose Insert from the menu.

You may fill-down (ctrl-D) to mark a sequence of collaborators, or copy affiliations. Excel has arrows that enable sorting. For "Last Active Date" and "Last Active" columns dates are optional, but will help NSF staff easily determine which information remains relevant for reviewer selection.

"Last Active Date" and "Last Active" columns may be left blank for ongoing or current affiliations.

Table 1: List the individual’s last name, first name, middle initial, and organizational affiliation (including considered affiliation) in the last 12 months.

1	Your Name:	Your Organizational Affiliation(s), last 12	Last Active Date
	Faulconer, Emily	Embry Riddle Aeronautical University	8/1/2012 - current

Table 2: List names as last name, first name, middle initial, for whom a personal, family, or business relationship would otherwise preclude their service as a reviewer.

R: Additional names for whom some relationship would otherwise preclude their service as a reviewer.

to disambiguate common names

2	Name:	Organizational Affiliation	Optional (email, Department)	Last Active

Table 3: List names as last name, first name, middle initial, and provide organizational affiliations, if known, for the following.

G: The individual’s Ph.D. advisors; and

T: All of the individual’s Ph.D. thesis advisees.

to disambiguate common names

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
---	-----------------------	----------------------------	------------------------------

G:	Mazyck, David	University of Florida	dmazyck@ufl.edu

C: Collaborators on projects, such as funded grants, graduate research or others in the last 48 months.

to disambiguate common names

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active
A:	Dixon, Zachary	Embry-Riddle Aeronautical University	dixonz@erau.edu	5/30/20
A:	Griffith, John	Embry-Riddle Aeronautical University	griff2ec@erau.edu	8/1/20
A:	Wood, Beverly	Embry-Riddle Aeronautical University	woodb14@erau.edu	8/1/20
A:	Roberts, Donna	Embry-Riddle Aeronautical University	rober596@erau.edu	1/15/20
A:	Acharyya, Soumyadip	Embry-Riddle Aeronautical University		5/2/19
A:	Hanamean, James R.	Embry-Riddle Aeronautical University	hanam2fb@erau.edu	1/18/19
A:	Mumpower, Lori	Embry-Riddle Aeronautical University		12/15/19
A:	Branham, Cassandra	Embry-Riddle Aeronautical University		12/15/19
A:	Clevenger, Aaron	Embry-Riddle Aeronautical University		12/15/19
A:	LeNoble, Chelsea	Embry-Riddle Aeronautical University		2/20/20
A:	McMasters, Bobby	Embry-Riddle Aeronautical University		8/1/20
A:	Frank, Hayden	Embry-Riddle Aeronautical University		2/1/20

must list the entire editorial board.

B: Editorial Board: List name(s) of editor-in-chief and journal in the past 24 months; and

E: Other co-Editors of journal or collections with whom the individual has directly interacted in the last 24 months.

to disambiguate common names

5	Name:	Organizational Affiliation	Journal/Collection	Last Active

The following information regarding collaborators and other affiliations (COA) must be separately provided for each individual identified as senior project personnel. The COA information must be provided through use of this COA template.

Please complete this template (e.g., Excel, Google Sheets, LibreOffice), save as .xlsx or .xls, and upload directly as a Fastlane Collaborators and Other Affiliations single copy doc. Do not upload .pdf.

If there are more than 10 individuals designated as senior project personnel on the proposal, or if there are print preview issues, each completed template must be saved as a .txt file [select the Text (Tab Delimited) option] rather than as an .xlsx or .xls file. This format will still enable preservation of searchable text and avoid delays in processing and review of the proposal.

Please note that some information requested in prior versions of the PAPPG is no longer requested. **THIS IS PURPOSEFUL AND WE NO LONGER REQUIRE THIS INFORMATION TO BE REPORTED.** Certain relationships will be reported in other sections (i.e., the names of postdoctoral scholar sponsors should not be reported, however if the individual collaborated on research with their postdoctoral scholar sponsor, then they would be reported as a collaborator). The information in the tables is not required to be sorted, alphabetically or otherwise.

There are five separate categories of information which correspond to the five tables in the COA template:

COA template Table 1:

List the individual's last name, first name, middle initial, and organizational affiliation (including considered affiliation) in the last 12 months.

COA template Table 2:

List names as last name, first name, middle initial, for whom a personal, family, or business relationship would otherwise preclude their service as a reviewer.

COA template Table 3:

List names as last name, first name, middle initial, and provide organizational affiliations, if known, for the following:

- The individual's Ph.D. advisors; and
- All of the individual's Ph.D. thesis advisees.

COA template Table 4:

List names as last name, first name, middle initial, and provide organizational affiliations, if known, for the following:

- Co-authors on any book, article, report, abstract or paper with collaboration in the last 48 months (publication date may be later); and
- Collaborators on projects, such as funded grants, graduate research or others in the last 48 months.

COA template Table 5:

List editorial board, editor-in chief and co-editors with whom the individual interacts. An editor-in-chief must list the entire editorial board.

- Editorial Board: List name(s) of editor-in-chief and journal in the past 24 months; and
- Other co-Editors of journal or collections with whom the individual has directly interacted in the last 24 months.

The template has been developed to be fillable, however, the content and format requirements must not be altered by the user. This template must be saved in .xlsx or .xls format, and directly uploaded into FastLane as a Collaborators and Other Affiliations Single Copy Document. Using the .xlsx or .xls format will enable preservation of searchable text that otherwise would be lost. It is therefore imperative that this document be uploaded in .xlsx or .xls only. Uploading a document in any format other than .xlsx or .xls may delay the timely processing and review of the proposal.

This information is used to manage reviewer selection. See Exhibit II-2 for additional information on potential reviewer conflicts.

1 Note that graduate advisors are no longer required to be reported.

2 Editorial Board does not include Editorial Advisory Board, International Advisory Board, Scientific Editorial Board, or any other subcategory of Editorial Board. It is limited to those individuals who perform editing duties or manage the editing process (i.e., editor in chief).

List names as Last Name, First Name, Middle Initial. Additionally, provide email, organization, and department (optional) Fixed column widths keep this sheet one page wide; if you cut and paste text, set font size at 10pt or smaller, and To insert *n* blank rows, select *n* row numbers to move down, right click, and choose Insert from the menu.

You may fill-down (ctrl-D) to mark a sequence of collaborators, or copy affiliations. Excel has arrows that enable sorting. For "Last Active Date" and "Last Active" columns dates are optional, but will help NSF staff easily determine which information remains relevant for reviewer selection.

"Last Active Date" and "Last Active" columns may be left blank for ongoing or current affiliations.

Table 1: List the individual’s last name, first name, middle initial, and organizational affiliation (including considered affiliation) in the last 12 months.

1	Your Name:	Your Organizational Affiliation(s), last 12	Last Active Date
	Wood, Beverly	Embry Riddle Aeronautical University	8/14/2015 - current

Table 2: List names as last name, first name, middle initial, for whom a personal, family, or business relationship would otherwise preclude their service as a reviewer.

R: Additional names for whom some relationship would otherwise preclude their service as a reviewer.

to disambiguate common names

2	Name:	Organizational Affiliation	Optional (email, Department)	Last Active

Table 3: List names as last name, first name, middle initial, and provide organizational affiliations, if known, for the following.

G: The individual’s Ph.D. advisors; and

T: All of the individual’s Ph.D. thesis advisees.

to disambiguate common names

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
---	-----------------------	----------------------------	------------------------------

G:	Berry, Robert Q.	University of Virginia	
G:	Garofalo, Joe	University of Virginia, retired	
G:	Chiu, Jennie	University of Virginia	
G:	Inkelas, Karen	University of Virginia	

C: Collaborators on projects, such as funded grants, graduate research or others in the last 48 months.

to disambiguate common names

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active
C:	Bourdeau, Debra T.	Embry-Riddle Aeronautical University		
C:	Krantz, Jerry	Embry-Riddle Aeronautical University		
C:	Rister, Alex	Embry-Riddle Aeronautical University		
C:	Ganter, Susan L.	Embry-Riddle Aeronautical University		
C:	Griffith, John C.	Embry-Riddle Aeronautical University		
C:	Faulconer, Emily K.	Embry-Riddle Aeronautical University		
C:	Roberts, Donna	Embry-Riddle Aeronautical University		1/15/20
C:	Acharyya, Soumyadip	Embry-Riddle Aeronautical University (formerly)		5/2/19
C:	Marcham, Cheri L.	Embry-Riddle Aeronautical University		2/1/19
C:	Floyd, Evan L.	University of Oklahoma Health Sciences Center		2/1/19
C:	Arnold, Susan	University of Minnesota		2/1/19
C:	Johnson, David L.	University of Oklahoma Health Sciences Center		2/1/19
C:	Mocko, Megan	University of Florida		6/1/17
C:	Everson, Michelle	The Ohio State University		6/1/17
C:	Horton, Nicholas	Amherst College		6/1/17
C:	Velleman, Paul	Cornell University		6/1/17
C:	Bolch, Charlotte	University of Florida		
C:	Barnett, Janet	CO State Univeristy - Puelbo (retired)		
C:	Klyve, Dominic	Central Washington University		
C:	White, Diana	University of Colorado - Denver		
C:	Clark, Kathy	Florida State University		
C:	Otero, Danny	Xavier University		
C:	Scoville, Nick	Ursinus College		
C:	Lodder, Jerry	NM State University		

must list the entire editorial board.

B: Editorial Board: List name(s) of editor-in-chief and journal in the past 24 months; and

E: Other co-Editors of journal or collections with whom the individual has directly interacted in the last 24 months.

to disambiguate common names

5	Name:	Organizational Affiliation	Journal/Collection	Last Active
B:	Witmer, Jeffrey	Oberlin College & Conservatory	Journal of Statistics Education	6/1/20
B:	Karali, Gizem	Pomona College	Journal of Humanistic Mathematics	
B:	Grawe, Nathan	Carlton College	Numeracy	
E:	Piercy, Victor	Ferris State University	Numeracy	

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./DUE DATE NSF 19-601 08/04/20		<input type="checkbox"/> Special Exception to Deadline Date Policy		FOR NSF USE ONLY	
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				NSF PROPOSAL NUMBER 2044302	
DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
08/04/2020	1	11040000 DUE	1998	052104791	08/04/2020 2:44pm
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		ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE Embry-Riddle Aeronautical University Sponsored Research Adm Daytona Beach,FL.321143910			
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 Embry-Riddle Aeronautical University 1 Aerospace Boulevard Daytona Beach ,FL ,321143966 ,US.			
IS AWARDEE ORGANIZATION (Check All That Apply)		<input type="checkbox"/> SMALL BUSINESS <input type="checkbox"/> FOR-PROFIT ORGANIZATION		<input type="checkbox"/> MINORITY BUSINESS <input type="checkbox"/> WOMAN-OWNED BUSINESS <input type="checkbox"/> IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE	
TITLE OF PROPOSED PROJECT Community of Inquiry and Cognitive Load in Online STEM: Persistence, Performance, and Perspectives					
REQUESTED AMOUNT \$ 237,298	PROPOSED DURATION (1-60 MONTHS) 36 months	REQUESTED STARTING DATE 08/01/21	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE		
THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW					
<input type="checkbox"/> BEGINNING INVESTIGATOR		<input checked="" type="checkbox"/> HUMAN SUBJECTS Human Subjects Assurance Number _____ Exemption Subsection _____ or IRB App. Date 08/01/20			
<input type="checkbox"/> DISCLOSURE OF LOBBYING ACTIVITIES		<input type="checkbox"/> FUNDING OF INT'L BRANCH CAMPUS OF U.S IHE <input type="checkbox"/> FUNDING OF FOREIGN ORG			
<input type="checkbox"/> PROPRIETARY & PRIVILEGED INFORMATION		<input type="checkbox"/> INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED _____			
<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 Research		<input checked="" type="checkbox"/> COLLABORATIVE STATUS Not a collaborative proposal			
PI/PD DEPARTMENT Department of STEM Education		PI/PD POSTAL ADDRESS 1 Aerospace Boulevard Daytona Beach,FL 32114 United States			
PI/PD FAX NUMBER					
NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Email Address	
PI/PD NAME Emily K Faulconer	PhD	2012	434-485-9021	faulcone@erau.edu	
CO-PI/PD Beverly L Wood	PhD	2012	540-244-9232	woodb14@erau.edu	
CO-PI/PD					
CO-PI/PD					
CO-PI/PD					

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, Section 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 IX.A.; 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 organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's 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.

Certification Regarding Flood Hazard Insurance

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 proposals for conferences, symposia, and workshops.)

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.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE		SIGNATURE	DATE
NAME Sarah Loftus		Electronic Signature	Aug 4 2020 2:42PM
TELEPHONE NUMBER 386-226-7395	EMAIL ADDRESS hurguys@erau.edu	FAX NUMBER	

NATIONAL SCIENCE FOUNDATION
Division of Undergraduate Education

NSF FORM 1295: PROJECT DATA FORM

The instructions and codes to be used in completing this form are provided in Appendix II.

