



Improving **U**ndergraduate **S**TEM **E**ducation **Initiative**



Field Notes from AI in STEM Education

Dr. Lynette Williamson

Dr. Tamara Tate

Dr. Richard Weiss



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AAAS Center for STEMM
Education & Workforce

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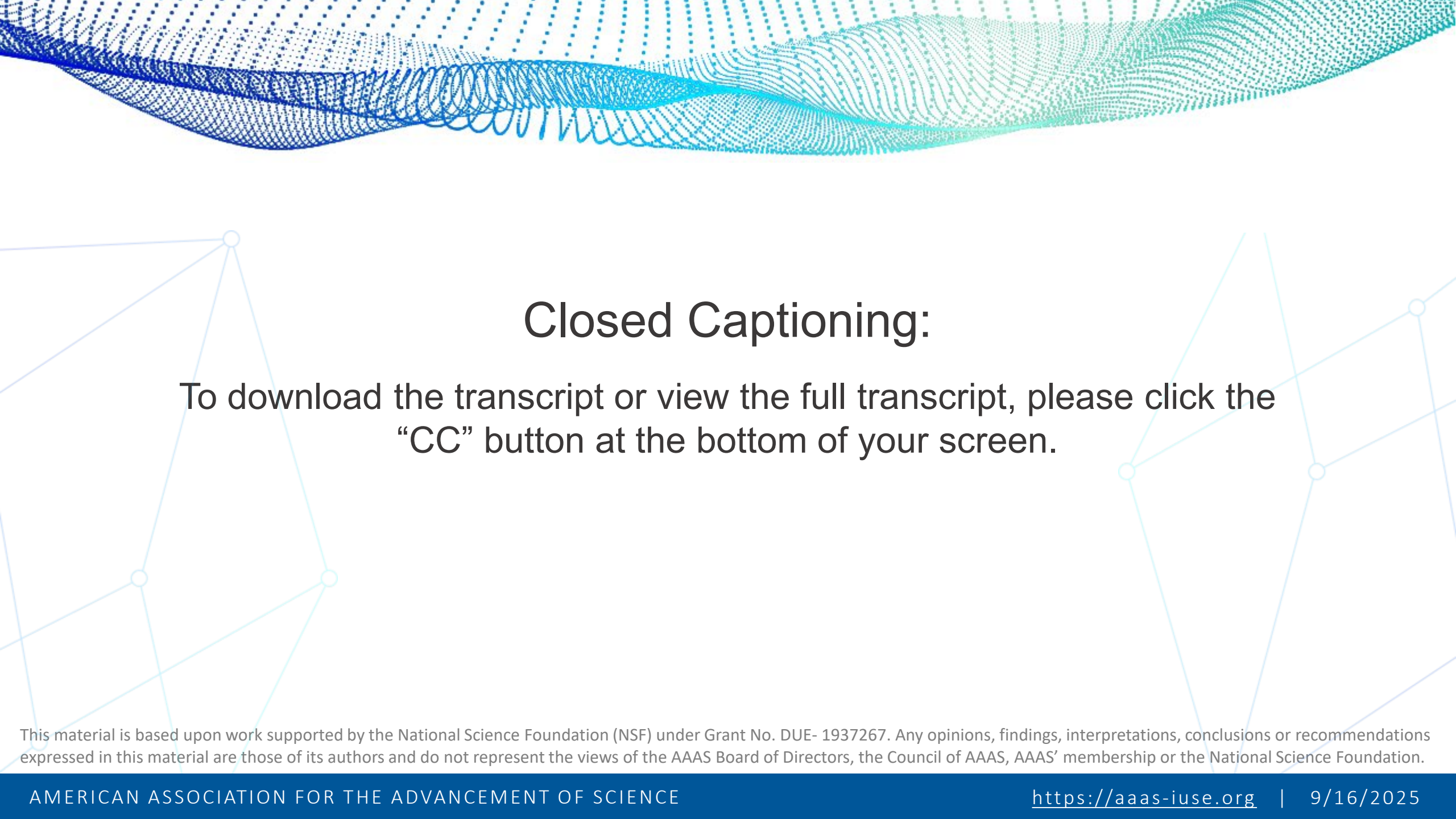
WORKSHOP



This presentation is being recorded. The recording and slides will be available in the coming week at <https://aaas-iuse.org>

Please note: The discussion break-out groups following the presentations will NOT be recorded.

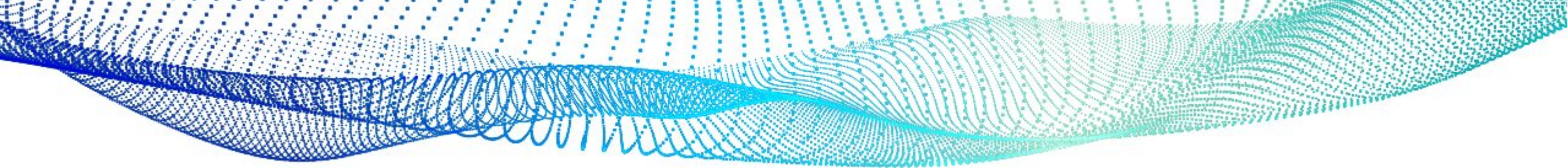
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The AAAS-IUSE initiative supports faculty, students, and the greater undergraduate STEM education community by disseminating research and knowledge about STEM teaching, learning, equity and institutional transformation.

Check out our website to learn more and view: <https://aaas-iuse.org>

- Blog
- Workshops
- Summer Labs On-Demand
- Resources
- Lessons Learned During COVID
- NSF IUSE Proposal Preparation Toolkit



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WORKSHOP

Field Notes from AI in STEM Education

Integrating Artificial Intelligence into STEM Education: Inspiring Creativity and Critical Thinking

Lynette M. Williamson, Ed.D., MBA, RHIA, CCS, CPC, FAHIMA, FCAHIIM

lmwilliamson@pipeline.sbccc.edu

QR code to
Presentation
Slide Deck
and Toolkit

Password:
Aloha







The AI Landscape in STEM

- Growing role in problem-solving and research
- Accessible classroom tools (math solvers, coding assistants, lab simulations).
- Importance of responsible integration

Case Study: AI in HIM & Health Sciences

- Senior-Level HIM course
- AI-assisted coding and clinical documentation improvement (CDI)
- Stimulate real-world workflow
- Successes
 - Student able to generate drafts
 - Increased creativity
- Challenges
 - Over-reliance without validating accuracy
 - Maintaining compliance knowledge

Artificial Intelligence

VECTOR ILLUSTRATION





Virtual Workshop: Field Notes from AI in STEM Education

Integrating Artificial Intelligence into STEM Education: Inspiring Creativity and Critical Thinking
Toolkit (Educator Resource)

Purpose

This toolkit equips educators across STEM disciplines with practical strategies, tools, and resources to meaningfully integrate Artificial Intelligence (AI) into teaching. The emphasis is on fostering critical thinking, creativity, and ethical awareness.

