

Interactive Online Interventions for improving belonging and performance in introductory physics

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Social belonging

- Feelings of inclusion in a community
- Relates to students' perception of the inclusion of the learning environment
- Relates to students' motivation and self-efficacy
- Belonging uncertainty more likely during transition (e.g., to college)



Self-efficacy

- Belief in one's capability to succeed
- Relates to persistence and engagement
- Can affect effectiveness with which students engage with learning
- Feedback loop



Belonging and self-efficacy intervention (prev. lit.)

- 30-minute activity done in the second recitation
- Writing prompt for students to reflect on concerns they have about physics/college
- Testimonials from other students
- Normalizing struggle: everybody goes through it
- Adapted for in-class
- Goal: interactive online activity (scale)

Rationale for Interactive Online Interventions (IOIs):

Calculus-based Intro Physics

- primarily in-coming engineering majors
- 16 sections of 135 each/yr (~2000 students)
- Lab and recitation taught by graduate TAs

Wide variation in students' academic preparation, motivation, mindset, etc.

Wide variation in approaches to teaching, willingness to teach beyond content, etc.



Supplement with resources to personalize instruction and attempt to level the playing field.

Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions



In the textbox, type a few sentences about what you are most concerned or worried about right now.

Enter your answer here

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Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions



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Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions



Almost all students (~95%) engaged
meaningfully with the prompt based
on their responses

In the textbox, type a few sentences about what you are most concerned or worried about right now.

Enter your answer here

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Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions



Concern	%
Workload, fast pace, falling behind Time management	57%
Ability to succeed Develop good study strategies Understand material, do well on exams, get good grades	47%
Balancing school with extracurriculars Making friends, maintaining a social life Finding a study group	8%
Other: Large classes Finding a job or internship Away from home Uncertainty about choice of major	17%
No concerns	3%

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Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions



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Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions



- New, unfamiliar experiences
- Isolation

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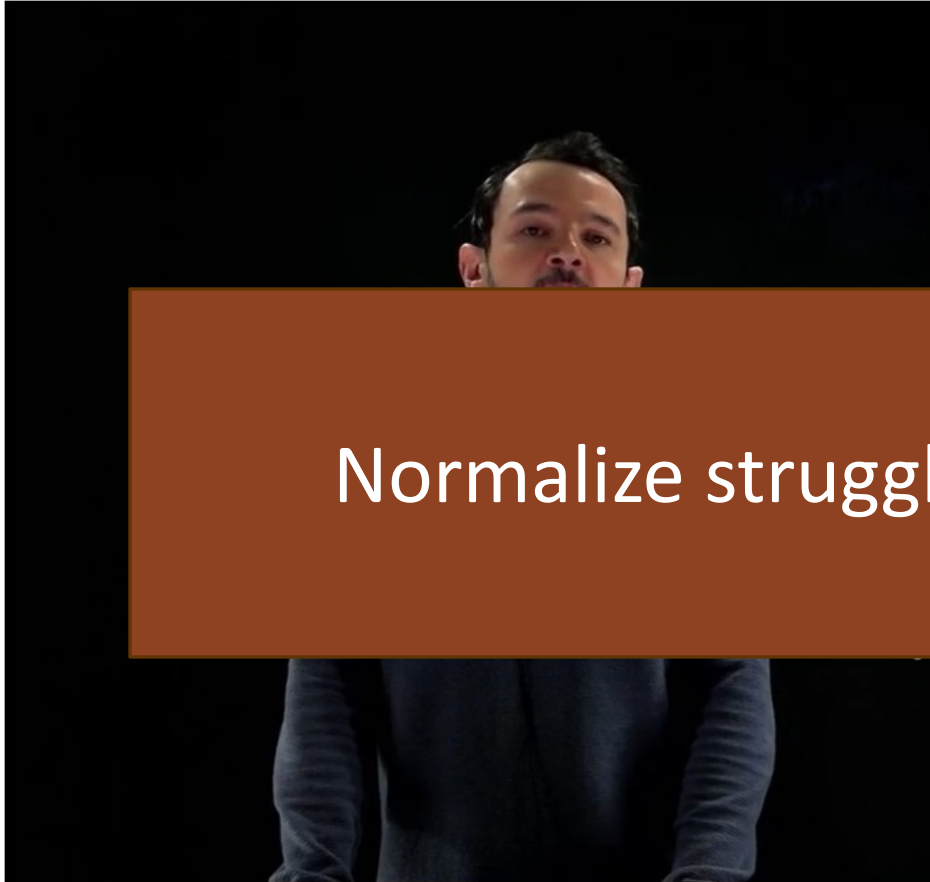
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Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions



Normalize struggle



iliar experiences

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Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions



In the textbox, type a few sentences about how your worries will get resolved.