1. **Program-track** to which the Proposal is submitted: **IUSE- Engaged Student Learning: Level I** _____
2. Name of **Principal Investigator/Project Director** (as shown on the Cover Sheet):
Faulconer, Emily _____
3. Name of submitting **Institution** (as shown on Cover Sheet):
Embry-Riddle Aeronautical University _____
4. **Other Institutions** involved in the project's operation:

Project Data:

- A. Major Discipline Code: **99** _____
- B. Academic Focus Level of Project: **LO** _____
- C. Highest Degree Code: **D** _____
- D. Category Code: **--** _____
- E. Business/Industry Participation Code: **NA** _____
- F. Audience Code: _____
- G. Institution Code: **PRIV** _____
- H. Strategic Area Code: _____
- I. Project Features: **1 2** _____

Estimated number in each of the following categories to be directly affected by the activities of the project during its operation:

- J. Undergraduate Students: **4524** _____
- K. Pre-College (PreK-12) Students: **0** _____
- L. College Faculty: **22** _____
- M. Pre-College (PreK-12) Teachers: **0** _____
- N. Graduate Students: **2** _____
- O. Postdoctoral Fellows: **0** _____

PROJECT SUMMARY

Overview:

This submission is for the Engaged Student Learning Track of the Development and Implementation, Level I program for NSF IUSE. Our goal is to support Community of Inquiry in asynchronous online STEM learning while mitigating impacts to cognitive load, with the goal of positively impacting persistence, performance, and perspectives. Online courses in general face large withdrawal rates; online STEM courses are no exception. In this study, we will design and test a pilot program for infusing Community of Inquiry into the asynchronous course discussions, including a best practices redesign of the discussion prompts, rubrics, and instructions by subject matter experts and instructional designers as well as professional development for instructors teaching the courses. This study will be implemented at Embry-Riddle Aeronautical University. The pilot program will utilize existing institutional frameworks to support the redesign, with scaffolding to support the redesign and professional development. In our mixed-methods study, we will collect student information related to academic success (course grades, discussion transcript analysis), persistence (withdrawal rate), and perspectives (survey – STEM attitudes (1), cognitive load (2), community of inquiry (3)), complemented by focus group interviews.

Intellectual Merit:

The key deliverable will be the pilot discussion framework designed from modern best practices, which can be transferred and scaled to other asynchronous online STEM courses. Another key contribution of this study will be the data generated regarding community of inquiry and cognitive load versus STEM attitudes. This data can be disseminated for a broad audience through manuscript publication in reliable open access venues.

Broader Impacts:

This project will generate a Community of Inquiry – Cognitive Load framework for asynchronous online STEM courses that supports persistence, performance, and positive attitudes through promotion of social, teaching, and cognitive presences while mitigating cognitive load impacts. This project offers a benefit to society through research disseminated through open access, high impact venues aimed at practitioners and administrators. This framework can be used by course designers and educators for both design and facilitation of asynchronous online discussions. The framework efficacy will be thoroughly evaluated on multiple criteria through this project.

The research generated will advance discovery and promote learning through:

- establishing the influence of community of inquiry and cognitive load on persistence, performance, and perspectives;
- clearly identifying withdrawal reasons from asynchronous online STEM courses, allowing for targeted interventions beyond the framework.

TABLE OF CONTENTS

For font size and page formatting specifications, see PAPPG section II.B.2.

	Total No. of Pages	Page No.* (Optional)*
Cover Sheet for Proposal to the National Science Foundation		
Project Summary (not to exceed 1 page)	<u>1</u>	<u> </u>
Table of Contents	<u>1</u>	<u> </u>
Project Description (Including Results from Prior NSF Support) (not to exceed 15 pages) (Exceed only if allowed by a specific program announcement/solicitation or if approved in advance by the appropriate NSF Assistant Director or designee)	<u>15</u>	<u> </u>
References Cited	<u>7</u>	<u> </u>
Biographical Sketches (Not to exceed 2 pages each)	<u>4</u>	<u> </u>
Budget (Plus up to 3 pages of budget justification)	<u>7</u>	<u> </u>
Current and Pending Support	<u>30</u>	<u> </u>
Facilities, Equipment and Other Resources	<u>3</u>	<u> </u>
Special Information/Supplementary Documents (Data Management Plan, Mentoring Plan and Other Supplementary Documents)	<u>2</u>	<u> </u>
Appendix (List below.) (Include only if allowed by a specific program announcement/ solicitation or if approved in advance by the appropriate NSF Assistant Director or designee)	<u> </u>	<u> </u>
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.

Community of Inquiry and Cognitive Load in Online STEM: Persistence, Performance, and Perspectives

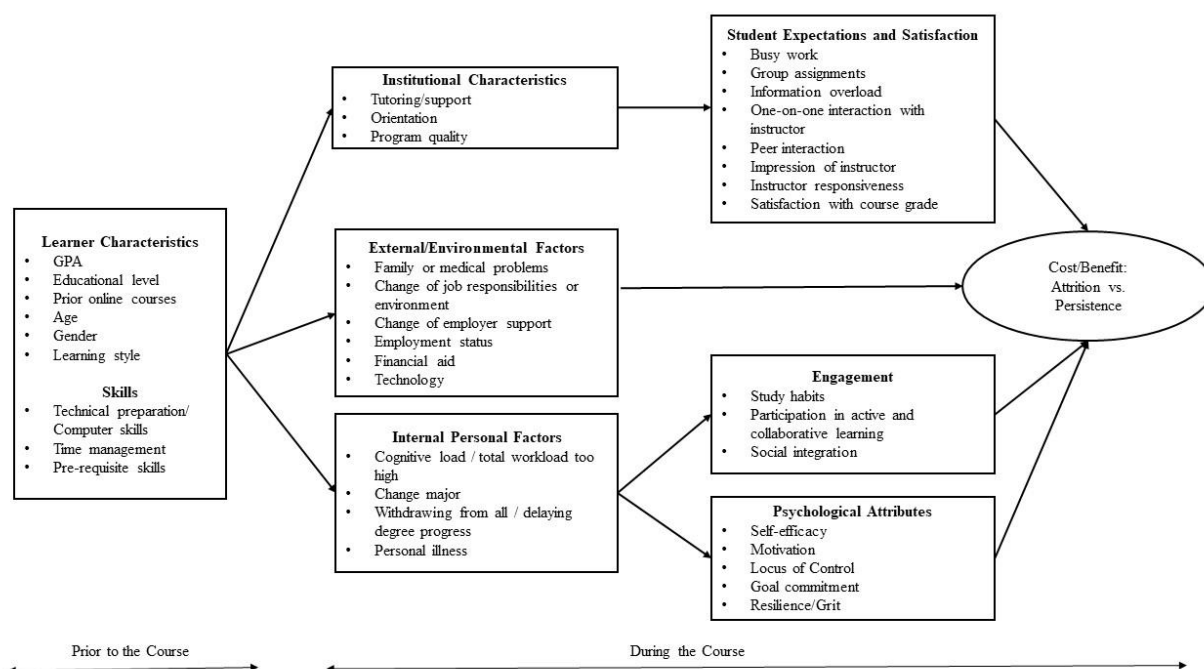
Introduction

Online courses have shown a higher drop and withdrawal rates compared to the face-to-face course modality (1-6), particularly in online STEM courses (7). The asynchronous modality plays an important role in online education, accounting for approximately half of all online courses in recent years (8). Reported withdrawal rates have varied significantly due to selection bias and how withdrawal was defined (9). In STEM-specific studies, some showed no influence of demographic variables on persistence (10,11) while others showed certain minorities had lower persistence (12). Online STEM course enrollments tend to be non-traditional students (e.g. part-time enrollment, full time employment) (13) with minority students showing lower enrollment (13). Age has shown positive correlation with persistence in online STEM courses (10,12).

There are several models and theories for student persistence, including the Student Integration Model (14), Social Cognitive Theory (15), and the Model of Student Departure (16). The dimensions from the literature were operationalized into key elements in a conceptual framework (Figure 1). Some dimensions are not easily addressed by an institution, such as previous degrees and professional experience (17-20), prior online course experience (18), GPA (3,20-22), external support (9,23), learning style (21), and locus of control (24). Reflecting the larger trend in online education, GPA and prior performance in online courses were predictors of STEM course outcomes (12,25). Other factors to improve online persistence are easier for the institution to address, including strategies to build transferable skills, learning skills, computer skills, and motivation (21,23,26-29).

Figure 1

Conceptual Framework of Student Persistence in Online Courses



Attrition in online courses is linked to cognitive load, particularly early in the course (30). Cognitive overload is often the result of extraneous and intrinsic load (31). Intrinsic load is due to task complexity, element interactivity, and task environment and results from the amount of mental processing required to understand the task (32). Extraneous load results from material presentation, including the split attention effect, modality effect, redundancy effect, and learner characteristics (32). Cognitive load, particularly extraneous and germane load, influence student satisfaction with online courses (33,34). In certain STEM disciplines, cognitive load influenced academic performance for traditional (35) and online students (36).

Instructors can influence persistence in online STEM courses through pedagogical methods employed (37). Online discussions are a key component of online courses because of the ability to nurture communication and community. Engagement can be promoted by using the Community of Inquiry (CoI) framework in online discussions (38). This framework outlines the relationship between social presence, teaching presence, and cognitive presence (39).

Social presence is the ability of learners to project their personality into the community (39). Social presence indicators in online discussions include affective responses (e.g. expressing emotion), open and interactive communication (e.g. asking questions), and cohesive responses (e.g. using names in conversation). Online courses tend to be text-heavy with infrequent interactions that lack non-verbal cues, which may make forming social presence difficult (40) and contribute to learner isolation and a perceived lack of support (41). The peer support hypothesis predicts that strong peer connections limit isolation in an online course as a persistence barrier (29,42,43). In online STEM, social presence is linked to persistence (44,45) and, in some disciplines, academic performance (46,47). It is important to note that the influence of social presence on persistence is still debated within online education (23,26,44,48-50). Students value online courses with strong instructor social and teaching presence (51-53).

Teaching presence is the sum of the design, direction, and facilitation of the social and cognitive interactions, including instructor formative and summative feedback (54). Stronger teaching presence is associated with lower extraneous load (34). Meaningful instructor feedback and the quality of faculty-student interaction contribute to persistence in online courses (26,48,55), including certain STEM disciplines (56). Teaching presence is related to academic performance in some online courses (41).

Cognitive presence – learner construction of meaning through continued communication (39) – is predicted by social and teaching presence (57-59). Even the teaching presence of a non-course-designer is related to learner cognitive presence (60). The online discussion is a natural place for cognitive presence in an asynchronous online course, though it tends to be at the two lower levels (61). Cognitive presence has four levels where students become interested (triggering event), are motivated to learn more by asking questions and discussing (exploration), synthesize information and construct knowledge (integration), and ultimately use critical thinking to apply the knowledge and draw conclusions (resolution). The Practical Inquiry model operationalizes cognitive presence, providing a tool to assess conversations (62). Course design and facilitation that supports strong cognitive presence is associated with persistence (58) and academic performance (41) in online courses for some disciplines.

Cognitive load mitigation and the CoI framework are not discipline-specific pedagogical approaches, thus making it transferable across STEM courses in online learning. Furthermore, these pedagogical practices can easily be converged and integrated with disciplinary pedagogical best practices. Careful course design can strengthen CoI presences while mitigating cognitive load impacts. Student satisfaction is correlated with perceived efficacy of course design elements, including interactive engagement strategies (63). Furthermore, student grades are correlated with the quality of

interpersonal interactions (resulting from the three presences) in an online course (41). There does not seem to be a linear relationship between cognitive presence and cognitive load (32), though there does seem to be a correlation between cognitive presence and increased intrinsic and germane load (34). This study explores the relationship between CoI and cognitive load interventions on persistence, performance, and perspectives (Figure 2).

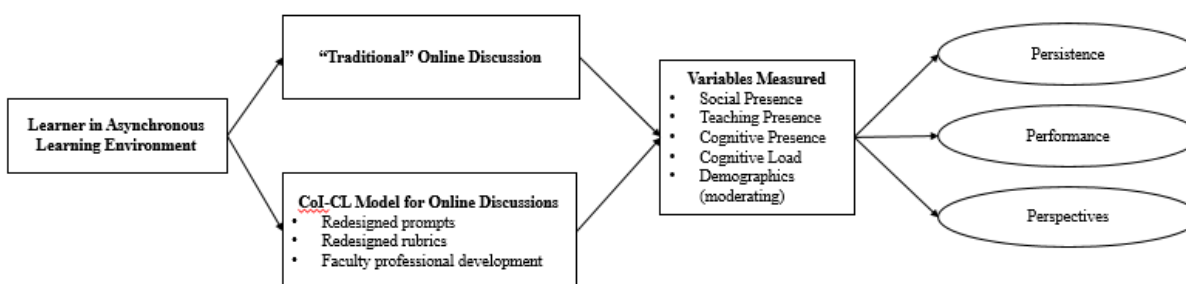


Figure 2

Conceptual Framework for the Project Design

Intellectual Merit

This proposed project will demonstrate successful implementation of best practices in asynchronous discussions by improving Community of Inquiry and reducing cognitive load. This study is novel and impactful. Of particular note, the relationship between CoI or Cognitive Load versus STEM attitudes is not explored. Because STEM careers are expected to grow, a strong STEM pipeline is desired; STEM attitudes correlate to STEM career interest (64). Gaps in the literature are presented in Table 1.