Core Components

A. AI Tools by STEM Discipline

- **Mathematics:** Symbolab, Wolfram Alpha, GeoGebra AI tutor
- **Biology/Health Sciences/Health Information Management (HIM):** ChatGPT for case study generation & creative assignments using gamification framework, Elicit for research reviews, BioRender for AI-assisted diagrams, Audacity for research & thought-question generation



Breakout Discussion Preview



REFLECT ON
INTEGRATION IN
YOUR DISCIPLINE.



DISCUSS CRITICAL
THINKING STRATEGY
FOSTERING.



DISCUSS ETHICAL
AND/OR PRACTICAL
CHALLENGES.



BRAINSTORM NEW
ASSIGNMENTS.

Thank you for your time and attention

- Many graphical images are from Freepik.com
- The content of this presentation was inspired by ChatGPT and my current work to incorporate more AI generated activities into my Fall 2025 courses.
- **Contact Information:**
- **lmwilliamson@pipeline.sbccc.edu**



thank
you

Field Notes from AI in STEM Education: Integrating Generative AI into Engineering Writing Courses

Tamara Tate, PhD

Associate Director, Digital Learning Lab

University of California, Irvine



Digital Learning Lab



PapyrusAI Team



Tamara Tate



Beth Harnick-Shapiro



Mark Warschauer



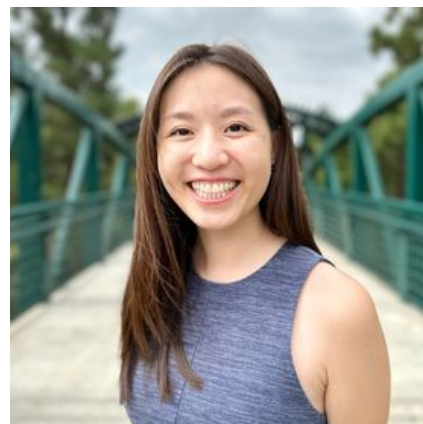
Michael Dennin



Daniel Ritchie



Jaeyoon Choi



Waverly Tseng



Maura White



Dana Saito-Stehberger



Soobin Yim



Kristi Werry



Gerardo Jr. Lopez



Meera Jagota

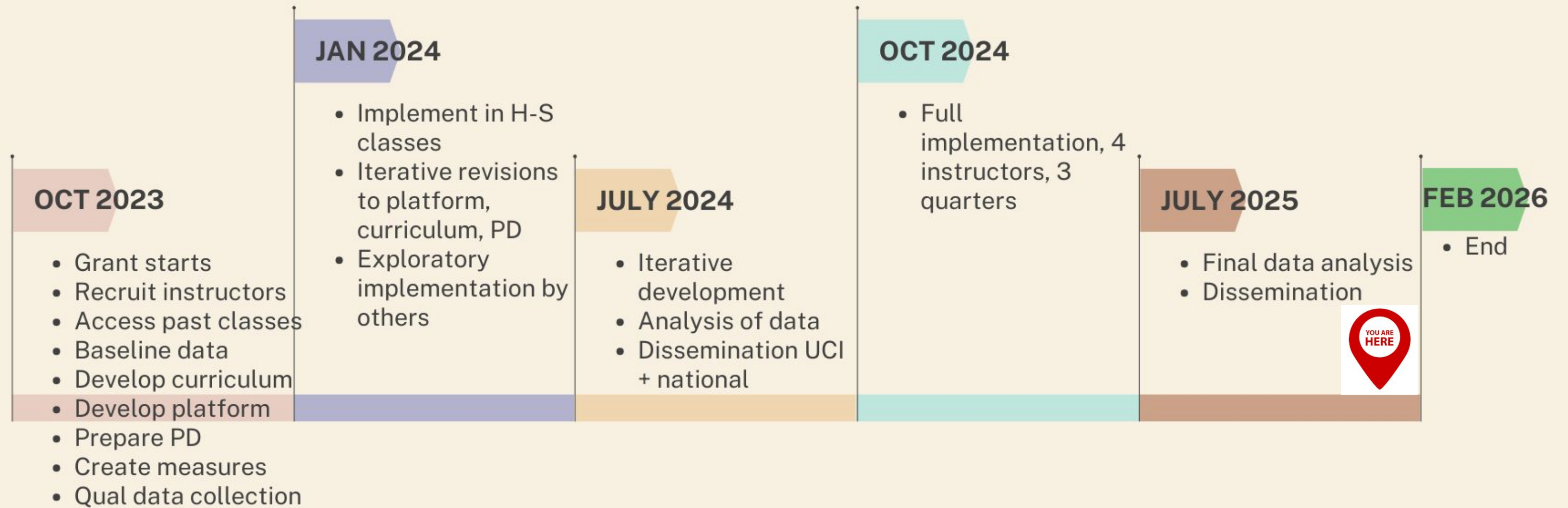
UCI Samueli | 
School of Engineering
University of California, Irvine