Enter your answer here

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Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions

Select the video you would like to watch, then click the *Next Page* button



Meet Nathan,
Computer Sciences senior.



Meet Allison,
Mechanical Engineering senior.

Choice of testimonial appears to be
based on major not gender

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Wk1: What worries you IOI

What Worries You?

Interactive Online Interventions



Common themes from testimonials

- Experience of struggle is normal, particularly at transition points
- Opportunities to make friends, create study groups, meet outside of school
- Ups and downs are normal
- Use university provided support:
 - Supplementary instruction
 - Learning Commons, MASS center
 - Learning Center in physics department

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Wk2: Saying is believing IOI

- Reinforce message from week 1
- Watch a student testimonial
- Reflect on own challenges
- Write letter to future student

Click on a picture to hear their story and learn how they achieved success!



Meet Maria, a 4th year mechanical engineering major and first in her family to go to college.

Meet Abai, a 3rd year computer science major.

Meet Camila, a 3rd year physics major and first in their family to go to college.

Meet David, a 4th year electrical engineering major and first in his family to go to college.

Meet Mateo, a 4th year biochemistry major.

Meet Elijah, a 3rd year aerospace engineering major.

Wk6: Exam wrapper (prev. lit.)

- Self-assessment after exam 1
- Successfully implemented in 10 different academic disciplines
- Changes in study habits
- Improvements in exam and course grade
- Metacognition



Wk6: Exam wrapper IOI

Exam Wrapper

Interactive Video Tutorials



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Wk6: Exam wrapper IOI

Exam Wrapper

Interactive Video Tutorials

Select the video you would like to watch, then click the *Next Page* button



Meet Elijah, a 3rd year
aerospace engineering major.



Meet Camila, a 3rd year
chemical engineering major.

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Wk6: Exam wrapper IOI

Exam Wrapper

Interactive Video Tutorials

Select the video you would like to watch, then click the *Next Page* button



aer



ear
major.

Testimonials both discuss struggling at first and adjusting study habits to improve.

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Wk6: Exam wrapper IOI

Exam Wrapper

Interactive Video Tutorials

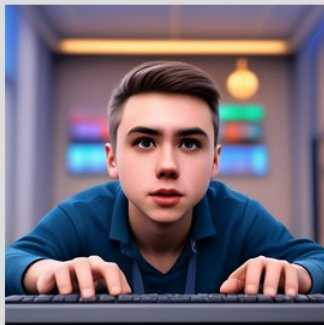
Choose from the following to explore research-backed learning strategies that have been shown to enhance comprehension and retention. The strategies have been organized into four key areas. You will have the opportunity to learn about more than one, if desired.



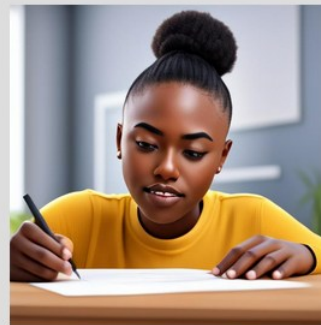
Before class preparation



During class engagement



After class review and approach
to homework



Exam preparation

Wk6: Exam wrapper IOI

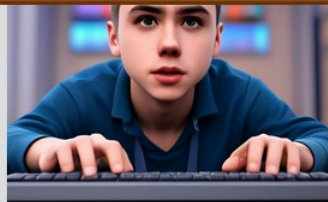
Exam Wrapper

Interactive Video Tutorials

Choose from the following to explore research-backed learning strategies that have been shown to enhance comprehension and retention. The strategies have been organized into four key areas. You will have the opportunity to learn about more than one, if desired.