Table 1

Summary of Knowledge Gaps Revealed through Literature Review

	Persistence			Performance			STEM Attitudes	
	Online	STEM	Online STEM	Online	STEM	Online STEM	STEM	Online STEM
Cognitive Load	(30)				(35)	(36)		
Social Presence	(23)		(44,45)	(41)		(47)		
Teaching Presence	(26,48)			(41)		(56)		
Cognitive Presence	(58)			(41)				

This project will develop a transferable, scalable CoI-CL framework. The goals are to increase STEM course persistence, improve academic performance, and develop positive STEM attitudes. With a robust evaluation plan, we will be able to make evidence-based decisions regarding framework aspects.

The Proposed Solution

Foundational Work

In foundational work to support this proposal, the authors sought to compare predominant withdrawal reasons at their own institution compared to the variety of withdrawal reasons presented in the literature for online courses (Figure 1). However, the existing data collection instrument for withdrawal reasons was not granular enough to meaningfully investigate various elements of student persistence to ensure targeted interventions had their intended effect on withdrawal reasons. This project will implement a more robust method for capturing withdrawal reasons institutionally. Furthermore, IRB-approved preliminary research is underway to measure current cognitive load, CoI presences, and STEM attitudes in the target courses.

The Framework

We propose a program with targeted interventions in undergraduate introductory STEM courses taught asynchronously online (Table 2), with the aim to reduce withdrawal, increase performance, and positively impact STEM attitudes. The interventions target cognitive load and the COI presences. The intervention will directly impact 4,524 students during the project timeline. This project involves a partnership between multiple Embry-Riddle Aeronautical University (ERAU) – Worldwide entities (Table 3). Because the interventions are embedded in the course templates and because the professional development offers post-development scaffolding, the impact is sustainable. Once efficacy is demonstrated, the course redesign and faculty professional development is transferable and scalable to additional STEM courses.

Table 2

Target General Education STEM Courses for Pilot Program

	Course	Annual Enrollments in 20-21 AY (#)
<i>Science</i>	Explorations in Physics (PHYS 102)	2751
<i>Mathematics</i>	Pre-Calculus for Aviation (MATH 111)	1773

Table 3

Framework for Cognitive Presence Intervention in Online STEM Learning

Development		Implementation	
Partner	Task	Partner	Task
IDD and Course Developers	Course redesign	Research Team	Data Collection
CTLE	Instructor PD development & implementation	CoAS	Peer observation
Advising	Policy and training on documenting withdrawal reasons	Advising CTLE	Withdrawal monitoring Instructor PD implementation

Development Phase

Course Refresh. Asynchronous online discussion forums do not inherently support natural, constructive interactions. Course developers for the target courses housed by the College of Arts and Sciences (CoAS) will work with the Worldwide Instructional Design Department (IDD) as a design cohort

to implement changes to the asynchronous online discussions within the target courses, establishing a Community of Inquiry framework while mitigating impacts to cognitive load (Table 4).

Table 4

Discussion Design Aspects based on Best Practices

Aspect	Description	Target Variable	Reference
Prompt	Mini audio presentation	Teaching presence	(65)
	Use Practical Inquiry Model	Cognitive presence	(66)
	Real-world scenarios, brainstorming, debates, collaboration, and metacognition	Cognitive presence	(32)
	Anchored discussion system	Cognitive load	(67,68)
	Word economy and “weeding” to eliminate interesting but extraneous material	Cognitive load	(69)
Instructions	Clearly defined student roles and responsibilities	Cognitive presence	(70,71)
	Expectation of peer facilitation	Cognitive presence	(61)
	Expectation of defense of work/supporting evidence	Cognitive presence	(32,66)
	Word economy and “weeding” to eliminate interesting but extraneous material	Cognitive load	(69)
	Clear expectations: response frequency, due dates, expectations for social and cognitive presence	Cognitive load	(71)
	Signaling cues for how to process material	Cognitive load	(68,69)
Rubric	Evaluation alignment: social and cognitive presence	Cognitive presence	(72)
	Emphasize importance of sharing personal experience	Social presence	(73)
	Word economy and “weeding” to eliminate interesting but extraneous material	Cognitive load	(69)
General Design	Small, permanent discussion groups (3-5 learners)	Social presence	(74,75)
	Required product to submit based on discussion	Teaching presence	(72)
	Post-filtering to limit post visibility (segmenting) to reduce essential processing demands	Cognitive load	(69,76)
	Separate pre-training separate to introduce characteristics, expectations, provide example posts	Cognitive load	(69,76)
	Pre-training to emphasize the importance of social and cognitive presence	Cognitive load	(73)

Instructor Professional Development. The full-time and adjunct instructors scheduled to teach the target courses for the study timeframe will be provided access to asynchronous professional development (PD) opportunities through Worldwide’s Center for Teaching and Learning Excellence (CTLE). The asynchronous online platform will mirror the student learning environment to foster empathy for students and will include asynchronous online discussions designed and facilitated using the CoI and cognitive load best practices. Faculty who complete online PD are more engaged in the online courses they teach (77). Because STEM faculty with fixed mindset regarding student ability have greater racial achievement gaps (78), the PD will be infused with growth mindset strategies for faculty and emphasize the value of interpersonal relationships within their STEM discipline (79).

Facilitation is key to CoI presences in online discussions (80). Best practices in discussion facilitation will be a central aspect of the PD. Chickering’s seven principles of good practice in

undergraduate education (81) will be presented in terms of online discussion facilitation. To promote cognitive presence, instructors will learn how to ask facilitation questions focused on application (personal, professional, or real world) or explanation (32) and how to avoid high cognitive presence posts, which inhibits student achievement of these levels of cognitive presence (32). Instructors will also practice ideal “wait time” in online discussions to avoid preemptive posting or ‘ghosting’, with balance in the instructor’s social presence promoting strong learner social presence (75).

Strong instructor feedback promotes teaching presence. Instructors will learn feedback best practices, including the impact of asynchronous audio feedback on perceived teaching presence and sense of community (82). Instructors will also explore strategies to pair pre-discussion coaching with immediate feedback post-discussion to strengthen the instructor’s teaching presence and promote learner cognitive presence (83).

Advising. The Worldwide Academic Advising department will modify their data collection to implement a consistent process for documenting student withdrawal reasons. The current list of withdrawal reasons is not detailed enough or aligned with research-based persistence factors and results in a large “other” category. The process will be modified to implement a standardized set of withdrawal reasons based on elements identified in the literature and coded based on their dimensions (Figure 1). The data will be collected by advisors and recorded by the registrar using the existing system, with data managed and stored through the Office of Institutional Research. Advisors will implement this new data collection process prior to the launch of the redesigned courses so that pre-intervention withdrawal data and reasons can be collected in a manner that will be consistent with the data collection during the implementation of the redesigned courses.

Implementation Phase

Peer Observation. A best practice in higher education is peer observation of instruction (84,85). In 2019, the College of Arts and Sciences – Worldwide established a Peer Observation program. This program will be leveraged for targeted peer observation of facilitation best practices presented in the instructor professional development. The Peer Observation program contains a post-observation synchronous debrief. For this project, the debrief will also include a representative from IDD and CTLE so that feedback can be operationalized and implemented.

Withdrawal monitoring. Advisors will continue to collect withdrawal reasons using the newly implemented system of data collection and management previously described.

Instructor Professional Development. To address the fading impact of professional development over time (86), a post-PD scaffold and follow-up support will be implemented to maintain a long-term connection between instructional designers, instructional technologists, and faculty. In the previously-discussed asynchronous professional development, a timeline will be presented that communicates the post-PD support that will be offered.

Using the asynchronous online platform for professional development, the faculty cohort will continue to engage with their learning group through weekly asynchronous online discussions. The prompts will be selected to target potential current barriers to implementing the best practices or discussion various discussion design aspects as they are experiencing them in their teaching. This discussion will be moderated and facilitated by the CTLE trainer who oversaw the initial training. The course will also have a follow-up support request form so that they can reconnect with their trainer by request to address specific questions and concerns. The instructors will also be given a list of additional resources to support independent exploration and extension.

A final post-PD support will be the collection of delayed feedback through an online survey, with data collected after the instructor has concluded teaching the redesigned course. The survey will consist of open-ended questions that encourage reflection and metacognition on the professional development, the effectiveness of the course redesign components, and their teaching.

Project Objectives and Goals

The goal of this project is to target key withdrawal reasons in online STEM courses through improvements to the Community of Inquiry in the online discussions while mitigating impacts to cognitive load. Additional goals are to improve student performance and STEM attitudes. Specific objectives for the proposed project period are to develop a Community of Inquiry – Cognitive Load (COI-CL) Framework for online discussion design, implementation, and facilitation in STEM courses that will:

1. Increase STEM course persistence, as evidenced by student progression in the course (drop and withdrawal rate).
2. Increase academic performance in online STEM courses, as measured by grades.
3. Positively influence STEM attitudes, as evidenced through self-reported student perspectives.
4. Decrease cognitive load, as evidenced through self-reported student perspectives.
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.

Methodology

Proposed Work

In this project, our goal is to develop a transferable model to improve persistence, performance, and perspectives in online STEM courses through targeted interventions including course design and instructor development (Tables 5 and 6).

Table 5

Research Questions and Data Sources

Research Question	Institutional Data	Interviews	Surveys
RQ1: How does the Framework affect online STEM course persistence?	X ¹		
RQ2: How does the Framework influence academic performance in online STEM courses?	X ²		
RQ3: How does the Framework influence STEM attitudes?		X	X ³
RQ4: How does the Framework influence cognitive load?		X	X ⁴
RQ5: How were subscales for the Col presences impacted?	X	X	X ⁵
RQ6: How do persistence, learning, and perspectives differ among student sub-groups?	X ^{1,2,3, 4, 5, 6}		

¹ Enrollment Data

² LMS Data

³ STEM Attitudes Survey Instrument (87)

⁴ Cognitive Load Survey Instrument (88)

⁵ Col Survey Instrument (39)

⁶ Demographic Data

Table 6*Research Hypotheses*

Research Question	Alternative Hypotheses (H_a)
1	Increased student persistence will occur in Col-CL Framework vs. original course design. The predominant withdrawal dimensions will be different between the Col-CL Framework and the original course design.
2	Increased student pass rate will occur in Col-CL Framework vs. original course design. The grade distribution will be different between Col-CL Framework and original design.
3	Positive STEM attitudes will increase in Col-CL Framework vs. original course design.
4	Student-reported cognitive load will be lower in Col-CL Framework vs. original design.
5	Student-reported perspectives on Social Presence subscales will be different between the Col-CL Framework. Student-reported perspectives on Teaching Presence subscales will be different between the Col-CL Framework. Student-reported perspectives on Cognitive Presence subscales will be different between the Col-CL Framework.
6	Persistence will differ among learner sub-groups. Learning outcomes will differ among learner sub-groups. Cognitive load perspectives will differ among learner sub-groups. Col perspectives will differ among learner sub-groups.

Study Population

Pre- and post-implementation data will be collected from the target courses (Table 3). In 2019, 14% were female and 30% were minorities. This project will proceed over a 3-year period (Table 7).

Table 7*Study Timeline*

Tasks	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Development of Redesign Cohort structure	X											
Advising policy development & training on withdrawal documentation	X											
Advising withdrawal documentation	X	X	X	X	X	X	X	X				
Course redesign cohort		X	X	X								
Instructor PD development		X	X									
Initial Instructor PD Cohort 1				X								
Framework launch Cohort 1					X							
Initial Instructor PD Cohort 2					X							
Framework launch Cohort 2						X						

Preliminary external evaluation of framework	X	X		
Preliminary dissemination	X			
Initial Instructor PD Cohort 3	X			
Framework launch Cohort 3			X	
Initial Instructor PD Cohort 4			X	
Framework launch Cohort 4				X
Peer observation	X	X	X	X
Post-PD scaffolding	X	X	X	X
External evaluation of framework				X X
Develop transferability plan to other online STEM courses				X
External evaluation of transferability plan				X
Disseminate final results				X

Data Collection and Analyses

Institutional Data

The use of all institutional data will be reviewed by ERAU's Institutional Review Board. The dependent variables measured through institutional data are persistence and performance. Persistence will be measured through drop and withdrawal rate rates in the target courses, collected through reports generated in Campus Solutions (an application from Oracle's PeopleSoft utilized by ERAU). Withdrawal reasons (as documented through academic advisors) will be requested as secondary data from ERAU's Institutional Research Office. Academic performance will be measured through final course grades and discussion rubric scores, collected through Campus Solutions reports. Final course grades and discussion rubric scores will be used to determine pass rate and grade distribution.