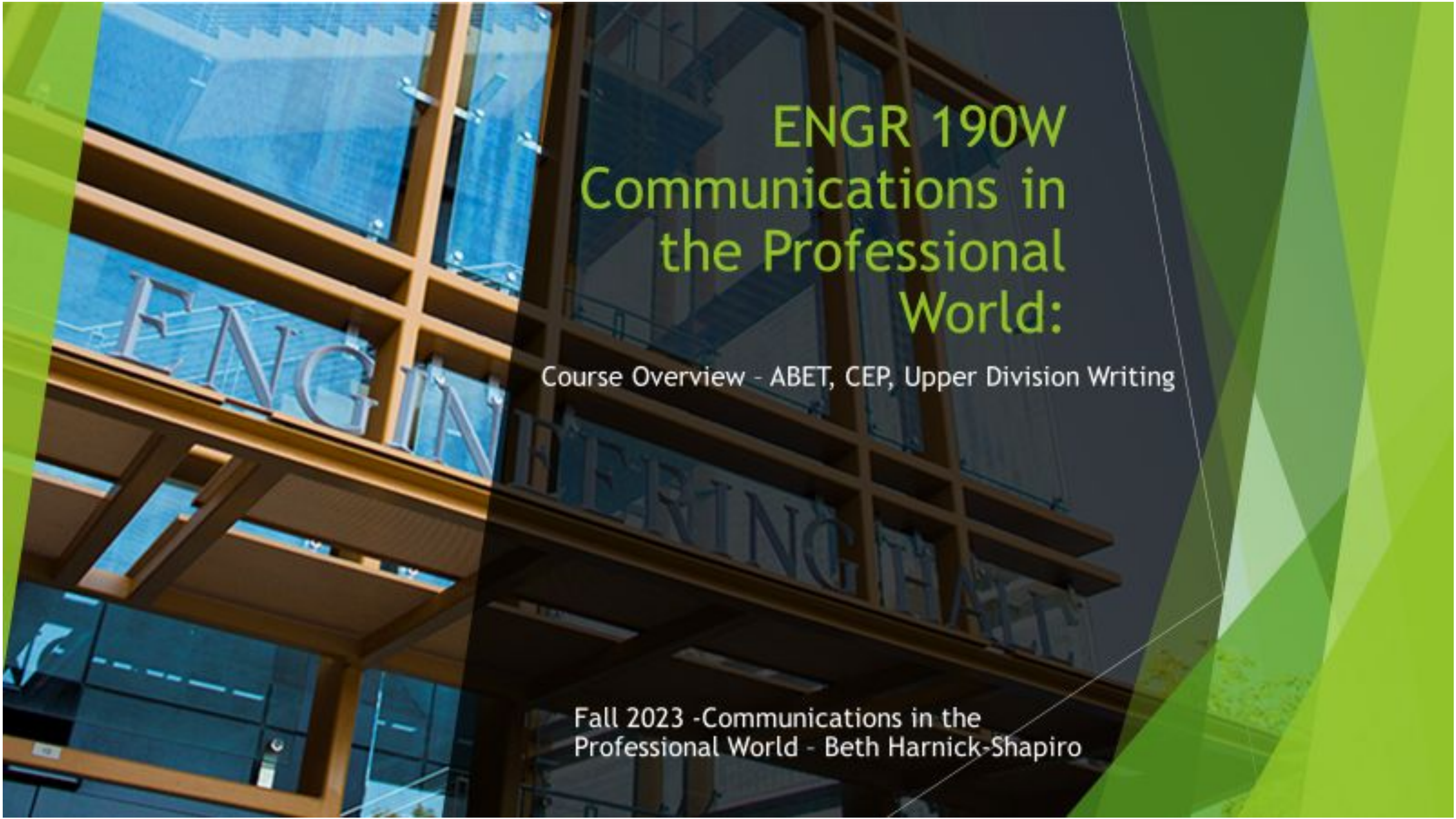


Digital Learning Lab



NSF Eng190W Timeline





ENGR 190W Communications in the Professional World:

Course Overview - ABET, CEP, Upper Division Writing

Fall 2023 -Communications in the
Professional World - Beth Harnick-Shapiro

My goals for ENGR 190W can be understood in the course learning outcomes

- ▶ Communicate effectively both orally and in writing to technical audiences.
- ▶ Communicate effectively both orally and in writing to non-technical audiences.
- ▶ Produce quality technical papers totaling 4,000 words or more of finished work.
- ▶ Produce a collaborative written and oral presentation where the team members provide leadership, establish goals, plan tasks, and meet objectives.
- ▶ Demonstrate an understanding of professional and ethical responsibilities, intellectual property, and a broad consideration of security and social issues.
- ▶ Describe the basic process model and identify the key elements that form the basis for effective technical writing and sound scientific research.
- ▶ Demonstrate the ability to make appropriate decisions regarding the form, format, and style of a proposed technical document based on the target audience.
- ▶ Apply effective methodologies for reviewing, editing, and revising a technical document.

Our instructors



**Beth
Harnick-Shapiro**

Co-PI & Lead
Instructor



Patrick Hong, Lecturer

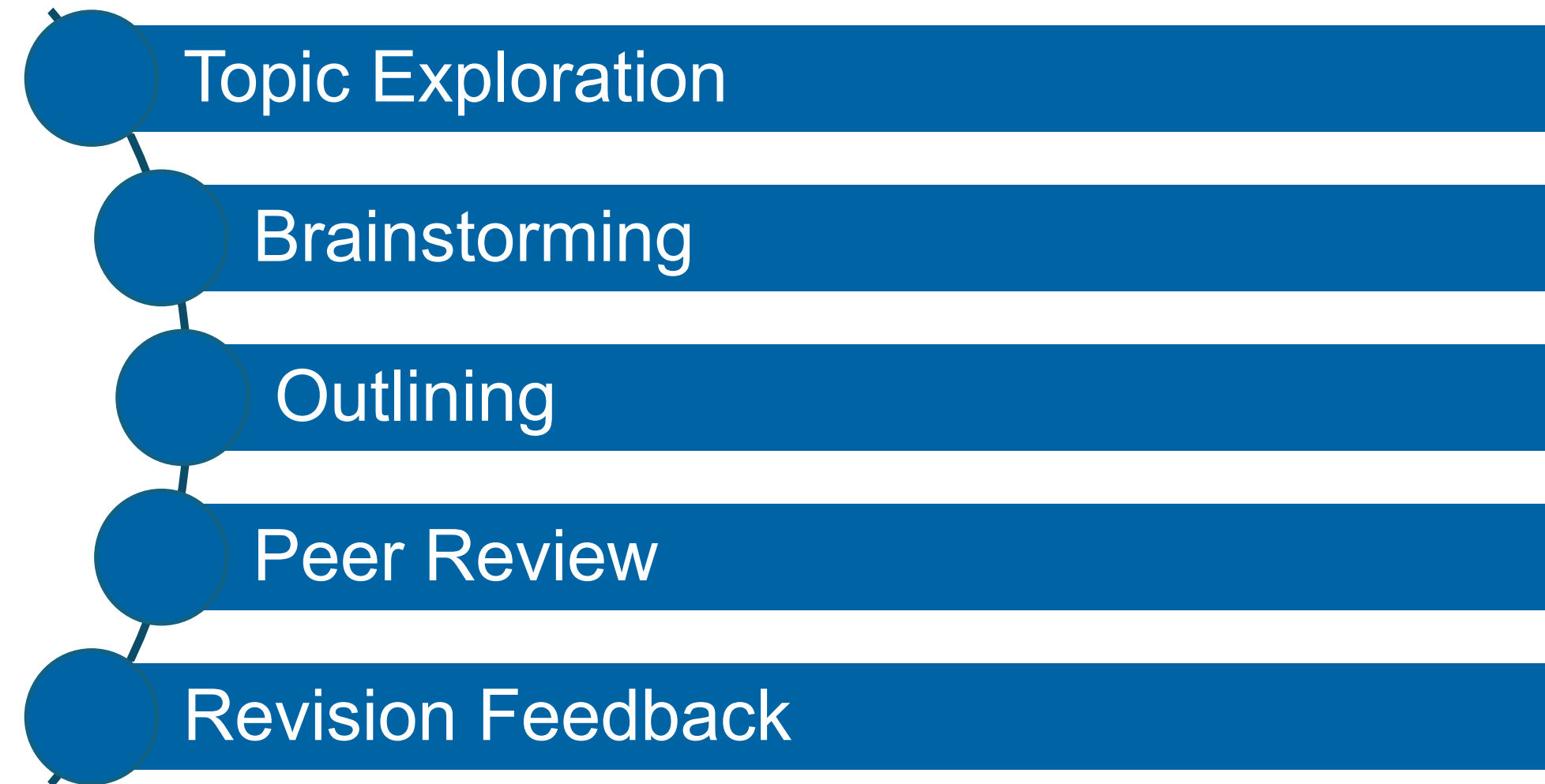


Jon-Erik Tateri, Lecturer



Jeff Foresta, Lecturer

Course Implementations



PapyrusAI

- Web-based tool incorporating generative AI via commercial LLM API
- Embedded prompts
- Professional development and instructional resources for both teachers and students.
- Teacher-facing pages allow instructors to customize classes and modules with specific prompts and functionality that the teacher finds pedagogically appropriate, as well as to receive reports on student use and links to the entire content of the interaction between students and PapyrusAI.
- Students use PapyrusAI through an interface that resembles the ChatGPT interface, with text boxes for student input and AI output.