Emphasis that it's not just exam preparation,
it's how you approach learning in the class as a
whole



After class review and approach
to homework

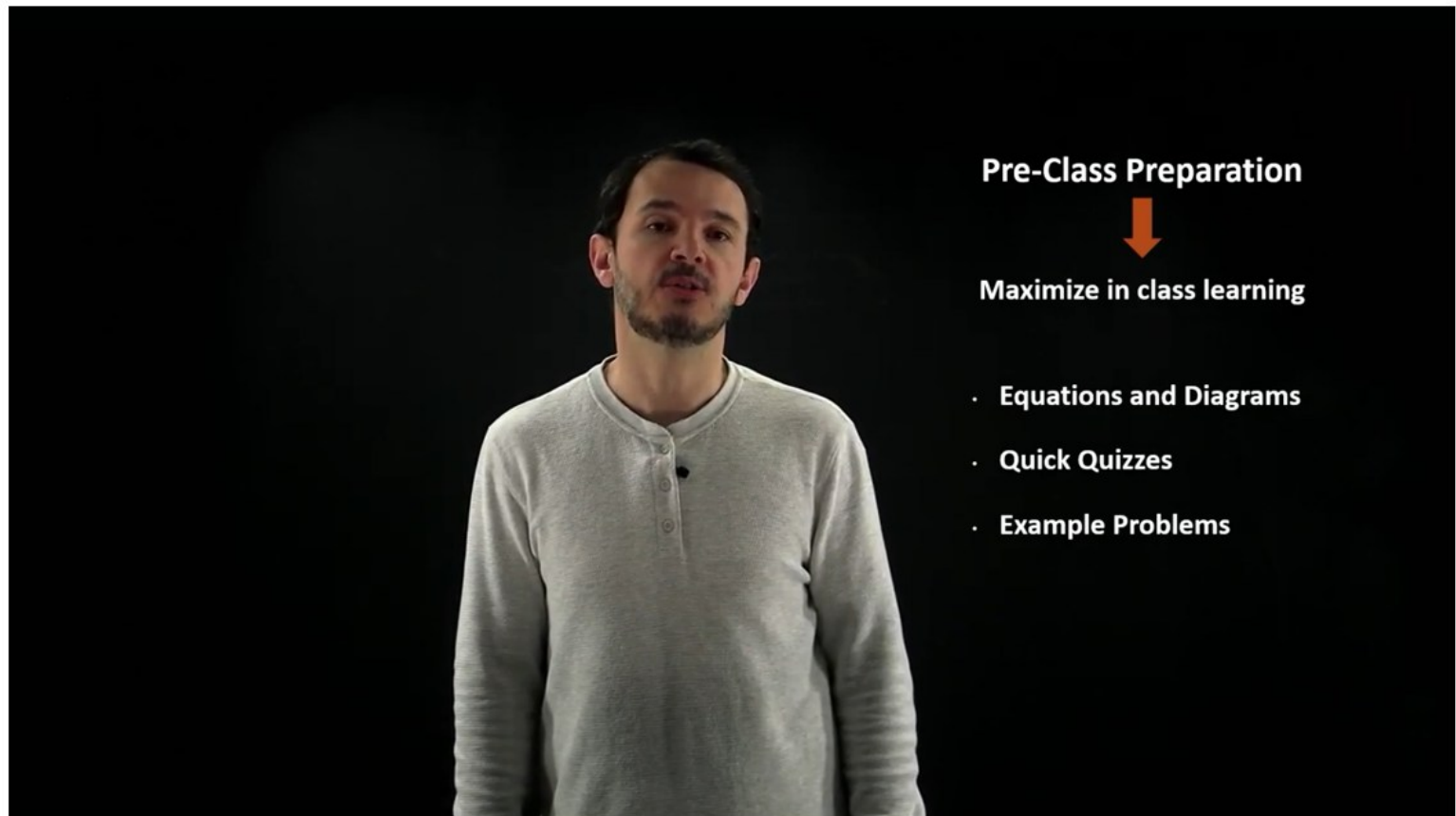


Exam preparation

Wk6: Exam wrapper IOI

Exam Wrapper

Interactive Video Tutorials



Pre-Class Preparation

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Maximize in class learning

- Equations and Diagrams