Discussion post content generated by participants will be analyzed to support the self-reported perspectives on the three CoI presences, with inter-rater agreement (%) reported. To measure social presence, learner posts will be coded based on factors of affective responses (e.g. expression of emotion), interactive responses (e.g. quoting other messages), and cohesive responses (e.g. vocatives) using operational definitions for each, with results reported as social presence density (SPD) (89-91). To measure teaching presence, instructor posts will be coded based on the facilitating discourse and direct instruction components of teaching presence (92,93). Similar to SPD, teaching presence will be reported as a teaching presence density (TPD). To measure cognitive presence, posts will be coded based on the four phases of cognitive presence using expert coders using previously reported categories and examples (90) and rating rubric (as cited in (94)). Based on previous work, triggering event and exploration may predominate without intervention (95).

Surveys Instruments

Pre- and post-intervention experience perspectives will be collected through voluntary surveys. The independent variables manipulated through the redesign of the course discussions are cognitive load and the CoI's three presences. To validate the redesign, self-reported cognitive load and perspectives on the CoI presences will be measured to compare pre- and post conditions. The

dependent variable measured through the survey instrument is STEM attitudes. The survey instrument and collection methods will be reviewed by ERAU's Institutional Review Board.

QuestionPro will be used as a web-based platform for disseminating surveys. The platform allows anonymous responding without logging user information or IP address. Distinct survey links will be generated for each course so that effects can be compared across STEM disciplines. The survey invitation will be sent out in the final week of the course, with a reminder invitation sent out the week after the course concludes. To encourage strong participation and survey completion, respondents will earn a small incentive. The instrument was divided into four major parts.

Section 1 of the survey collects demographic information and learner characteristics. Questions will collect information on the following potential moderating variables: gender, age range, academic major, prior online course experience, employment status, and financial aid status. Additionally, locus of control will be explored using select questions a locus of control instrument applied to e-learning (96). It is not reasonable to fully capture all potential moderating variables from Figure 1, but this captures key variables identified by the research team.

Section 2 of the survey measures STEM attitudes using a modified Behaviors, Related Attitudes, and Intentions toward Science (BRAINS) Survey. The instrument will be modified to replace "science" with "STEM". This instrument contains 30 items (Likert scale) across five subscales (attitudes towards STEM, behavioral beliefs about STEM, intentions to engage in STEM, normative beliefs, and control beliefs) and has a reported high internal consistency and reliability (87). This instrument was selected over other instruments (e.g. (97)) due to the use of operational definitions, connection to measurement goals, and alignment of factor structure with the theoretical framework.

Section 3 of the survey measures CoI presences using the Community of Inquiry instrument (39). The instrument contains 34 items (Likert scale) across three subscales (social presence, teaching presence, and cognitive presence) and has a reported high internal consistency and reliability (39,98,99). This instrument was selected due to its widespread use and validation in the literature as well as its ability to cover all three presences in one instrument.

Section 4 of the survey measures cognitive load. From a practical perspective, subjective self-reporting is used for capturing cognitive load in field-based studies (88,100). The National Aeronautics and Space Administration – Task Load Index (NASA-TLX) is reliable and valid for quantifying learning perceptions of cognitive load in asynchronous online courses (88,101). The NASA-TLX instrument uses multidimensional rating to derive a total workload score using a weighted average from six subscales: mental activity, physical activity, time pressure, perceived success, effort, and frustration (88). For the NASA-TLX instrument, the cognitive load of the asynchronous online discussions was operationalized into 5 tasks: understanding expectations, crafting an initial post, reading posts from instructors and peers, creating reply posts, and understanding instructor feedback and grading.

Interviews

Thirty adult students from the target courses will be purposely selected for an end-of-term interview. Interviewees will represent diverse age, gender, ethnic status, and asynchronous online course experience. Interviews will be conducted virtually, lasting 30 – 45 minutes. Interview protocols will be approved by ERAU's Institutional Review Board.

Semi-structured interviews will be designed to dig deeper into student experiences and perspectives related to the CoI presences and cognitive load by exploring factors for each presence. For social presence, interview questions will address the factors of social respect, social sharing, open mind, social identity, and intimacy (102). For teaching presence, interview questions will be guided by the

Post-Course Teaching Presence Rubric and Instructor Scorecard in the Teaching Presence Evaluation Toolkit (103). For cognitive presence, interview questions will address the subcategories of each phase of cognitive presence (94,104).

Data Analysis

Baseline data from students enrolled in the original course will be compared to participant data. Spearman's rho will be used to identify significant correlations between Col presences, cognitive load, persistence, performance, and attitudes. Cronbach's alpha coefficient will assess internal reliability for all subscales in the survey instrument. Frequencies and descriptive statistics will also be used to describe results. Instructional efficiency will be calculated in pre- and post-intervention courses using cognitive load as mental effort and social and cognitive presence (separately) as discussion quality (76).

All interview transcripts and discussion transcripts will be entered into NVivo. Boundaries and relationships will be clarified by comparing, subdividing, and refining initial codes. The frequency of responses in specific codes and categories will identify general themes.

Program Effectiveness Evaluation

Evaluation of benchmarks within three key areas will establish the effectiveness of the framework: course redesign, instructional professional development, and student impact (Table 8).

Table 8

Summative Evaluation Metrics for the Col-Cognitive Load Framework

Measure	Benchmark
<i>Course Redesign</i>	
Social Presence in Online Discussions	80% of students report positive social presence
	Discussion transcript analysis will demonstrate SPD >4 in each factor
	Social presence is consistent across disciplines
	Social presence is consistent across learner subgroups
Teaching Presence in Online Discussions	80% of students report positive teaching presence
	Qualitative data from Peer Observations support strong teaching presence
	Discussion transcript analysis will demonstrate TPD >4 in each factor for both categories.
	Teaching presence is consistent across disciplines
Cognitive Presence in Online Discussions	Teaching presence is consistent across learner subgroups
	80% of students report positive cognitive presence
	Discussion transcript analysis will demonstrate >40% of learner posts achieve higher cognitive presence
	Cognitive presence is consistent across disciplines
Cognitive Load in online discussions	Cognitive presence is consistent across learner subgroups
	The mean cognitive load for each task is <50
	Cognitive load is consistent across disciplines
Instructional Efficiency	Cognitive load is consistent across learner subgroups
	Instructional efficiency of the redesigned target courses will be >0.5 for both learner social presence and learner cognitive presence
<i>Instructor Professional Development</i>	
Instructor completion of professional development	100% of instructors teaching the redesigned target courses complete initial PD activities

Faculty completion of peer observation	100% of instructors teaching the redesigned target courses participate in Peer Observation during the implementation term
Faculty engagement in post-PD discussions	80% of instructors teaching the redesigned target courses engage in 60% of the weekly discussions during the implementation term
Faculty completion of post-PD feedback	70% of instructors teaching the redesigned target courses complete the post-PD feedback survey
<i>Student Impact</i>	
Persistence	70% will continue in the course past the withdrawal deadline
	Persistence is consistent across disciplines
	Persistence is consistent across learner subgroups
Academic performance	60% will have a final grade of \geq B- 90% will have a final grade of \geq D-
	Performance is consistent across disciplines
	Performance is consistent across learner subgroups
STEM attitudes	90% will report positive STEM attitudes
	STEM attitudes are consistent across disciplines.
	STEM attitudes are consistent across learner subgroups

Broader Impacts

Online STEM learning faces persistence problems, with demographics and learner characteristics having a demonstrated influence. Community of Inquiry is a best practice that has demonstrated efficacy in online learning. However, cognitive load must be considered in asynchronous online courses. This project will result in the development of a Col-CL framework for online STEM courses that supports persistence, performance, and attitudes through promotion of social, teaching, and cognitive presences while mitigating cognitive load. This activity, related to research, offers a benefit to society because this framework will be evaluated for efficacy and disseminated in a manner to reach practitioners and administrators. With the increase in asynchronous online course offerings, this is an impactful framework for course designers and educators as it offers guidance for both design and facilitation of discussions. As a leader in online education for many years, ERAU is well-positioned to serve as a model for this framework. The efficacy of the framework will be evaluated on multiple criteria (Table 7), including evidence that the intervention achieved strong Col presences and lower cognitive load as well as strong persistence, performance, and attitudes. The framework will be assessed to ensure the goals of increased persistence, performance, and attitudes are achieved relative to the original discussion format and facilitation in the target courses (Table 5). By using high-enrollment courses, we will be able to explore impacts on student subgroups, including at-risk students.

There are two major research-related impacts that advance discovery and promote learning. First, this study will establish the influence of Col and cognitive load on persistence, performance, and STEM attitudes. These relationships are not yet clearly established in research literature. Second, this study will help identify more clearly the withdrawal reasons in online STEM, which is underexplored in higher education. The instrument used for capturing withdrawal reasons in this study is based upon moderating variables identified in the literature, which offers an easy to implement instrument at other institutions. Using this instrument will allow for a fine-grained analysis of withdrawal dimensions and elements, allowing for targeted interventions beyond the Col-CL Framework. The project team is well positioned to disseminate these broad research impacts due to alignment with research agendas and history of publication success.

These broader impacts will be straightforward to achieve through the structure of the project. The external evaluator will assess achievement of broader impacts. The project team leverages researchers, online STEM instructors, faculty developers, and student advisors. The funding supports the professional development of instructors, time investment of expert coders, provides a survey incentive to increase participation by learners in the target classes, and to support the time of the project personnel. The key milestones in the project are:

- 1) redesign of the online STEM course discussions,
- 2) implementation of new method of documenting withdrawal reasons,
- 3) instructor professional development,
- 4) evaluation of the CoI-CL Framework and transferability plan
- 5) dissemination of research results:
 - a. withdrawal in online STEM
 - b. CoI-CL influence on persistence, performance, and STEM attitudes
- 6) dissemination of the CoI-CL Framework

Dissemination Plan

This project will directly impact approximately 4,500 students at ERAU during the project time frame. However, the template for the redesigned courses and the asynchronous instructor professional development offer sustainability and significantly higher number of directly impacted students. Furthermore, the framework can be translated to other online STEM courses at ERAU and beyond, potentially impacting a large number of students. With the recent dramatic shift to online learning in early 2020, dissemination of this framework will be timely.

Emily Faulconer plans to present preliminary data at the Online Learning Consortium (OLC) Innovate Conference (Winter 2022 dates TBA). The OLC conference offers a virtual hub, allowing access to both in-person and virtual attendees. The Co-PIs will disseminate the framework and results through manuscripts submitted to high-impact, open access peer-reviewed journals such as *Peer Review* (Impact Factor 10.273), *Learning, Media, and Technology* (Impact Factor 3.18), and *International Review of Research in Open and Distributed Learning* (Impact Factor 1.003).

Assessment and Evaluation

Formal external evaluation of this project will occur at three points: 1) after the 2nd cohort and 2) after the development of the CoI-CL Framework and 3) after the development of the transferability plan, prior to dissemination of final findings. At the first evaluation point, the evaluator will review the draft framework and provide recommendations for the remaining two cohorts in the project. At the second evaluation point, the evaluator will review the final CoI-CL Framework and provide final recommendations based on evaluation data. At the third evaluation point, the evaluation will provide feedback on the transferability plan developed for translating the framework to additional online STEM courses within ERAU and externally. Evaluator feedback will be incorporated into the project deliverables (framework and transferability plan). This external review will ensure that our deliverables are high quality and broadly applicable, as it is our goal to develop a framework useful across STEM disciplines. Specifically, the evaluator will review:

- Data, analysis, and interpretations of data
- Completion of project goals
- Program effectiveness, measured as achievement of benchmarks (Table 8)
- Dissemination plans for data and framework

- Final deliverables (framework and transferability plan) for broad applicability
- Achievement of broader impacts

Informal external evaluation will be ongoing, with quarterly reports from the external evaluator to the research team, including feedback on goal completion, data collection, and benchmark achievements.

Project Personnel and Roles

Dr. Emily Faulconer, *Co-PI*, (Ph.D. Environmental Engineering Sciences) is an Assistant Professor in the STEM Education Department at Embry-Riddle Aeronautical University, Worldwide Campus. Her research has focused on the scholarship of teaching and learning, specifically online education. Dr. Faulconer will report interim results to the team and funding agency. She will collect and manage data, co-develop the Framework and Transferability Plan, and disseminate preliminary and final results.