Reflections from the Classroom

Understanding the learning goals will drive the evaluation of if / when / how to use generative AI.

We need to understand why we are using writing

- Is it to communicate?
- Is it to support our thinking?
- Is it to show what we know (proof of subject matter knowledge acquisition)?

Generative AI might play a role throughout the process of writing

Planning

- Setting goals
- Generating ideas
- Organizing ideas

Drafting

- Putting the writing plan into action

Reviewing

- Evaluating
- Editing
- Revising

Real purposes & audiences

Opportunities and Challenges of Generative AI

Opportunities:

- Personalization at scale
(tutoring, coaching)
- Thinking partner
(organizing thoughts)
- Feedback (iterative writing)
- Perspective taking

Opportunities and Challenges of Generative AI

Opportunities:

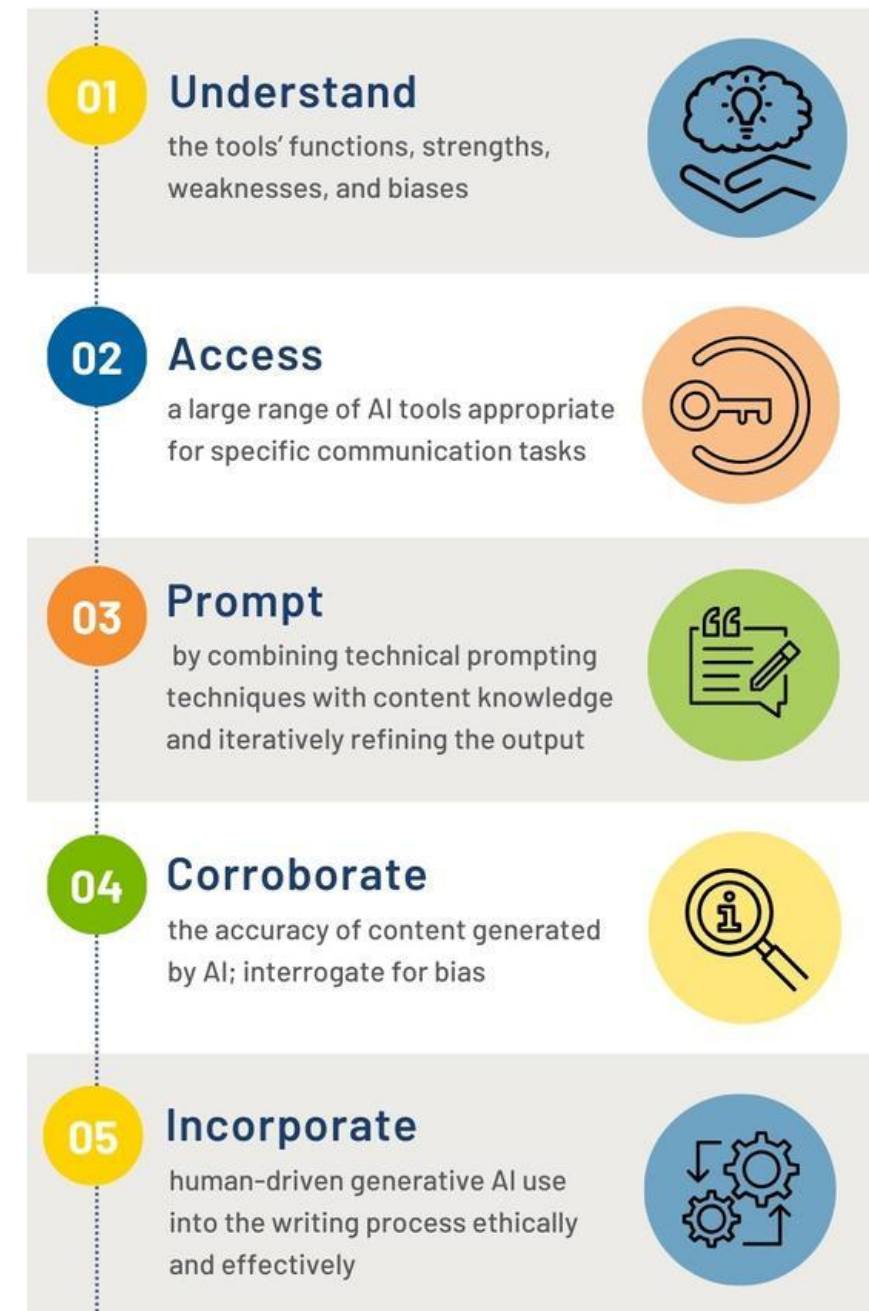
- Personalization at scale (tutoring, coaching)
- Thinking partner (organizing thoughts)
- Feedback (iterative writing)
- Perspective taking

Challenges:

- Risks over-reliance, hinders authentic skill development
- Ethical, IP, environmental & privacy concerns
- Faculty time & energy

What Decades of Research Tell Us About Writing Technology

HUMAN-DRIVEN GENERATIVE AI INSTRUCTIONAL FRAMEWORK



For more information, visit

www.genAled.org



Digital Learning Lab

First things first

If students are using generative AI, they must **understand** it

REMEMBER...

AI has limitations.

1

AI can't think.

AI only predicts the next text based on what you put in. It can't think or reason! Which is why...

2

AI makes things up.

AI can't check its output for accuracy or truth. Sometimes, AI will make things up just to keep you chatting!

3

AI is biased.

AI is trained on human texts, including books, social media, and more. Then it was trained some more by humans. The AI output might contain human biases because of this training.



Keep your personal information private!



Human-Driven GenAI Use

Think First

You are more creative, interesting, diverse, and aware of the desired outcome than any AI can be. Think about what you want to write before you start – you only have one chance to think before being influenced by the AI.

“Good Enough” Prompting

Harness prompting techniques like using personas, goals, and details + content knowledge, but if all else fails, use a conversational tone.

Be the Boss

Remember you are the boss of the AI. Ask it questions, make it clarify, expand, or revise things – iterative prompting allows you to define what is needed. Make the output fit *your* needs and desires.

Corroborate & Interrogate

Corroborate the information AI provides with other reliable sources. Interrogate the output: is there bias you need to address? The human is ultimately responsible for any output they use.

Reflect

Taking a moment to consider what worked, what didn't, and what could be done differently allows for improvement and agency.

Reminders for students

When interacting with AI...



Think first.

Know what you want from the AI before you start.



Ask for what you want.

What would make the output better? Ask for it!



Be the boss.

Remember, the AI doesn't have feelings. Keep asking questions and pushing back until you get what you want.



Reflect.

Did the AI help you, or was it more trouble than it was worth?