- Quick Quizzes
- Example Problems

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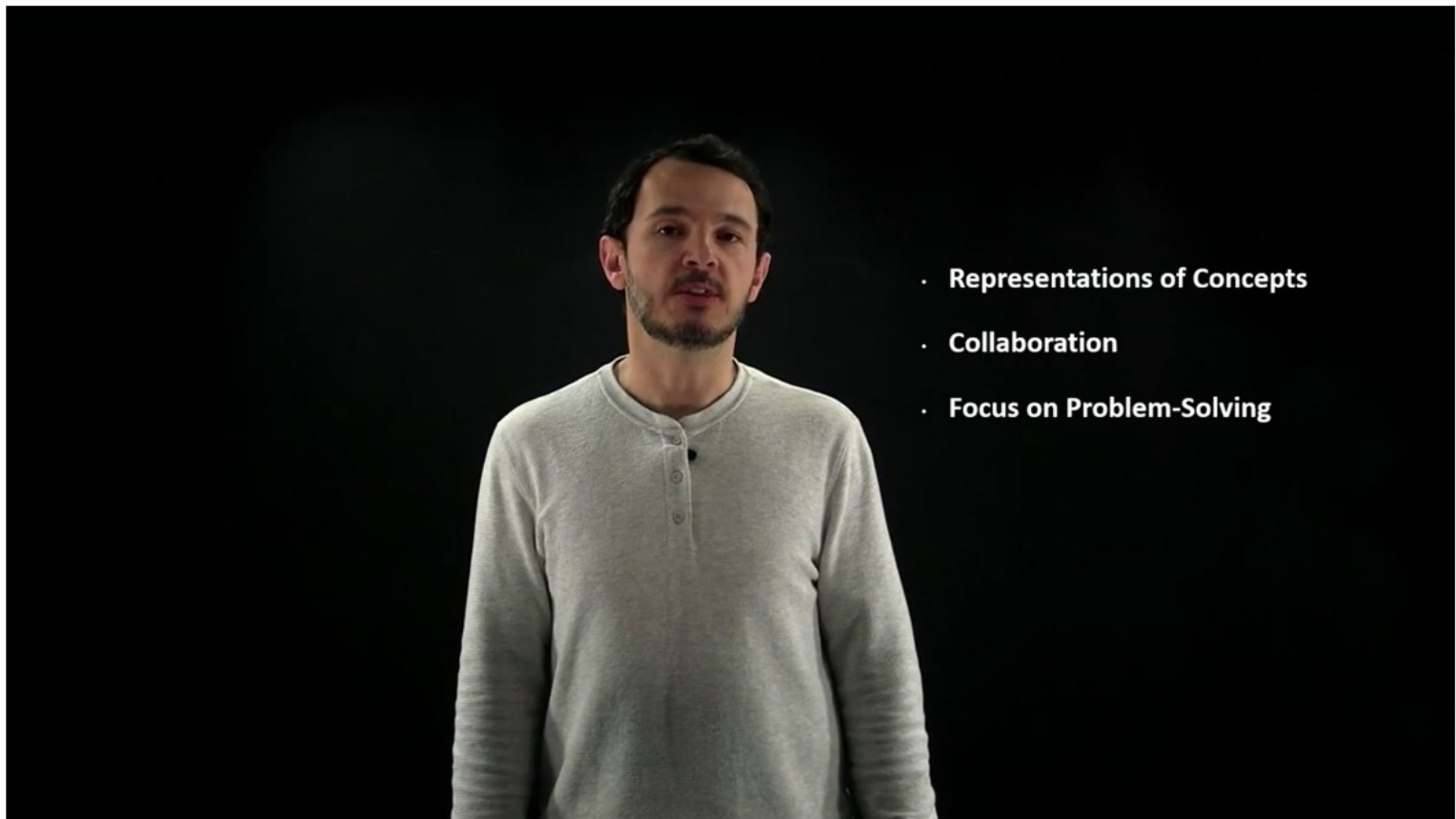
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Wk6: Exam wrapper IOI

Exam Wrapper

Interactive Video Tutorials

A man with dark hair and a beard, wearing a grey long-sleeved shirt, stands in front of a black background. To his right, a list of topics is displayed in white text.