Dr. Beverly Wood, *Co-PI*, (Ph.D. Mathematics Education) is an Assistant Professor and the Associate Chair for the STEM Education Department at Embry-Riddle Aeronautical University, Worldwide Campus. Her research has focused on the scholarship of teaching and learning, specifically humanistic STEM education. Dr. Wood's participation demonstrates a high level of institutional support and capacity for the project. She will collect and manage data, co-develop the Framework and Transferability Plan, and disseminate preliminary and final results.

Ms. Angela Atwell, *Unfunded Collaborator*, (M.S. Educational Leadership and Administration) is the Associate Director of the Rothwell Center for Teaching and Learning Excellence, Embry-Riddle Aeronautical University, Worldwide Campus. She has significant experience as a faculty developer. In this role, she will develop and facilitate the instructor professional development, including post-PD scaffolding.

Amy Jeffs, *Unfunded Collaborator*, is the Executive Director of Online Advising for the Department of Online Education at Embry-Riddle Aeronautical University, Worldwide Campus. She has oversight of online advisors and can support the suggested modifications to the withdrawal reason documentation proposed in this project. In this role, she will train advising team on withdrawal reason documentation and supervise this revised process.

Graduate Assistants (2) will be hired for part-time work on this project to support data management and analysis, particularly expert coding of discussion and interview transcripts.

Dr. Alireza Lari, *External Evaluator*, is associated with the American Institute of Higher Education, LLC as an expert in design of total quality systems, performance audit, and improvement of operational processes. Dr. Lari will ensure the project team remains on target with activities and deliverables through quantitative and qualitative evaluations throughout the project.

Results from Prior NSF Support

Although the lead investigators do not have prior support to report, the team has lead other major undergraduate initiatives that have contributed to the knowledge base regarding online education best practices, persistence, and student perspectives. These activities last five years that have resulted in many external products, which include but are not limited to the following:

Carver, R., Everson, M., Gabrosek, J., Horton, N., Lock, R., Mocko, M., Rossman, A., Roswell, G.H., Velleman, P., Witmer, J., **Wood, B.** (2016). Guidelines for assessment and instruction in statistics education (GAISE) college report 2016. *American Statistical Association*.

Bourdea, D.T., Roberts, D., **Wood, B.**, Koriath, J. (2017) A study of video-mediated opportunities for self-directed learning in required core curriculum. *International Journal of Educational Methodology*, 3(2), 85.

Faulconer, E. (2017) Increasing student interactions with learning objectives. *Journal of College Science Teaching*, 46(5).

Faulconer, E., Griffith, J.C., **Wood, B.**, Acharyya, D., Roberts, D.L. (2018). A comparison of online and traditional chemistry lecture and lab. *Chemistry Education Research and Practice*, 19(1), 392-397.

Faulconer, E., Griffith, J.C., **Wood, B.**, Acharyya, D., Roberts, D.L. (2018) A comparison of online, video synchronous, and traditional learning modes for an introductory undergraduate physics course. *Journal of Science Education and Technology*, 27(5), 404-411.

Wood, B., Mocko, M., Everson, M., Horton, N.J., Velleman, P. (2018). Updated Guidelines, Updated Curriculum: The *GAISE College Report* and introductory statistics for the modern student. *CHANCE*, 31(2), 53-59.

Bolch, C. & **Wood, B.** (2018) Seeing and Understanding Data: a mini-primary source project for students of statistics. *Convergence*.

Faulconer, E. & Gruss, A. (2018) A review to weigh the pros and cons of online science laboratory experiences. *International Review of Research in Open and Distributed Learning*, 19(2).

Faulconer, E., Griffith, J., Frank, H. (2019) If at first you do not succeed: the student benefits of multiple trials on summative assessments. *Teaching in Higher Education*.

Bourdeau, D.T. & **Wood, B.** (2019) What is humanistic STEM and why do we need it? *Journal of Humanistic Mathematics*, 9(1), 205-216.

Faulconer, E. & **Wood, B.** (2019) Formative assessment techniques for online learning. *The Teaching Professor*.

Roberts, D.L., Griffith, J.C., **Faulconer, E.**, **Wood, B.**, Acharyya, D. (2019) An investigation of the relationship between grades and learning modes in an introductory research methods course. *The Online Journal of Distance Learning Administration*, 22(1), 1.

Faulconer, E., **Wood, B.**, Griffith, J.C. (2020) Infusing humanities in STEM Education: student opinions of disciplinary connections in an introductory chemistry course. *Journal of Science Education and Technology*.

Faulconer, E., Dixon, Z., Griffith, J., Faulconer, L. (2020) Perspectives on undergraduate research mentorship: a comparative analysis between online and traditional faculty. *Online Journal of Distance Learning Administration*, 23(2).

References

- (1) Atchley TW, Wingenbach G, Akers C. Comparison of course completion and student performance through online and traditional courses. *The International Review of Research in Open and Distributed Learning* 2013;14(4).
- (2) R. R. Paden. A comparison of student achievement and retention in an introductory math course delivered online, face to face, and blended modalities; 2006.
- (3) Jaggars SS, Edgecombe N, Stacey GW. Creating an effective online instructor presence. 2013.
- (4) Murphy CA, Stewart JC. On-campus students taking online courses: factors associated with unsuccessful course completion. *The Internet and Higher Education* 2017;34:1-9.
- (5) Smith G, Ferguson D. Student attrition in mathematics e-learning. *Australasian Journal of Educational Technology* 2005;21(3):323-334.
- (6) Bawa P. Retention in online courses: exploring issues and solutions - a literature review. *Sage Open* 2016;6(1).
- (7) An analysis of the effect of the online environment on STEM student success. 15th Annual Conference on Research in Undergraduate Mathematics Education; 2012.
- (8) Best Colleges. 2019 Online Education Trends Report. 2020; Available at: <https://www.bestcolleges.com/research/annual-trends-in-online-education/>.
- (9) Park JH, Choi HJ. Factors influencing adult learners' decision to drop out or persist in online learning. *Educational Technology & Society* 2009;12(4):207-217.
- (10) Wladis C, Hachey AC, Conway KM. The representation of minority, female, and non-traditional STEM majors in the online environment at community colleges: a nationally representative study. *Community College Review* 2015;43(1):89-113.
- (11) Mau WCJ. Characteristics of US students that pursued a STEM major and factors that predicted their persistence in degree completion. *Universal Journal of Educational Research* 2016;4(6):1495-1500.
- (12) Xu D, Jaggars S. Adaptability to online learning: differences across types of students and academic subject areas. 2013;54.
- (13) Wladis C, Hachey AC, Conway K. Which STEM majors enroll in online courses, and why should we care? The impact of ethnicity, gender, and non-traditional student characteristics. *Computers & Education* 2015;87:285-308.
- (14) Tinto V. *Leaving College: Rethinking the causes and cures of student attrition*. Chicago, IL: The University of Chicago Press; 1987.
- (15) Bandura A. Social cognitive theory in cultural context. *Applied Psychology* 2002;51(2):269-290.

- (16) Bean JP. Why students leave: insights from research. In: Hossler D, Bean JP, editors. *The Strategic Management of College Enrollments* San Francisco, CA: Jossey-Bass; 1990. p. 170-185.
- (17) Levy Y. Comparing dropouts and persistence in e-learning courses. *Computers & Education* 2007;48(2):185-204.
- (18) Dupin-Bryant P. Pre-entry variables related to retention in online distance education. *American Journal of Distance Education* 2004;18(4):199-206.
- (19) Xenos M, Pierrakeas C, Pintelas P. A survey on student dropour rates and dropout causes concerning the student in the Course of Informatices of the Hellenic Open University. *Computers & Education* 2002;39(4):361-377.
- (20) Cochran J, Campbell SM, Baker HM, Leeds EM. The role of student characteristics in predicting retention in online courses. *Res High Educ* 2014;55(1):27-48.
- (21) Harrell IL, Bower BL. Student characteristics that predict persistence in community college online courses. *American Journal of Distance Education* 2011;25(3):178-191.
- (22) McKinney L, Novak H, Hagerdorn LS, Luna-Torres M. Giving up on a course: an analysis of course dropping behaviors among community college students. *Research in Higher Education* 2018:1-19.
- (23) Hart C. Factors associated with student persistence in an online program of study: a review of the literature. *Journal of Interactive Online Learning* 2012;11(1):19-42.
- (24) Lee Y, Choi J, Kim T. Discriminating factors between completers of and dropouts from online learning courses. *British Journal of Educational Technology* 2012;44(2).
- (25) Hachey AC, Wladis C, Conway K. Prior online course experience and GPA as predictors of subsequent online STEM course outcomes. *The Internet and Higher Education* 2015;25:11-17.
- (26) Ivankova NV, Stick SL. Students' persistence in a distributed doctoral program in educational leadership in higher education: a mixed methods study. *Research in Higher Education* 2007;48(1):93-135.
- (27) Stanford-Bowers DE. Persistence in online classes: a study of perceptions among community college stakeholders. *Journal of Online Learning and Teaching* 2008;4(1).
- (28) Pierrakeas C, Xenos M, Panagiotakopoulos C, Vergidis D. A comparative study of dropout rates and causes for twi different distance education courses. *International Review of Research in Open and Distance Learning* 2004;52(2):1-13.
- (29) Moore J. Effects of online interaction and instructor presence on students' satisfaction and success with online undergraduate public relations courses. *Journalism & Mass Communication Educator* 2014;69(3):271-288.

(30) Tyler-Smith K. Early Attrition among First Time eLearners: A Review of Factors that Contribute to Drop-out, Withdrawal, and Non-completion Rates of Adult Learners undertaking eLearning Programmes. *J Online Learn Teach* 2006;2(2):73-85.

(31) Stiller KD, Koster A. Learner attrition in an advanced vocational online training: the role of computer attitude, computer anxiety, and online learning experience. *European Journal of Open, Distance, and E-Learning* 2016;19(2):1-14.

(32) J. Mills. A mixed methods approach to investigating cognitive load and cognitive presence in an online and face-to-face college algebra course; 2016.

(33) Bradford GR. A relationship study of student satisfaction with learning online and cognitive load: initial results. *The Internet and Higher Education* 2011;14(4):217-226.

(34) K. Kozan. The predictive power of the presences on cognitive load; 2015.

(35) Gillmor SC, Poggio J, Embretson S. Effects of reducing the cognitive load of mathematics test items on student performance. *Numeracy: Advancing Education in Quantitative Literacy* 2015;8(1):1-18.

(36) Stachel J, Marghitu D, Brahim TB, Sims R, Reynolds L, Czelusniak V. Managing cognitive load in introductory programming courses: a cognitive aware scaffolding tool. *Journal of Integrated Design and Process Science* 2013;17(1):37-54.

(37) Lou Y, Bernard RM, Abrami PC. Media and pedagogy in undergraduate distance education: A theory-based meta-analysis of empirical literature. *Educ Technol Res Dev* 2006;54(2):141-176.

(38) deNoyelles A, Zydney J, Chen B. Strategies for creating a community of inquiry through online asynchronous discussions. *Journal of Online Learning and Teaching* 2014;10(1):153-165.

(39) Garrison DR, Anderson T, Archer W. Critical inquiry in a text-based environment: computer conferencing in higher education. *The Internet and Higher Education* 2000;2:87-105.

(40) Garrison DR. *E-learning in the 21st century: a framework for research and practice*. 2nd ed. New York: Taylor & Francis; 2011.

(41) Jaggars SS, Xu D. How do online course design features influence student performance? *Computers & Education* 2016;95:270-284.

(42) A case study of the importance of peer support for e-learners. *Proceedings of the 9th International Conference on Computer Supported Education*; 2017.

(43) Faulconer EK, Griffith J, Wood B, Acharyya S, Roberts D. A comparison of online, video synchronous, and traditional learning modes for an introductory undergraduate physics course. *Journal of Science Education and Technology* 2018;27(5):404-411.

(44) Liu SY, Gomez J, Yen C. Community college online course retention and final grade: predictability of social presence. *Journal of Interactive Online Learning* 2009;8(2):165-182.