YOU are the author of your work – it's your job to make sure the output is accurate and truthful.



Keep your personal information private!



Good pedagogical
practice is the
foundation of an
AI-infused curriculum

Use It When:

- Productive struggle requires scaffolding.
- Use requires critical thinking.
- Authentic.

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- Productive struggle requires scaffolding.
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Skip It When:

- Simply off-loading task without higher order effort required.
- Human connection or imperfection is a value.
- Students are not in a position to corroborate & that matters.

Use It When:

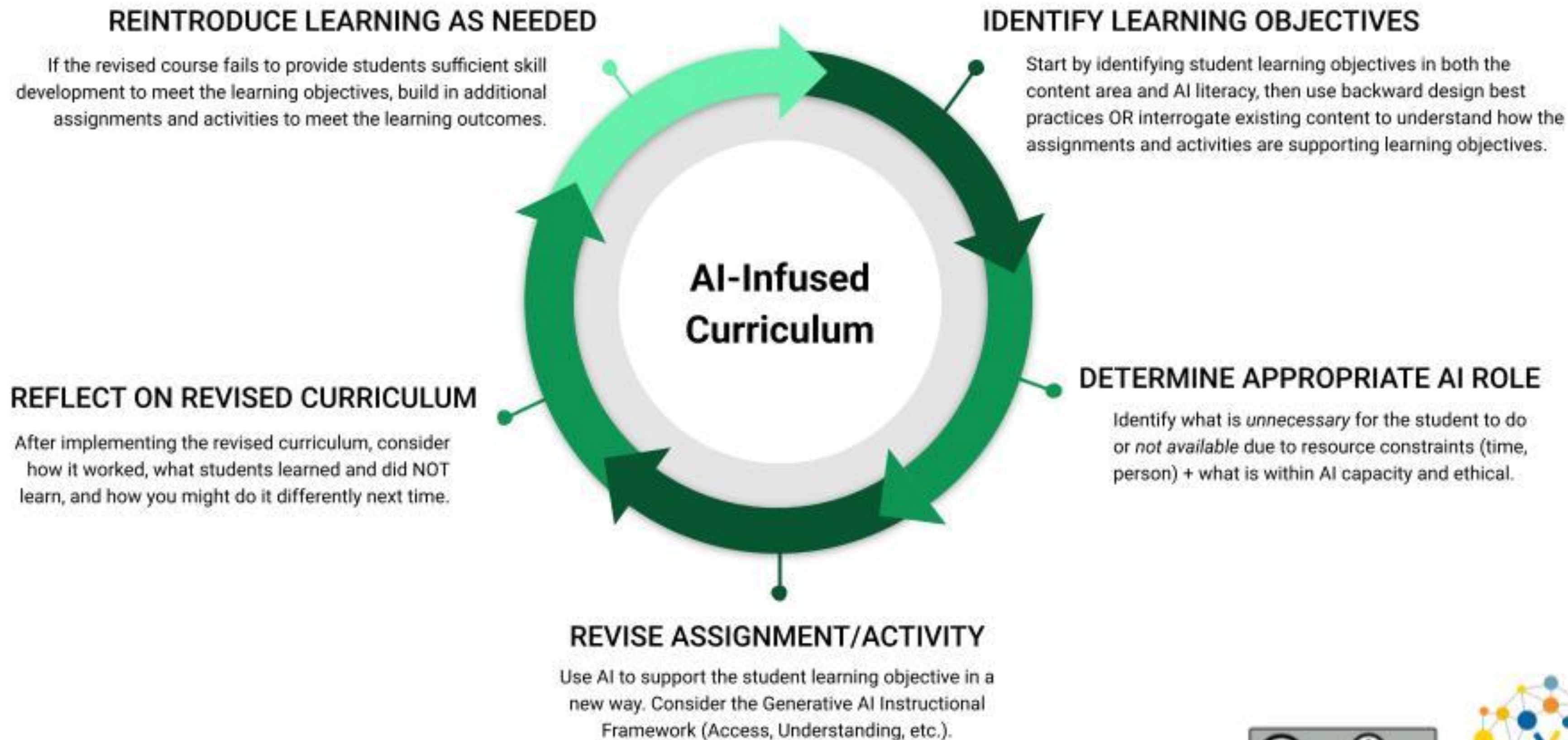
- Productive struggle requires scaffolding.
- Use requires critical thinking.
- Authentic.

Skip It When:

- Simply off-loading task without higher order effort required.
- Human connection or imperfection is a value.
- Students are not in a position to corroborate & that matters.

How to Decide:

- Align with learning outcomes.
- Consider the student's developmental stage.
- Do risks of over-reliance outweigh benefits?
- Do you have the time to do it well?



Example #1



Feedback Comparison Worksheet

Take notes on how you evaluate your peer's essay. Then, compare your feedback with the feedback generated by PapyrusAI. Identify key differences between the two sets of feedback. Use specific examples from both to support your comparison.

- What I liked about my peer's essay: _____
- What I think needs improvement: _____

- What to look out for when reviewing an essay: Refer to any specific rubric or assignment instructions provided by your instructor. Consider multiple aspects such as content, organization, clarity, redundancy, grammar and mechanics, tone and style, evidence and support, analysis and critical thinking, cohesion and flow.