- Representations of Concepts
- Collaboration
- Focus on Problem-Solving

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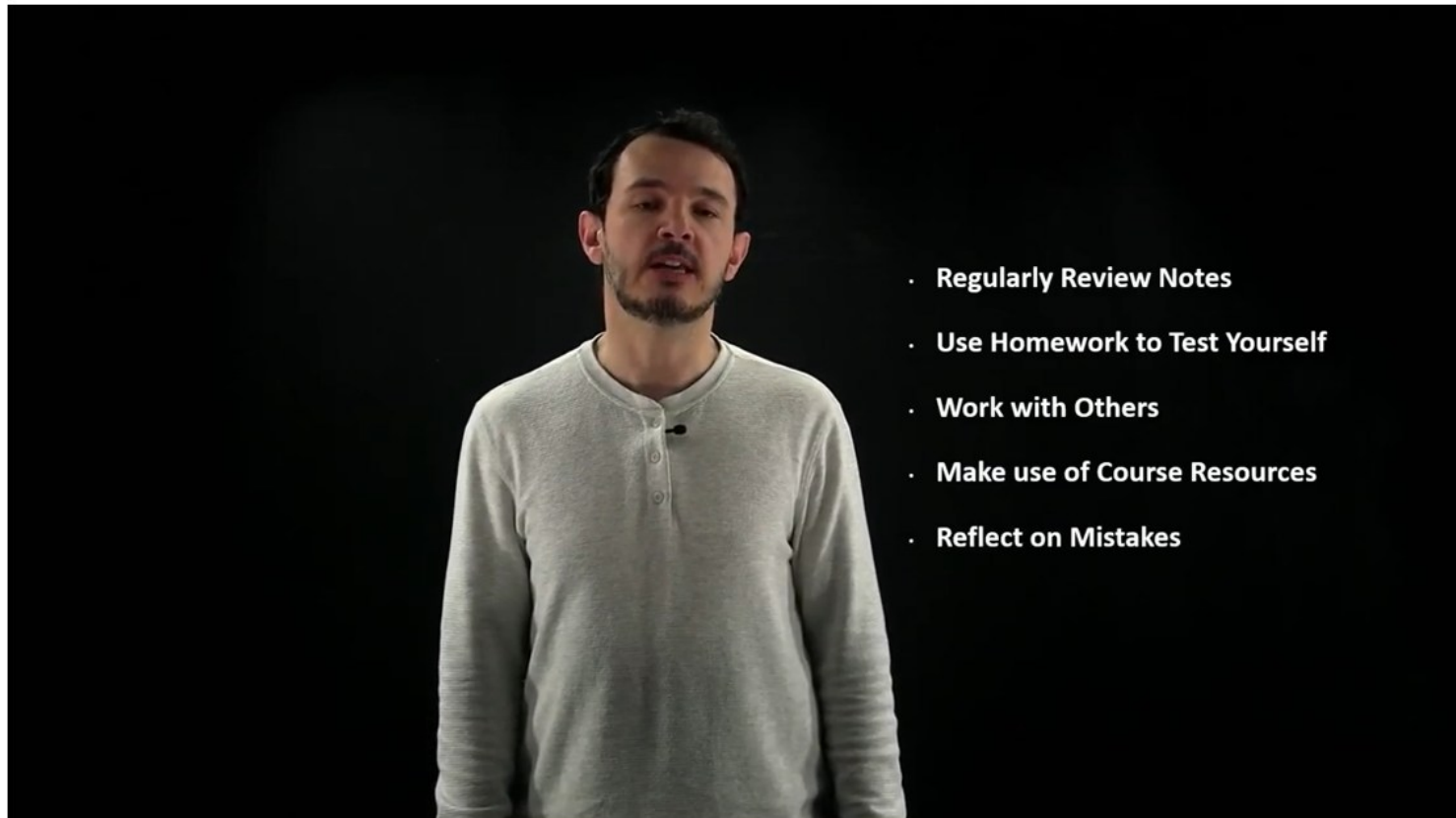
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Wk6: Exam wrapper IOI