- (45) J. J. C. Burch. An application of Tinto's Student Integration Model and Bandura's Social Cognitive Theory to Student Retention in STEM Disciplines; 2018.
- (46) Hostetter C. Community matters: social presence and learning outcomes. *Journal of the Scholarship of Teaching and Learning* 2013;13(1):77-86.
- (47) Joksimovic S, Gasevic D, Kovanovic V, Riecke BE, Hatala M. Social presence in online discussions as a process predictor of academic performance. *Journal of Computer Assisted Learning* 2015;31(6).
- (48) Ojokheta KO. A path-analytic study of some correlates predicting persistence and student's success in distance education in Nigeria. *Turkish Online Journal of Distance Education* 2011;11(1).
- (49) Drouin MA. The relationship between students' perceived sense of community and satisfaction, achievement, and retention in an online course. *Quarterly Review of Distance Education* 2008;9(3):267-284.
- (50) Pigliapoco E, Bogliolo A. The effects of psychological sense of community in online and face-to-face academic courses. *International Journal of Emerging Technologies in Learning* 2008;3(4):60-69.
- (51) Herbert M. Staying the course: a study in online student satisfaction and retention. *Online Journal of Distance Learning Administration* 2006;94(4):300-317.
- (52) Joyner SA, Fuller MB, Holzweiss PC, Henderson S, Young R. The importance of student-instructor connections in graduate level online courses. *Journal of Online Learning and Teaching* 2014;10(3):436-445.
- (53) Angelino LM, Williams FK, Natvig D. Strategies to engage online students and reduce attrition rates. *Journal of Educators Online* 2007;4(2):2.
- (54) Dunlap JC, Verma G, Johnson HL. Presence+Experience: a framework for the purposeful design of presence in online courses. *TechTrends* 2016;60(2):134-151.
- (55) Gaytan J. Comparing faculty and student perceptions regarding factors that affect student retention in online education. *American Journal of Distance Education* 2015;29(1):56-66.
- (56) Hegeman JS. Using instructor-generated video lectures in online mathematics courses improves student learning. *Online Learning* 2015;19(3):70-87.
- (57) X. Zhu. Facilitating effective online discourse: investigating factors influencing students' cognitive presence in online learning; 2018.
- (58) Ice P, Gibson AM, Bostom W, Becher D. An exploration of differences between community of inquiry indicators in low and high disenrollment online courses. *Journal of Asynchronous Learning Networks* 2011;15(2):44-70.
- (59) Lee SM. The relationships between higher order thinking skills, cognitive density, and social presence in online learning. *The Internet and Higher Education* 2014;21:41-52.

- (60) L. A. Silva. Moderating relationships: online learners' cognitive presence and non-designer instructor's teaching presence; 2018.
- (61) Chen Y, Lei J, Cheng J. What if online students take responsibility: students' cognitive presence and peer facilitation techniques. *Online Learning Journal* 2019;23(1):37-61.
- (62) Garrsion DR, Anderson T, Archer W. Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education* 2001;15(1):7-23.
- (63) Chen B, Bastedo K, Howard W. Exploring design elements for online STEM courses: active learning, engagement, and assessment design. *Online Learning Journal* 2018;22(2):59-75.
- (64) Wiebe E, Unfried A, Faber M. The relationship of STEM attitudes and career interest. *Eurasia Journal of Mathematics, Science, & Technology* 2018;14(10).
- (65) Dringus L, Snyder M, Terrell S. Facilitating discourse and enhancing teaching presence: Using mini audio presentations in online forums. *The Internet and Higher Education* 2010;13:75-77.
- (66) Sadaf A, Olesovab L. Enhancing cognitive presence in online case discussions with questions based on the Practical Inquiry model. *American Journal of Distance Education* 2017;31(1):56-69.
- (67) AMCIS 2009 Proceedings. ; 2009.
- (68) Re-design and evaluation of an anchored discussion system. 45th Hawaii International Conference on System Sciences; 2012.
- (69) Mayer RE, Moreno R. Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist* 2003;38(1):43-52.
- (70) Kanuka H, Rourke L, Laflamme E. The influence of instructional methods on the quality of online discussion. *British Journal of Educational Technology* 2006;38(2).
- (71) Gasevic D, Adesope O, Joksimovic S, Kovanovic V. Externally-facilitated regulation scaffolding and role assignment to develop cognitive presence in asynchronous online discussions. *Internet and Higher Education* 2015;24:53-65.
- (72) Center for Online Teaching Excellence. Designing an online course and becoming an online educator: a step-by-step guide. 2015.
- (73) Swan K, Shih LF. On the nature and development of social presence in online course discussions. *Journal of Asynchronous Learning Networks* 2005;9(3):115-136.
- (74) Akcaoglu M, Lee E. Increasing social presence in online learning through small group discussion. *International Review of Research in Open and Distance Learning* 2016;17(3).
- (75) Savvidou C. 'Thanks for sharing your story': the role of the teacher in facilitating social presence in online discussion. *Technology, Pedagogy, and Education* 2013;22(2):193-211.

- (76) Darabi A, Jin L. Improving the quality of online discussions: the effects of strategies designed based on cognitive load theory principles. *Distance Education* 2013;34(1):21-36.
- (77) W. J. Ganza. The impact of online professional development on online teaching in higher education; 2012.
- (78) Canning EA, Muenks K, Green DJ, Murphy MC. STEM faculty who believe ability is fixed have larger racial achievement gaps and inspire less student motivation in their classes. *Science Advances* 2019;5(2).
- (79) Shaffer ES, Marx DM, Prislun R. Mind the gap: framing of women's success and representation in STEM affects women's math performance under threat. *Sex Roles* 2013;68:454-463.
- (80) Hosler KA. The importance of course design, feedback, and facilitation: student perceptions of the relationship between teaching presence and cognitive presence. *Educational Media International* 2012;49(3):217-229.
- (81) Chickering AW, Ehrmann SC. Implementing the seven principles: technology as lever. *American Academy of Higher Education Bulletin* 1996;49(2):3-6.
- (82) Ice P, Reagan C, Phillips P, Wells J. Using asynchronous audio feedback to enhance teaching presence and students' sense of community. *Online Learning Consortium* 2007;11(2):3-25.
- (83) Stein DS, Wanstreet CE, Slagle P, Trinko LA, Lutz M. From 'hello' to higher-order thinking: The effect of coaching and feedback on online chats. *The Internet and Higher Education* 2013;16:78-84.
- (84) Hammersley-Fletcher L, Orsmond P. Evaluating our peers: is peer observation a meaningful process? *Studies in Higher Education* 2004;29(4):213-224.
- (85) Ostovar-Nameghi SA, Sheikahmadi M. From teacher isolation to teacher collaboration: theoretical perspectives and empirical findings. *English Language Teaching* 2016;9(5):197-205.
- (86) Gersten R, Taylor MJ, Keys TD, Rolffhus ER, Newman-Gonchar R. Summary of research on the effectiveness of math professional development approaches. 2014;REL 2014-010.
- (87) Summers R, Abd-El-Khalick F. Development and validation of an instrument to assess student attitudes toward science across grades 5 through 10. *Journal of Research in Science Teaching* 2018;55(2):172-205.
- (88) McQuaid JW. Using cognitive load to evaluate participation and design of an asynchronous course. *American Journal of Distance Education* 2010;24(4):177-194.
- (89) Rourke D, Anderson T, Garrison R, Archer W. Assessing social presence in asynchronous text-based computer conferencing. *Journal of Distance Education/ Revue de l'education Distance* 1999;14(2):50-71.
- (90) P. R. Lowenthal. Social presence: What is it? How do we measure it?; 2012.

- (91) Hughes M, Ventura S, Dando M. Assessing social presence in online discussion groups: a replication study. *Innovations in Education and Teaching International* 2007;44(1):17-29.
- (92) Anderson T, Rourke L, Garrison R, Archer W. Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks* 2001;5(2):1-17.
- (93) Shea P, Li CS, Swan K, Pickett A. Developing learning community in online asynchronous college courses: the role of teaching presence. *Journal of Asynchronous Learning Networks* 2005;9(4):59-82.
- (94) Darabi A, Arrastia MC, Nelson DW, Cornille T, Liang X. Cognitive presence in asynchronous online learning: a comparison of four discussion strategies. *Journal of Computer Assisted Learning* 2010;27(3).
- (95) Towards automated content analysis of discussion transcripts: a cognitive presence case. *Proceedings of the 6th International Conference on Learning Analytics & Knowledge*; 2016.
- (96) Lowes S, Lin P. Learning to learn online: using locus of control to help students become successful online learners. *Journal of Online Learning Research* 2015;1(1):17-48.
- (97) Guzey SS, Harwell M, Moore T. Development of an instrument to assess attitudes toward science, technology, engineering, and mathematics (STEM). *School Science and Mathematics* 2014;114(6).
- (98) Carlon S, Bennet-Woods D, Berg B, Claywell L, LeDuc K, Marcisz N, et al. The community of inquiry instrument: validation and results in online health care disciplines. *Computers & Education* 2012;59(2):215-221.
- (99) Garrison DR, Cleveland-Innes M, Fung TS. Exploring causal relationships among teaching, cognitive and social presence: Student perceptions of the community of inquiry framework. *Internet and Higher Education* 2010;13:32-36.
- (100) Skulmowski A, Rey GD. Measuring cognitive load in embodied learning settings. *Frontiers in Psychology* 2017;8:1191.
- (101) Shepherd CE, Bolliger DU. The effects of electronic portfolio tools on online students' perceived support and cognitive load. *Internet and Higher Education* 2011;14:142-149.
- (102) Sung E, Mayer RE. Five facets of social presence in online distance education. *Computers in Human Behavior* 2012;28(5):1738-1747.
- (103) J. Chingwe. Affordances of community of inquiry methods in measuring and evaluating teaching presence to guide practice; 2018.
- (104) Park CL. Replicating the use of a cognitive presence measurement tool. *Journal of Interactive Online Learning* 2009;8:140-155.

NAME: Emily Faulconer

POSITION TITLE & INSTITUTION: Assistant 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)
Virginia Commonwealth University	Richmond, VA	Forensic Science	B.S.	2004
University of Florida	Gainesville, FL	Environmental Engineering Sciences	Ph.D.	2012

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

From - To	Position Title, Organization and Location
2016 - current	Assistant Professor, STEM Education Department, Embry-Riddle Aeronautical University, Daytona Beach, FL
2012 - 2016	Assistant Professor, Physical Sciences Department, Embry-Riddle Aeronautical University, Daytona Beach, FL
2008 - 2012	Graduate Teaching Assistant, Department of Environmental Engineering Sciences, University of Florida, Gainesville, FL
2006 - 2008	Adjunct Instructor, Tidewater Community College, Suffolk, VA

C. PRODUCTS

(see [PAPPG Chapter II.C.2.f.\(i\)\(c\)](#))

Products Most Closely Related to the Proposed Project

1. Faulconer, E. (2020) eService-Learning: a decade of research in undergraduate online service learning. Distance Education (Under Review)
2. Faulconer, E. (2020) A reflection on the changing reality of science. Journal of College Science Teaching, 49(4), 6-7.
3. Faulconer, E., Griffith, J., Frank, H. (2019) If at first you do not succeed: the student benefits of multiple trials on summative assessments. Teaching in Higher Education. doi: 10.1080/13562517.2019.1664454
4. Faulconer, E., and Wood, B. (2019) Can You Even Do That Online? The Teaching Professor, May 13, Retrieved from <https://www.teachingprofessor.com/topics/online-learning/grading-feedback-online-learning/formative-assessment-techniques-for-online-learning/>.
5. Faulconer, E. (2019) In support of scholarly teaching. Journal of College Science Teaching, 48(6), 9.

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

1. Faulconer, E., Griffith, J., Faulconer, L., Dixon, Z. (2020) A course in context: video course trailers. Journal of General Education (Accepted pending revisions)
2. Faulconer, E., Wood, B., Griffith, J. (2020) Infusing humanities in STEM education: student opinions of disciplinary connections in an introductory chemistry course. Journal of Science Education and Technology. doi: 10.1007/s10956-020-09819-7
3. Faulconer, E., Griffith, J., Dixon, Z., Roberts, D. (2020) Undergraduate students' perceived barriers to research in online education. Scholarship and Practice of Undergraduate Research. doi: 10.18833/spur/3/3/1

D. SYNERGISTIC ACTIVITIES

(see [PAPPG Chapter II.C.2.f.\(i\)\(d\)](#))

1. Advisory Board Member for the Journal of College Science Teaching (2016 - present).
2. Designed and conducted research workshops on the topics of 1) Working with Human Subjects (February 2020), 2) Critical Perseverance (January 2020), 3) Planning Your Pathway of Scholarly Influence and Impact (October 2019), and 4) Research and Publication Strategy (September 2019).
3. Developed, recorded, and implemented interactive asynchronous lectures (H5P), chemical demonstration videos, and calculation videos for the General Chemistry I course redesign (taught fully online).
4. Participated in the Virtual Community of Practice on Feedback, ERAU Center for Teaching and Learning Excellence (2018)
5. Accepted to present "Does instructor quality affect student grades" at Lilly Conference - Asheville (August 2020)

NAME: Beverly L. Wood

POSITION TITLE & INSTITUTION: Assistant 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)
University of Tampa	Tampa, FL	Mathematics	B.S.	1988
University of Wisconsin - Oshkosh	Oshkosh, WI	Mathematics Education	M.S.	2003
University of Virginia	Charlottesville, VA	Mathematics Education	Ph.D.	2012

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

From - To	Position Title, Organization and Location
2015 - present	Assistant Professor, STEM Education Department, Embry-Riddle Aeronautical University, Daytona Beach, FL
2012 - 2015	Assistant Professor, Mathematics Department, Indian River State College, Ft. Pierce, FL
2011 - 2012	Adjunct Instructor, Mathematics Department, Piedmont Virginia Community College, Charlottesville, VA
2009 - 2012	Adjunct Instructor, Mathematics Department, University of Virginia, Charlottesville, VA
2008 - 2009	Instructor, James Madison University, Harrisonburg, VA
2004 - 2008	Adjunct Faculty, Lakeland College (now University), Green Bay Center, Green Bay, WI
Fall 2004	Associate Lecturer, Mathematics Department, University of Wisconsin-Oshkosh, Oshkosh, WI

C. PRODUCTS

(see [PAPPG Chapter II.C.2.f.\(i\)\(c\)](#))

Products Most Closely Related to the Proposed Project

1. Faulconer, E., and Wood, B. (2019) Can You Even Do That Online? The Teaching Professor, May 13, Retrieved from <https://www.teachingprofessor.com/topics/online-learning/grading-feedback-online-learning/formative-assessment-techniques-for-online-learning/>.
2. Faulconer, E.K., Griffith, J.C., Wood, B.L., Acharyya, S., & Roberts, D.L. (2018). A comparison of online, video synchronous, and traditional learning modes for an introductory undergraduate physics course, Journal of Science Teaching.
3. Faulconer, E.K., Griffith, J.C., Wood, B.L., Acharyya, S., & Roberts, D.L. (2018). A comparison of online and traditional chemistry lecture and lab, Chemistry Education Research and Practice, 19(1), 392-397. DOI: 10.1039/C7RP00173H
4. Bourdeau, D., Roberts, D., Wood, B.L., & Koriath, J. (2017) A study of video-mediated opportunities for self-directed learning in required core curriculum. International Journal of Educational Methodology 3(2), 85-91. DOI: 10.12973/ijem.3.2.85
5. Sabbag, A., Wong, R. & Wood, B. (2020, May). Engaging diverse learners online. Panel for Electronic Conference on Teaching Statistics.