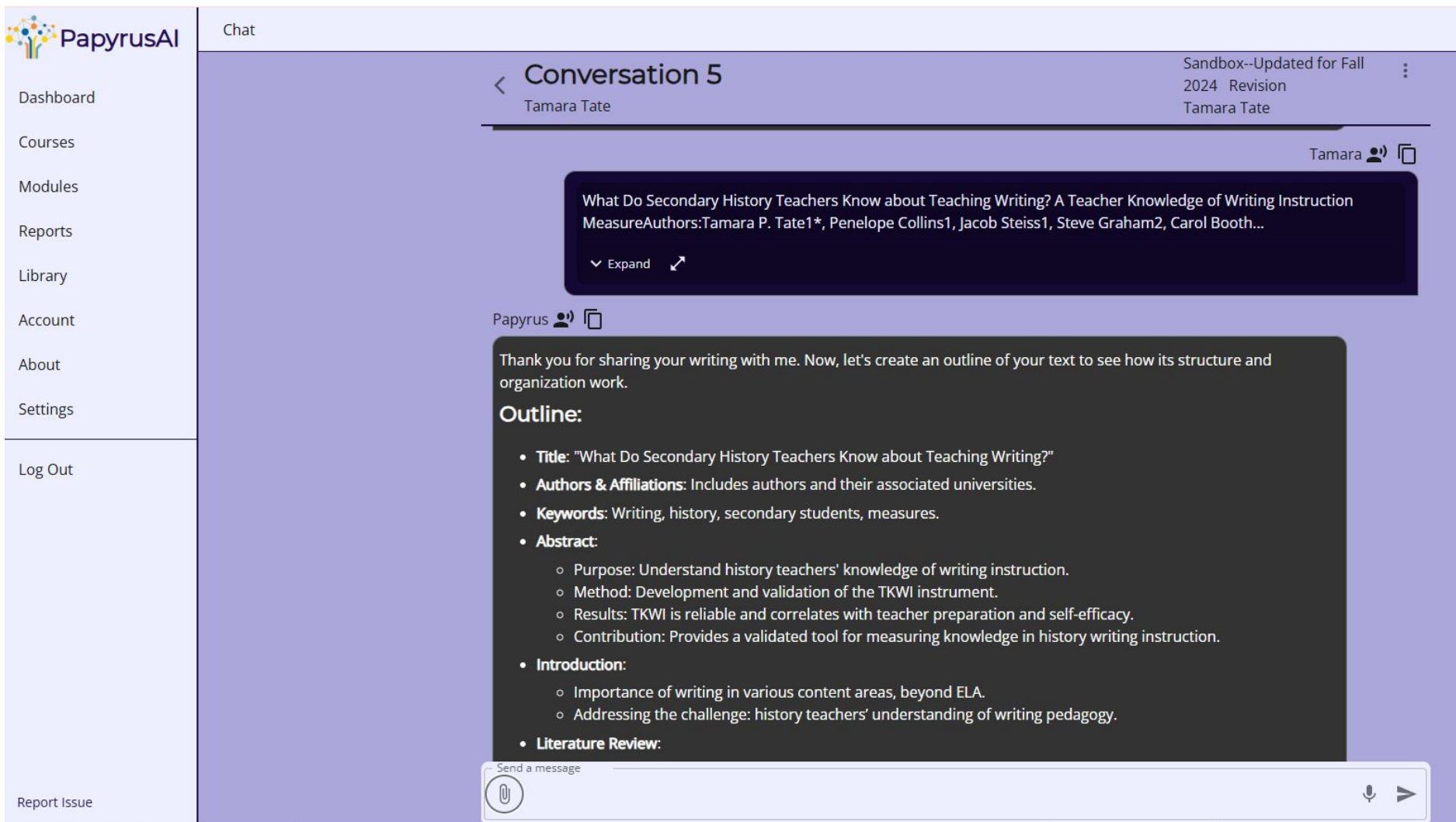
Category	Peer Feedback	AI Feedback	Observations on Differences
Strengths			
Areas of Improvement			
Other Comments			

- AI-Assisted Peer Review
 - Read the writing. Make some notes on things *you* notice. Consider the assignment and rubric.
 - Prompt the AI to provide feedback.
 - Consider the AI output for accuracy and clarity.
 - Consolidate your thoughts and the additional information from the AI and give your peer consolidated feedback.
 - Consider what you did well, where the AI helped, and what the AI got wrong or missed.

Example #2

- Reverse Outline

- Ask the AI to outline your writing.
- Look at the outline--what is missing? Are there logic gaps? Could you reorganize the flow?
- Think about whether the outline helped you revise and strengthen your writing.



Example #3



- Debate Opponent
 - Give the AI the debate topic and tell it to act as your opponent.
 - Tell it your position and arguments.
 - Have it counter you.
 - Then come up with counter arguments.
 - Ask it for suggestions of other things you might have argued or countered.

Since I know the intent behind each of my sentences, it's difficult to see how others might read and misinterpret certain points, **which is where ChatGPT becomes helpful if I don't have a peer available to read over my work.**

I used ChatGPT to explain the instructions. It helped me understand what kind of details I needed to include. **I am feeling more prepared now** since I think I understand what to focus on before starting the assignment.

Using PapyrusAI **helped me devise a much more effective controlling idea** ... it helped me brainstorm information to include in the controlling idea. Papyrus asked me questions like "What do you think is important about these concerns?", and **I realized I should be answering these questions in my research paper** to help the audience better understand the purpose and goal of our paper.

At first glance, the task itself seems fairly simple, I feel like I can write emails pretty well and have a good success rate with professors/coworkers that I write to.

→

The writing was more difficult than I thought. ... In this assignment, I used GenAI to give feedback from the perspective of the professor to gauge their response, and it helped a lot because **I gained an understanding of the professor's position.** I think that's a good use of GenAI tools.

From all the assignments, I noticed that **AI has limitations: restriction to human voice in writing.** It is helpful to use AI for revision and sentence generation with the provided idea, however, we need to add human revision into that text.

Once the general outline was finished, the rest of the paper was done through human writing and **real** peer review. ... **I wanted to believe that I learned from the process, so I avoided utilizing it [AI] as much.**

I generally find gen AI to be annoying to use and find it to produce less effective results. **On my own I am generally able to do work faster and better** than it would take me to: use gen AI, get it to generate something close to what I want, revise what it provided, and **ensure it matches my vision for a project.**

I was worried GPT can run the risk of plagiarizing sentences, and I wanted to write the results section because it was more effective for me to read the articles, understand their connections, and write up sentences in a way that makes sense to the reader. ... Overall, while AI was a useful aid, **I made sure to maintain control over my writing and analysis.**

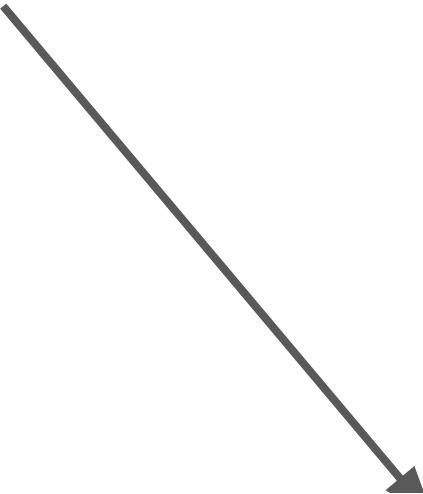
The use of AI hinders my ability to learn how to write at this level naturally, so I have chosen to abstain from using it as a [crutch] in this class so that I can learn how to write at a higher level myself. **I would rather receive a B in a class and know I improved my writing skills then receive an A submitting work mostly done by generative AI.**

While AI can help students improve writing, I am of the opinion **it often creates students who cheat through college without learning anything,** leading to college educated adults who don't have the ability to think for themselves.

Resources



GenAled.Org



UCI Teacher Academy

[About](#) [People](#) [Upcoming Workshops](#) [Classroom](#) [Certificate](#)

AI in Education Certificate Program

Engage with experts and colleagues to understand the foundations of AI in Education to impact teaching and learning in the K-12 classroom.



OVERVIEW

PAPYRUSAI

RESOURCES

AI TEACHER EDUCATION

RESEARCH

FUNDING

TEAM

MEDIA

DIGITAL LEARNING LAB

Resources

I'm interested in resources for...



Higher Education



K-12



AI Writing & Digital Literacy Fellows



Digital Learning Lab
University of California, Irvine

CONTACT US

digitallearninglab@uci.edu

FOLLOW US

@DLL_UCI

JOIN THE MAILING LIST

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Resources you can use/remix/adapt for free!

- Prompts
- Activities
- Foundational curriculum for students (and teachers)
- Videos on AI literacy for students & AI-infused pedagogy for instructors
- Research

Want to learn about generative AI?

Explore our [introductory curriculum](#) below.