Exam Wrapper

Interactive Video Tutorials



- Regularly Review Notes
- Use Homework to Test Yourself
- Work with Others
- Make use of Course Resources
- Reflect on Mistakes

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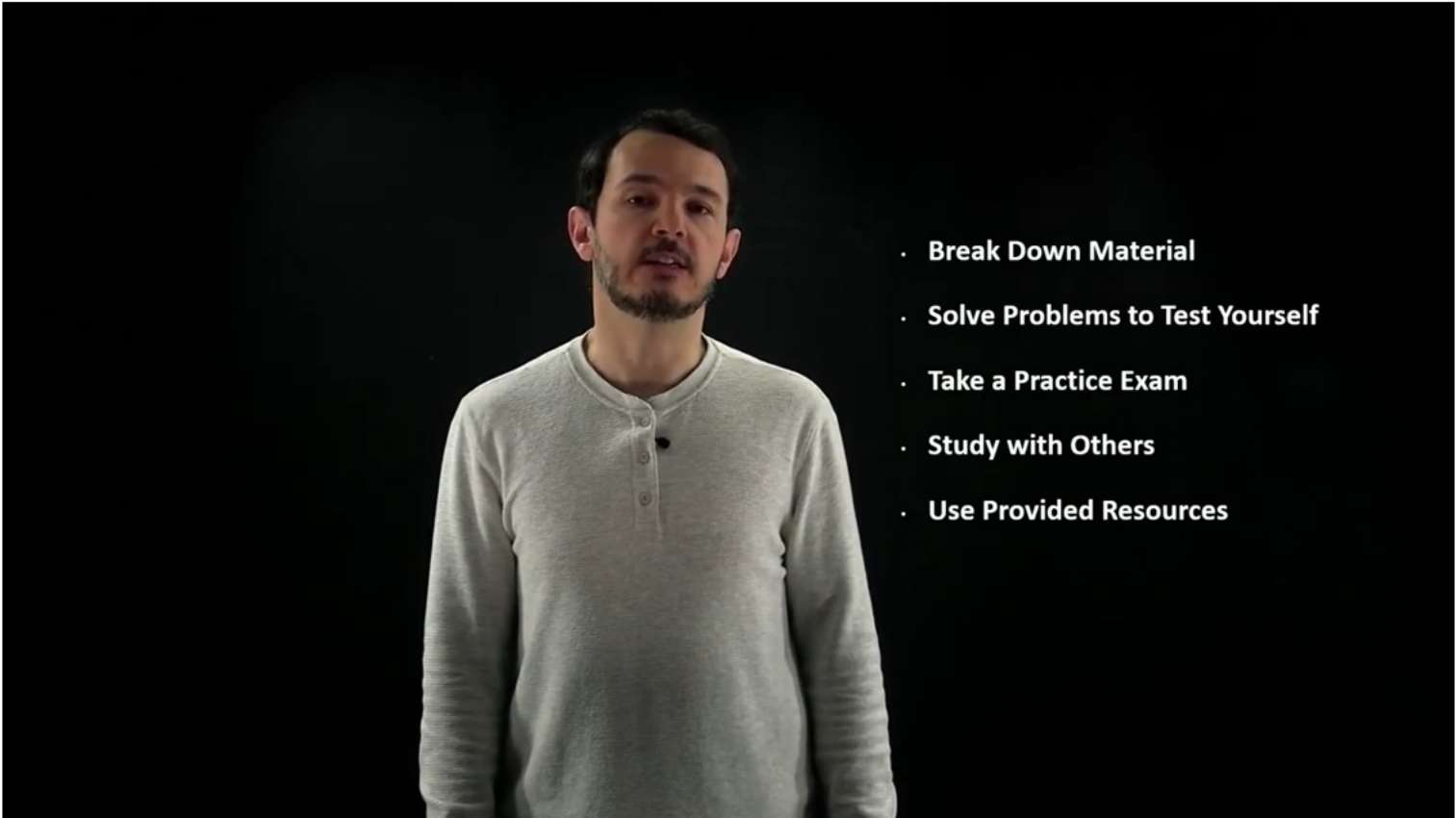
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Wk6: Exam wrapper IOI

Exam Wrapper

Interactive Video Tutorials



A man with dark hair and a beard, wearing a grey long-sleeved shirt, is speaking. To his right is a list of five study tips, each preceded by a bullet point.