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

1. GAISE College Report ASA Revision Committee (2016). Guidelines for Assessment and Instruction in Statistics Education College Report 2016. Available from <http://www.amstat.org/education/gaise>.
2. Bourdeau, D.T., & Wood, B.L. (2019) What is humanistic STEM and why do we need it?, Journal of Humanistic Mathematics, 7(1). DOI: 10.5642/jhummath.201901.11

D. SYNERGISTIC ACTIVITIES

(see [PAPPG Chapter II.C.2.f.\(i\)\(d\)](#))

1. At-Large member on the Executive Committee for the American Statistical Association' Section on Statistical and Data Science Education (2019-2021).
2. Faculty Developer (subject matter expert) on mathematics, statistics and Humanistic STEM courses for online delivery (2015 to present).
3. Completed the Canvas Network Course "Humanizing Online Instruction," earning badges for Instructor Presence, Social Presence and Cognitive Presence (2016)

SUMMARY PROPOSAL BUDGET

YEAR 1

ORGANIZATION Embry-Riddle Aeronautical University				FOR NSF USE ONLY		
				PROPOSAL NO.	DURATION (months)	
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Emily Faulconer				AWARD NO.	Proposed	Granted
					NSF Funded Person-months	
A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				CAL	ACAD	SUMR
1. Emily K Faulconer - PI				0.00	1.00	1.00
2. Beverly L Wood - Co-PI				0.00	1.00	1.00
3.						
4.						
5.						
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				0.00	0.00	0.00
7. (2) TOTAL SENIOR PERSONNEL (1 - 6)				0.00	2.00	2.00
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)						
1. (0) POST DOCTORAL SCHOLARS				0.00	0.00	0.00
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				0.00	0.00	0.00
3. (1) GRADUATE STUDENTS						15,000
4. (0) UNDERGRADUATE STUDENTS						0
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)						0
6. (32) OTHER						3,500
TOTAL SALARIES AND WAGES (A + B)						45,536
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)						4,087
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)						49,623
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)						
TOTAL EQUIPMENT						0
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)						4,355
2. INTERNATIONAL						0
F. PARTICIPANT SUPPORT COSTS						
1. STIPENDS \$ _____				0		
2. TRAVEL _____				0		
3. SUBSISTENCE _____				0		
4. OTHER _____				0		
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS						0
G. OTHER DIRECT COSTS						
1. MATERIALS AND SUPPLIES						0
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION						0
3. CONSULTANT SERVICES						5,753
4. COMPUTER SERVICES						1,050
5. SUBAWARDS						0
6. OTHER						2,500
TOTAL OTHER DIRECT COSTS						9,303
H. TOTAL DIRECT COSTS (A THROUGH G)						63,281
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) MTDC (Rate: 23.0000, Base: 63281)						
TOTAL INDIRECT COSTS (F&A)						14,555
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)						77,836
K. FEE						0
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)						77,836
M. COST SHARING PROPOSED LEVEL \$ 0				AGREED LEVEL IF DIFFERENT \$		
PI/PI NAME Emily Faulconer				FOR NSF USE ONLY		
ORG. REP. NAME* Sarah Loftus				INDIRECT COST RATE VERIFICATION		
		Date Checked	Date Of Rate Sheet	Initials - ORG		

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION Embry-Riddle Aeronautical University				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Emily Faulconer				AWARD NO.	Proposed	Granted	
				A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)			
				CAL	ACAD	SUMR	
1. Emily K Faulconer - PI				0.00	1.00	1.00	13,857
2. Beverly L Wood - Co-PI				0.00	1.00	1.00	13,989
3.							
4.							
5.							
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				0.00	0.00	0.00	0
7. (2) TOTAL SENIOR PERSONNEL (1 - 6)				0.00	2.00	2.00	27,846
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. (0) POST DOCTORAL SCHOLARS				0.00	0.00	0.00	0
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				0.00	0.00	0.00	0
3. (1) GRADUATE STUDENTS							15,000
4. (0) UNDERGRADUATE STUDENTS							0
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)							0
6. (32) OTHER							3,500
TOTAL SALARIES AND WAGES (A + B)							46,346
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							4,201
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							50,547
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							0
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)							4,355
2. INTERNATIONAL							0
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS \$ _____ 0							
2. TRAVEL _____ 0							
3. SUBSISTENCE _____ 0							
4. OTHER _____ 0							
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS							0
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES							0
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION							0
3. CONSULTANT SERVICES							5,845
4. COMPUTER SERVICES							1,050
5. SUBAWARDS							0
6. OTHER							2,500
TOTAL OTHER DIRECT COSTS							9,395
H. TOTAL DIRECT COSTS (A THROUGH G)							64,297
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
MTDC (Rate: 23.0000, Base: 64297)							
TOTAL INDIRECT COSTS (F&A)							14,788
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							79,085
K. FEE							0
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							79,085
M. COST SHARING PROPOSED LEVEL \$ 0 AGREED LEVEL IF DIFFERENT \$							
PI/PI NAME Emily Faulconer				FOR NSF USE ONLY			
ORG. REP. NAME* Sarah Loftus				INDIRECT COST RATE VERIFICATION			
		Date Checked	Date Of Rate Sheet	Initials - ORG			

SUMMARY PROPOSAL BUDGET

YEAR 3

ORGANIZATION Embry-Riddle Aeronautical University				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Emily Faulconer				AWARD NO.	Proposed	Granted	
A. SENIOR PERSONNEL: PI/PI, 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. Emily K Faulconer - PI				0.00	1.00	1.00	14,273
2. Beverly L Wood - Co-PI				0.00	1.00	1.00	14,409
3.							
4.							
5.							
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				0.00	0.00	0.00	0
7. (2) TOTAL SENIOR PERSONNEL (1 - 6)				0.00	2.00	2.00	28,682
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. (0) POST DOCTORAL SCHOLARS				0.00	0.00	0.00	0
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				0.00	0.00	0.00	0
3. (1) GRADUATE STUDENTS							15,000
4. (0) UNDERGRADUATE STUDENTS							0
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)							0
6. (32) OTHER							3,500
TOTAL SALARIES AND WAGES (A + B)							47,182
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							4,319
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							51,501
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							0
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)							4,355
2. INTERNATIONAL							0
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS \$ _____ 0							
2. TRAVEL _____ 0							
3. SUBSISTENCE _____ 0							
4. OTHER _____ 0							
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS							0
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES							0
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION							0
3. CONSULTANT SERVICES							5,941
4. COMPUTER SERVICES							1,050
5. SUBAWARDS							0
6. OTHER							2,500
TOTAL OTHER DIRECT COSTS							9,491
H. TOTAL DIRECT COSTS (A THROUGH G)							65,347
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
MTDC (Rate: 23.0000, Base: 65347)							
TOTAL INDIRECT COSTS (F&A)							15,030
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							80,377
K. FEE							0
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							80,377
M. COST SHARING PROPOSED LEVEL \$ 0 AGREED LEVEL IF DIFFERENT \$							
PI/PI NAME Emily Faulconer				FOR NSF USE ONLY			
ORG. REP. NAME* Sarah Loftus				INDIRECT COST RATE VERIFICATION			
		Date Checked	Date Of Rate Sheet	Initials - ORG			

SUMMARY PROPOSAL BUDGET Cumulative

ORGANIZATION Embry-Riddle Aeronautical University				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Emily Faulconer				AWARD NO.	Proposed	Granted	
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. Emily K Faulconer - PI				0.00	3.00	3.00	41,584
2. Beverly L Wood - Co-PI				0.00	3.00	3.00	41,980
3.							
4.							
5.							
6. () OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				0.00	0.00	0.00	0
7. (2) TOTAL SENIOR PERSONNEL (1 - 6)				0.00	6.00	6.00	83,564
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. (0) POST DOCTORAL SCHOLARS				0.00	0.00	0.00	0
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				0.00	0.00	0.00	0
3. (3) GRADUATE STUDENTS							45,000
4. (0) UNDERGRADUATE STUDENTS							0
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)							0
6. (96) OTHER							10,500
TOTAL SALARIES AND WAGES (A + B)							139,064
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							12,607
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							151,671
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							0
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)							13,065
2. INTERNATIONAL							0
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS \$ _____ 0							
2. TRAVEL _____ 0							
3. SUBSISTENCE _____ 0							
4. OTHER _____ 0							
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS							0
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES							0
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION							0
3. CONSULTANT SERVICES							17,539
4. COMPUTER SERVICES							3,150
5. SUBAWARDS							0
6. OTHER							7,500
TOTAL OTHER DIRECT COSTS							28,189
H. TOTAL DIRECT COSTS (A THROUGH G)							192,925
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
TOTAL INDIRECT COSTS (F&A)							44,373
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							237,298
K. FEE							0
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							237,298
M. COST SHARING PROPOSED LEVEL \$ 0				AGREED LEVEL IF DIFFERENT \$			
PI/PD NAME Emily Faulconer				FOR NSF USE ONLY			
ORG. REP. NAME* Sarah Loftus				INDIRECT COST RATE VERIFICATION			
				Date Checked	Date Of Rate Sheet	Initials - ORG	

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Embry-Riddle Aeronautical University
Budget Justification Narrative

A. Senior Personnel

To fully implement the research scope in the project description, we request the following support for senior personnel:

- **Dr. Emily Faulconer, PI:** (1.5 summer months) Support for Dr. Emily Faulconer (PI) is requested at 1.5 summer months in each year of the project. Dr. Faulconer will be responsible for guiding and managing the timeline for all aspects of the research plan. She will collect and manage data and co-develop the Framework and Transferability Plan. She will work directly with the external evaluator who will conduct systematic evaluations on the progress, quality, and impact of the project. Dr. Faulconer will prepare and disseminate interim results to the project team and will collaborate with the other team members on a final report and external dissemination via research manuscripts and conference presentations. She is budgeted for 1.5 months per calendar year (CY) (12.5% effort) for each year of the project.
- **Dr. Beverly Wood, Co-PI:** (1.5 summer months) Support for Dr. Beverly Wood is requested at 1.5 summer months in each year of the project. Dr. Wood will be responsible for co-developing key aspects of the Framework and Transferability Plan. She will collect and manage data. Dr. Wood will collaborate the preparation and dissemination of interim and final results to the project team and external dissemination via research manuscripts and conference presentations. She is budgeted for 1.5 months per calendar year (CY) (12.5% effort) for each year of the project.

Salary costs are based on the individual's Institutional Base Salary. A 3% cost of living increase has been applied annually. Embry-Riddle Aeronautical University's definition of a year for the purpose of compliance with NSF salary limitations is "the start of the Fall academic semester plus 12 consecutive months".

B. Other Personnel

- **Other Professionals – Course Redevelopers:** \$6,000 (\$2,000 in each year of the project) Support is requested for two internal course redevelopers at a rate of \$1,000 per person each year of the project. Subject Matter Experts will be recruited from the existing pool of faculty cleared to teach the two target courses. Course redevelopment at ERAU is stipend-based and does not count as service. Therefore, the partial course redevelopment proposed in this project will be compensated accordingly.
- **Internal Faculty Professional Development Stipend:** \$4,500 (\$1,500 in each year of the project) Support is requested to compensate internal faculty for engaging in the professional development designed as a part of this project. Because faculty teaching the redesigned course would need to engage in the professional development in order for the data collected in that

term to be used in this study, participation is incentivized to compensate for the time investment by faculty.