UNDERSTAND: HOW LLMS WORK	+
UNDERSTAND: LLMS' INHERENT LIMITATIONS AND BIASES	+
PROMPT GENERATION	+
ITERATIVE PROMPTING	+
UNDERSTAND: ENVIRONMENTAL IMPACT	+

Activity / Lesson	Learning Goal
<u>Introduction to AI</u>	Students will explore the capacities and limitations of generative AI.
<u>AI-Assisted Feedback</u>	Students will be able to use generative AI to efficiently generate feedback and understand their own role in ensuring that feedback is accurate and useful.
<u>AI-Assisted Peer Review</u>	Students will be able to use generative AI to efficiently generate suggestions for peer feedback and understand their own role in ensuring that feedback is accurate and useful.
<u>AI-Assisted Summary</u>	Students will be able to selectively use generative AI to produce concise summaries of a text, while also recognizing its supportive role and their responsibility to ensure the summary is accurate and meets their objectives.
<u>Imaginary / Persona Feedback</u>	Students will be able to use generative AI to receive feedback from an imagined audience and explore ways to improve their writing to meet the expectations and needs of different audiences.
<u>Organization / Reverse Outline</u>	Students will be able to use generative AI to create a reverse outline of their draft, analyze the structure of their writing, and identify areas where the organization can be improved. They will also learn to adjust the flow of their work to ensure clarity and cohesion.
<u>Topic Brainstorming / Background Knowledge</u>	Students will be able to use generative AI to effectively brainstorm writing topics, explore background knowledge, and refine their ideas to align with assignment goals. They will also learn how to evaluate each potential topic.
Take a look at our <u>“Think First” Question Bank</u> and <u>Reflection Question Bank</u> !	

Thank you!

Tamara Tate, PhD

Associate Director, Digital Learning Lab

University of California, Irvine

tatet@uci.edu



This material is based upon work supported by the National Science Foundation under Grant No. 2315294
and the California Educational Learning Lab AI Grand Challenge

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Discussion questions:

1. What strategies have you found helpful for integrating generative AI into your courses in human-centered ways?
2. How do you balance the use of generative AI to scaffold, but not off-load, student learning?
3. If you could give a colleague one piece of advice for integrating AI into their course, what would it be?

Using Machine Learning to Give Students Timely Feedback During Hands-on Exercises



Richard Weiss, The Evergreen State College (Olympia, WA)
Jens Mache, Lewis & Clark College (Portland, OR)
Justin Wang, Northeastern University (Boston, MA)

Project Goals

- Predict when students need a hint
- Generate effective hints using AI

edurange3

https://edurange.dev/scenarios/3/2

HomeScenariosLogout

Logged in as group0

ScenariosLogout

```
|_| |_| \_| / / \_| \_,_| |_| \_|
, |_| \_|
/ |
_/_

In this exercise, you will work through a series
of Linux
command-line challenges for managing files and f
le permissions.

Start by viewing the contents of the instruction:
.txt file with
the following command:
cat instructions.txt

*****
*****
group0@NAT:~$ ls
codes          manipulate    task1  task3  task
5  task9
instructions.txt permissions    task2  task4  task
8  view
group0@NAT:~$ cd manipulate/
group0@NAT:~/manipulate$ ls
file1.txt  file2.txt
group0@NAT:~/manipulate$ cat file1.txt
This is the first file!
group0@NAT:~/manipulate$
```

Task 1

The `pwd` command will give you the current working directory. This tells you where you are in the Linux file system. Steps:

Type `pwd` into the prompt

Answer question 1 in EDURange.

What is the full path of your directory when you typed the `pwd` command?

Response:

CHECK

Points Awarded: 0 / Points Possible: 5

Info

web-SSH

Chat

SSH

cmd: ssh group0@10.0.2.15 -p 32769

pw: IgUccu

Guide

WebSSH

Chat

Chapter Progress: Points: 0 / Max: 5

Scenario Progress: Points: 0 / Max: 80

edurange3

https://edurange.dev/scenarios/3/2

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Brief1234567891011Debrief

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What is the full path of your directory when you typed the `pwd` command?

Response: CHECK

Points Awarded: 0 / Points Possible: 5

Infoweb-SSHChatSSHcmd: ssh group0@10.0.2.15 -p 32769pw: IgUccu

GuideWebSSHChat

Chapter Progress:Points: 0 / Max: 5

Scenario Progress:Points: 0 / Max: 80

edurange3

https://edurange.dev/scenarios/3/2

HomeScenariosLogout

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InfoWebSSHChat

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GuideWebSSHChat

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```

rief	1	2	3	4	5	6	7	8	9	10	11	Debr
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EDURange Interface

Guide, embedded questions

Chat

Command Line Interface: Terminal

Intelligent Tutoring System vs Hint Generation

- Each student has a unique learning path
- Students learn common knowledge, skills, and abilities: the hint system account for differences

	Intelligent Tutoring System	Hint Generation
Guide/textbook	individual	same
questions/tasks	individual	same
hints	individual	individual

Predict When a Student Needs a Hint

Classical Machine Learning

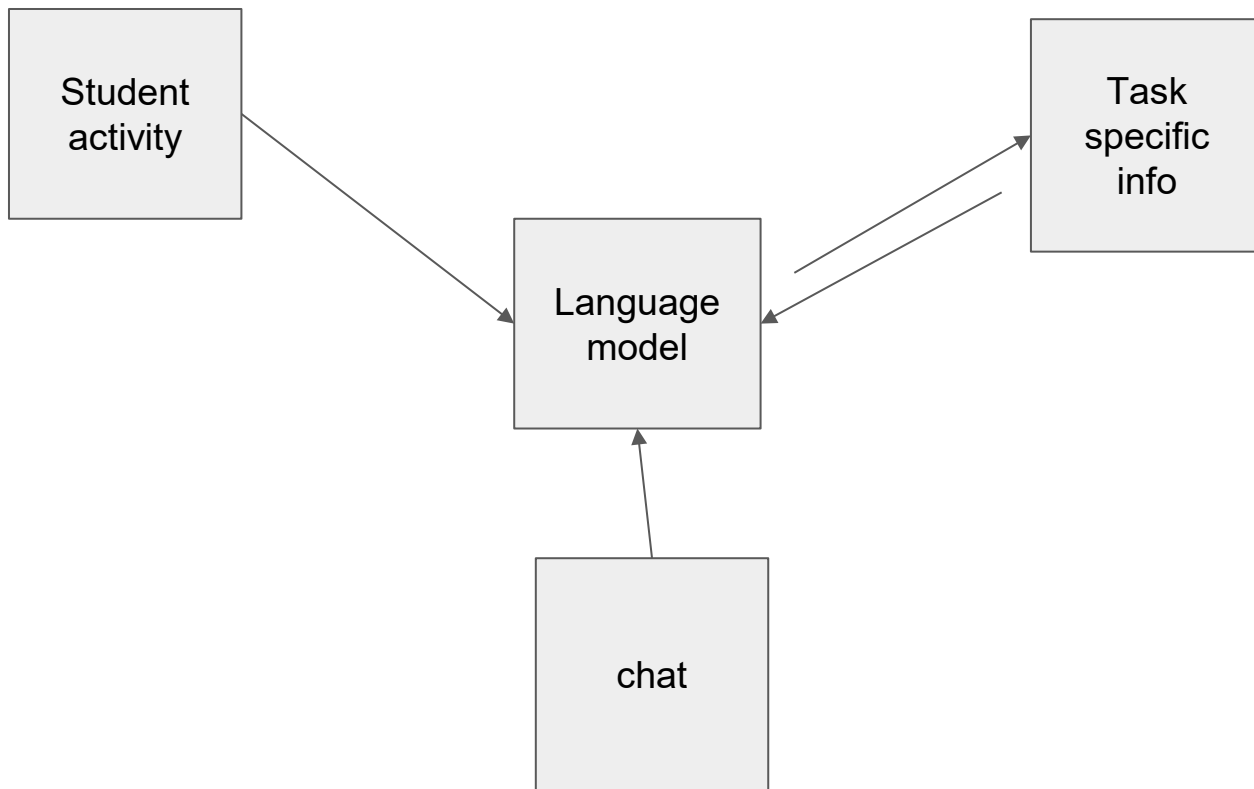
Up to 90% accuracy, even higher sensitivity

Students can also request a hint

Classifier	Sensitivity	Specificity	Balanced Accuracy	AUC
XGBoost	0.466	0.925	0.696	0.832
Random Forest	0.500	0.877	0.693	0.884
Decision Tree	0.399	0.794	0.597	0.648
K Nearest Neighbors	0.666	0.850	0.758	0.860
SVM with RBF	0.933	0.869	0.901	0.955
SVM with linear	0.766	0.850	0.808	0.904
Naive Bayes	0.533	0.780	0.656	0.702
Logistic Regression	1.0	0.850	0.925	0.973

Table 1: Comparison of performance of 8 classifiers on our 67 datapoints

Hint Generation



Human in the loop

Figure 1. Typical AI System

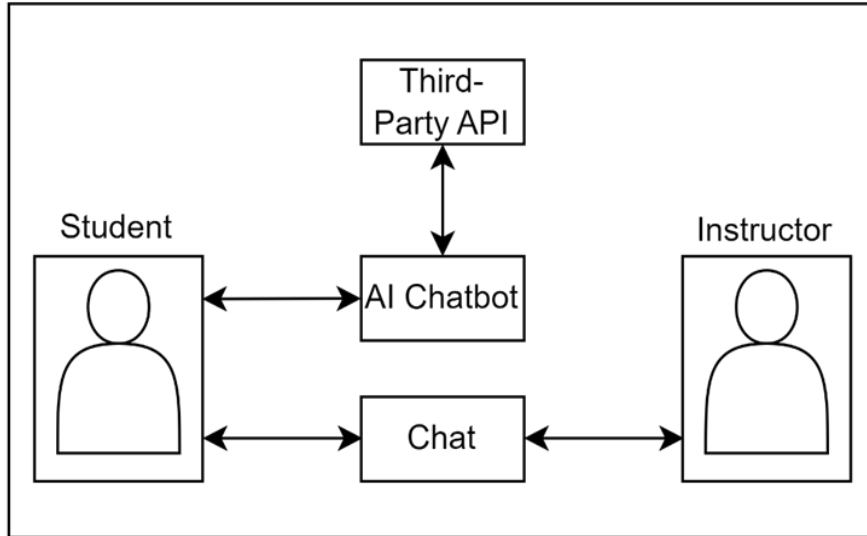
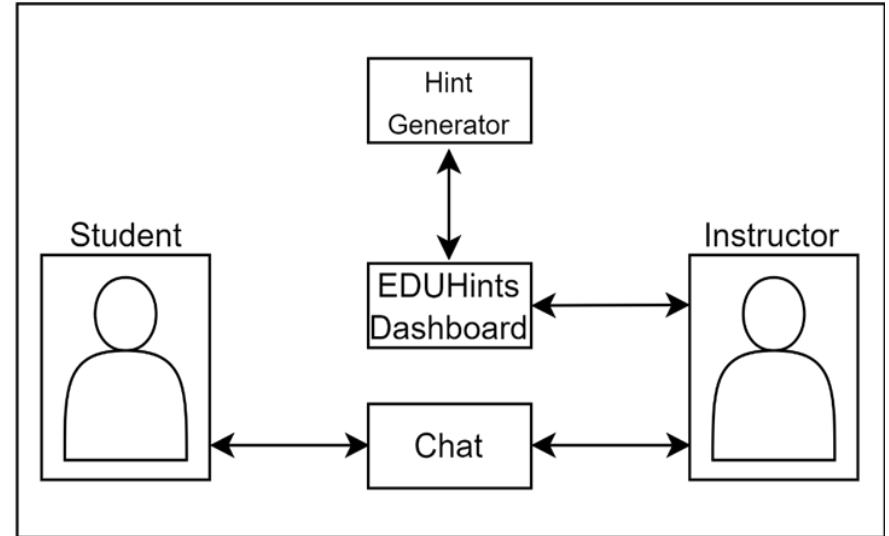


Figure 2. EDUHints System



Generating Effective Hints

Not all hints are equal

- For inquiry-based learning, hints should raise questions
- Hints should be general
- Hints should reinforce student knowledge without repeating it

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Questions for Breakout

Do you [or TAs] give individual hints to students?

If you had an AI generation system that produced effective hints, how would you use it?

We evaluate the usage of data logged from cybersecurity exercises in order to predict students who are potentially at risk of performing poorly.

Hands-on exercises are essential for learning since they enable students to practice their skills.

In cybersecurity, hands-on exercises are often complex and require knowledge of many topics. Therefore, students may miss solutions due to gaps in their knowledge and become frustrated, which impedes their learning.

Targeted aid by the instructor helps, but since the instructor's time is limited, efficient ways to detect struggling students are needed. We develop automated tools to predict when a student is having difficulty. We formed a dataset with the actions of 313 students from two countries and two learning environments: KYPO and EDURange. These data are used in machine learning algorithms to predict the success of students in exercises deployed in these environments. After extracting features from the data, we trained and cross-validated eight classifiers for predicting the exercise outcome and evaluated their predictive power. The contribution is comparing two approaches to feature engineering, modeling, and classification performance on data from two learning environments. Using the features from either learning environment, we were able to detect and distinguish between successful and struggling students. A decision tree classifier achieved the highest balanced accuracy and sensitivity with data from both learning environments. The results show that activity data from cybersecurity exercises are suitable for predicting student success. In a potential application, such models can aid instructors in detecting struggling students and providing targeted help. We publish data and code for building these models so that others can adopt or adapt them.



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Field Notes from AI in STEM Education

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Embracing and Implementing Innovative Teaching Concepts

October 23, 2025 | 2:00pm-3:30pm ET

Dr. Kaitlyn Casimo

Dr. Steven Neshyba

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