- **Graduate Hourly Student Worker:** \$45,000 (\$15,000 in each year of the project) Support for two graduate hourly student workers who will be responsible for assisting with interviews, the coding of transcripts, and quantitative analysis.

C. Fringe Benefits \$12,608

Embry-Riddle Aeronautical University’s federally negotiated fringe benefit rates have been applied to the salaries and wages in the budget. The 29.1% rate for full-time employees is applied to all academic year salaries and 8% rate is applied to summer and supplemental effort salaries. 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.

E. Travel \$13,065 (\$4,355 in each year of the project)

Support to attend the Annual NSF PI meeting and at the OLC Conference professional conference annually for the purpose of dissemination of research and scientific information. The annual travel estimate is based on (2) travelers, for three and 4 nights, departing from traveling to domestic location TBD.

Travel for 2 travelers/ 3 days to attend Annual NSF Meeting				
Item	Cost	No. Persons	No. Days	Extended Cost
Air Fare	\$500	2		\$1,000
Lodging	\$150	2	3	\$900
Per Diem	\$55	2	3	\$330
Ground Transportation	\$10	2	3	\$60
Total Annual NSF Conference Travel				\$2,290
Travel for 1 traveler/ 4 days to attend Travel to Location TBD				
Item	Cost	No. Persons	No. Days	Extended Cost
Air Fare	\$500	1		\$500
Conference Registration Fees	\$895	1		\$895
Lodging	\$113	1	4	\$450
Per Diem	\$55	1	4	\$220
Ground Transportation	\$5	1	4	\$20
Total Annual Conference Travel to attend OLC Conference				\$2,065
Total Annual Travel Estimate				\$4,355

Per Embry-Riddle Aeronautical University's policy, employees will use the Federal GSA CONUS rates for travel within the Continental U.S. Estimated costs are based on historical cost data from previous conferences.

F. Participant Support Costs

None.

G. Other Direct Costs

Consultants (G3): \$17,539 (\$5,753 in year 1; \$5,845 in year 2; \$5,941 in year 3)

Support is requested for external evaluation services performed by Dr. Alireza Lari, at the American Institute of Higher Education, LLC. Dr. Lari is an expert in design of total quality systems, performance audit, and improvement of operational processes. Dr. Lari's expertise and guidance will ensure the project team remains on target with activities and deliverables through quantitative and qualitative evaluations throughout the project.

Computer Services (G4): \$3,150 (\$1,050 in each year of the project)

Support for subscription access to an online survey platform service is requested for the purpose of collecting data as described in the Methodology section of the Project Description (Table 5).

Other Direct Costs (G6)

- **Research Study Participant Payment:** \$7,500 (\$2,500 in each year of the project) Support to incentivize response to the survey tool is requested at \$5 per respondent for an estimated 500 respondents. This payment process will be transacted through an established organizational procedure that incorporates generally accepted internal control protocols and generates source documents for actual transactions.

H. Total Direct Cost \$192,925

I. Indirect Costs (F&A 23%) \$44,373

ERAU's 23% Modified Total Direct Cost (MTDC), federally negotiated, off-campus rate is applied to the proposal. This agreement for ERAU has been negotiated with the Department of Health and Human Services, Federal Cognizant Agency. The agreement is in effect from July 1, 2016 to June 30, 2021.

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.

J. Total Direct and Indirect Cost \$237,298

*PI/co-PI/Senior Personnel Name: Emily Faulconer

***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^[2], irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.^[3]

Please enter your support entries so they are grouped together based on the "Status of Support" and are in the order of Current, Pending, Submission Planned, and Transfer of Support from top to bottom

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

^[2] For example, Federal, State, local, foreign, public or private foundations, non-profits, industrial or other commercial organizations or internal funds allocated toward specific projects.

^[3] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1.*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): 2021221

*Source of Support: National Science Foundation

*Primary Place of Performance : Embry-Riddle Aeronautical University

Project/Proposal Start Date (MM/YYYY) (if available) : 08/2020

Project/Proposal End Date (MM/YYYY) (if available) : 07/2023

*Total Award Amount (including Indirect Costs): \$ 295,967

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2021	2.00	4.	
2. 2022	1.50	5.	
3. 2023	1.80		

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

*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) : 08/2021

Project/Proposal End Date (MM/YYYY) (if available) : 07/2024

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	2.00	4.	
2. 2023	2.00	5.	
3. 2024	2.00		

Projects/Proposals

3.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

4.* Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

5.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

6.* Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

7.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

8.* Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

9. *Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

10. *Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

11.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

12.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

13.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

14.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

15. *Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

In Kind Contributions

*Required fields

In-Kind Contribution Section:

Current and Pending Support also includes in-kind contributions (such as office/laboratory space, equipment, supplies, employees, students). If the in-kind contributions are intended for use on the project being proposed to NSF, the information must be included as part of the Facilities, Equipment and Other Resources section of the proposal and need not be replicated in the individual's Current and Pending Support submission. In-kind contributions not intended for use on the project/proposal being proposed that have associated time obligations must be reported below. If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.

Please enter your support entries so they are grouped together based on the "Status of Support" and are in the order of Current to Pending from top to bottom

1. *Status of Support : <input type="radio"/> Current <input type="radio"/> Pending			
*Source of Support :			
*Primary Place of Performance :			
*Summary of In-Kind Contributions :			
Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year			
If the time commitment is not readily ascertainable, reasonable estimates should be provided.			
*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			
*Dollar Value of In-Kind Contribution: \$			

In Kind Contributions

2.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

3.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

In Kind Contributions

4.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

5.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

In Kind Contributions

6.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

7.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

In Kind Contributions

8.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

9.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

In Kind Contributions

10.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

*PI/co-PI/Senior Personnel Name: Dr. Beverly L. Wood

***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^[2], irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.^[3]

Please enter your support entries so they are grouped together based on the "Status of Support" and are in the order of Current, Pending, Submission Planned, and Transfer of Support from top to bottom

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

^[2] For example, Federal, State, local, foreign, public or private foundations, non-profits, industrial or other commercial organizations or internal funds allocated toward specific projects.

^[3] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1.*Project/Proposal Title : Collaborative Research: Transforming Instruction in Undergraduate Mathematics via Primary Historical Sources (TRIUMPHS)

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

Proposal/Award Number (if available): 1524098

*Source of Support: National Science Foundation

*Primary Place of Performance : Embry-Riddle Aeronautical University

Project/Proposal Start Date (MM/YYYY) (if available) : 08/2015

Project/Proposal End Date (MM/YYYY) (if available) : 07/2021

*Total Award Amount (including Indirect Costs): \$ 385,446

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2018	0.00	4. 2021	0.00
2. 2019	0.00	5.	
3. 2020	0.00		

2.*Project/Proposal Title : Collaborative Research: A National Consortium of Synergistic Undergraduate Mathematics via Multi-institutional Interdisciplinary Teaching Partnerships (SUMMIT-P)

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

Proposal/Award Number (if available): 1822451

*Source of Support: National Science Foundation

*Primary Place of Performance : Embry-Riddle Aeronautical University, Daytona Beach FL

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2017

Project/Proposal End Date (MM/YYYY) (if available) : 08/2021

*Total Award Amount (including Indirect Costs): \$ 1,009,015

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2020	0.24	4.	
2. 2021	0.24	5.	
3.			

Projects/Proposals

3.*Project/Proposal Title : Humanistic STEM

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

Proposal/Award Number (if available): N/A

*Source of Support: National Science Foundation

*Primary Place of Performance : Embry-Riddle Aeronautical University, Daytona Beach FL

Project/Proposal Start Date (MM/YYYY) (if available) : 08/2021

Project/Proposal End Date (MM/YYYY) (if available) : 07/2024

*Total Award Amount (including Indirect Costs): \$ 287,998

*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	1.50	5.	
3. 2024	1.50		

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

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

Proposal/Award Number (if available): N/A

*Source of Support: National Science Foundation

*Primary Place of Performance : Embry-Riddle Aeronautical University, Daytona Beach FL

Project/Proposal Start Date (MM/YYYY) (if available) : 08/2021

Project/Proposal End Date (MM/YYYY) (if available) : 07/2024

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

*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	1.50	5.	
3. 2024	1.50		

Projects/Proposals

5.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

6.* Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

7.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

8.* Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

9. *Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

10. *Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

11. *Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

12. *Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

13.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

14.*Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

Projects/Proposals

15. *Project/Proposal Title :

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

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

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

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

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

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

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

In Kind Contributions

*Required fields

In-Kind Contribution Section:

Current and Pending Support also includes in-kind contributions (such as office/laboratory space, equipment, supplies, employees, students). If the in-kind contributions are intended for use on the project being proposed to NSF, the information must be included as part of the Facilities, Equipment and Other Resources section of the proposal and need not be replicated in the individual's Current and Pending Support submission. In-kind contributions not intended for use on the project/proposal being proposed that have associated time obligations must be reported below. If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.

Please enter your support entries so they are grouped together based on the "Status of Support" and are in the order of Current to Pending from top to bottom

1. *Status of Support : <input type="radio"/> Current <input type="radio"/> Pending			
*Source of Support :			
*Primary Place of Performance :			
*Summary of In-Kind Contributions :			
Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year			
If the time commitment is not readily ascertainable, reasonable estimates should be provided.			
*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			
*Dollar Value of In-Kind Contribution: \$			

In Kind Contributions

2.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

3.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

In Kind Contributions

4.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

5.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

In Kind Contributions

6.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

7.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

In Kind Contributions

8.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

9.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

In Kind Contributions

10.*Status of Support : Current Pending

*Source of Support :

*Primary Place of Performance :

*Summary of In-Kind Contributions :

Time Commitment - Month(s) (or Partial Person-Months) Committed Per Year

If the time commitment is not readily ascertainable, reasonable estimates should be provided.

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Dollar Value of In-Kind Contribution: \$

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:

Facilities

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 professional development for faculty regarding discussion facilitation. CTLE staff are located in Daytona Beach with access to the studio.

Equipment

Learning Glass Lightboard

The learning glass lightboard is a new technology that allows instructors to face their class while writing with markers on the lighted glass board during lecture and problem-solving time. This technology can be used in a live classroom or to record personable videos for the online classroom. The written text or images are horizontally flipped so they appear written from left to right when viewed on a screen or monitor. PowerPoint, video, and images can be projected onto the board to enhance the presentations. This equipment will be used for generating professional development for faculty regarding discussion facilitation.

Processes & Human Resources

Instructional Design and Development Department (UNFUNDED COLLABORATION)

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.

The Instructional Design Department will contribute to this project through an unfunded collaboration. IDD will support the redesign of the course discussions and implement the redesigned course templates.

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.

This entity will oversee the human subjects research associated with the proposed project.

Rothwell Center for Teaching and Learning Excellence (UNFUNDED COLLABORATION)

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.

The Rothwell Center for Teaching and Learning Excellence will contribute to this project through an unfunded collaboration, co-developing and coordinating faculty professional development opportunities to support: 1) discussion facilitation and 2) CoI-CL framework implementation in discussion redesign.

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

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.

VECTOR will provide on-demand support for strong communication in research dissemination.

Software and Digital Platforms

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.

Research products resulting from this project will be placed on the Scholarly Commons platform.

Skype for Business

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

Skype for Business will be used by the research team for synchronous collaboration.

Data Management Plan

Data Generation

This project will collect student outcome data (e.g. assignment rubric scores), institutional data (e.g. withdrawals), and participant-provided data (e.g. surveys and interviews). The data to be used outside of the research team will be reviewed by the Institutional Review Board; 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 discussion assignments ((assignment rubric scores) and final course grades. All student work will be de-identified through alphanumeric coding. Discussion transcripts will also be retrieved from the LMS. The transcript data will be coded, analyzed, and stored electronically.

Student Survey Data. Survey data will be collected through surveys administered through an online survey response platform using existing metrics as well as collecting demographics and learner characteristics.

Student Interview Data. Interview data will be coded, analyzed, and stored electronically along with transcripts and audio files from interviews.

Institutional Data. Withdrawal rate and reasons will be collected through the Institutional Research Department as secondary data.

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, will be prepared by the research team, with aggregate coding results placed within Excel files (.xlsx) and resulting tables and figures being used in text and presentation documents.

All 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 Emily Faulconer (co-PI), and Beverly Wood (co-PI). Graduate assistants will have access to raw discussion transcripts and interview video files. Access to the raw data will be permitted to the research team for five year after the project has ended, after which time all digital files (.xlsx, .docx, .pdf, .pptx, .mp4, etc.) containing raw data (e.g. discussion transcripts, interview files, non-anonymized course grades, 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 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 framework and final 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 Emily Faulconer (co-PI) and Beverly Wood (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.