- Break Down Material
- Solve Problems to Test Yourself
- Take a Practice Exam
- Study with Others
- Use Provided Resources

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Wk6: Exam wrapper IOI

Exam Wrapper

Interactive Video Tutorials



What specific actions do you plan to implement to strengthen your understanding and enhance your performance on the next exam?

Enter a few actions here

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Wk15: End of semester reflection

End of Course Reflection

Interactive Online Interventions



	What I typically did	What I wish I had done
Before Class		
During Class		
After Class		
Preparing for Exams		

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Wk15: End of semester reflection

End of Course Reflection

Interactive Online Interventions



Grid to guide self-reflection.
Submitted to canvas

	What I typically did	What I wish I had done
Before Class		
During Class		
After Class		
Preparing for Exams		

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Wk15: End of semester reflection

End of Course Reflection

Interactive Online Interventions

Let's begin!



What did you usually do to prepare before each class?

In the first empty space in your table, write down any strategies from the list below that reflect what you actually did before each class.

In the next column, write down any strategies you wish you had used to better support your learning.

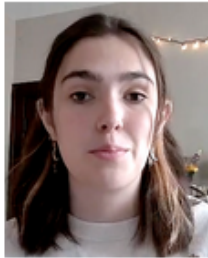
- A. Nothing
- B. Skimmed the relevant textbook sections.
- C. Read the textbook sections and tried to understand them.
- D. Took notes while reading.
- E. Skimmed example problems without trying to understand them.
- F. Read example problems and tried to understand the solutions.
- G. Tried solving example problems before checking the answers.

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Wk15: End of semester reflection



What did you usually do during each class?

In your table, write down how you typically engaged during each class using the list below.

In the next column, write down what you wish you had done to better support your learning and success in the course.

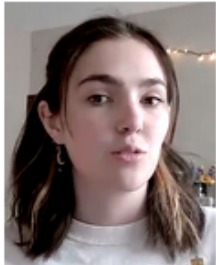
- A. Not much. I mostly attended class for the attendance points.
- B. Took notes to refer to later.
- C. Focused on understanding the material as it was taught.
- D. Did my best to learn the problem-solving strategies taught in class.
- E. Worked with students around me.
- F. Asked the teaching team for help when confused or stuck on a problem.

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Wk15: End of semester reflection



What did you usually do after each class?

In your table, use the list below to describe the strategies you used to complete your **homework** after each class.

In the next column, write down what you wish you had done differently to help you learn more effectively.

- A. Reviewed my notes before starting the homework.
- B. Applied the problem-solving strategies taught in class.
- C. If stuck on a problem, I tried to figure it out on my own (e.g., reviewed notes, watched videos online).
- D. If stuck on a problem, I used AI or Googled the solution.
- E. If stuck on a problem, I asked for help (e.g., classmates, office hours, or learning center).
- F. Reflected on mistakes to avoid repeating them.
- G. Worked with other students.

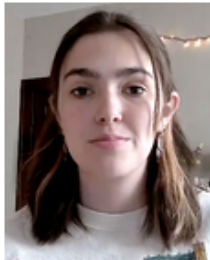
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Wk15: End of semester reflection

We are almost finished!



How did you typically prepare for exams?

In your table, use the list below to describe your typical study habits.

In the next column, note any strategies you wish you had used to improve your exam performance.

- A. Studied in one day instead of spreading it out.
- B. Broke the material into chunks and studied different sections on different days.
- C. Skimmed problem solutions to be sure I understood the steps.
- D. Solved problems on my own before checking the solutions.
- E. Practiced additional problems beyond the assigned homework.
- F. Took a practice exam before studying to identify areas to focus on.
- G. Took a practice exam after studying and treated it like a real exam.
- H. Studied with other students.
- H. Asked questions to clear up confusion (e.g., classmates, office hours, or learning center).

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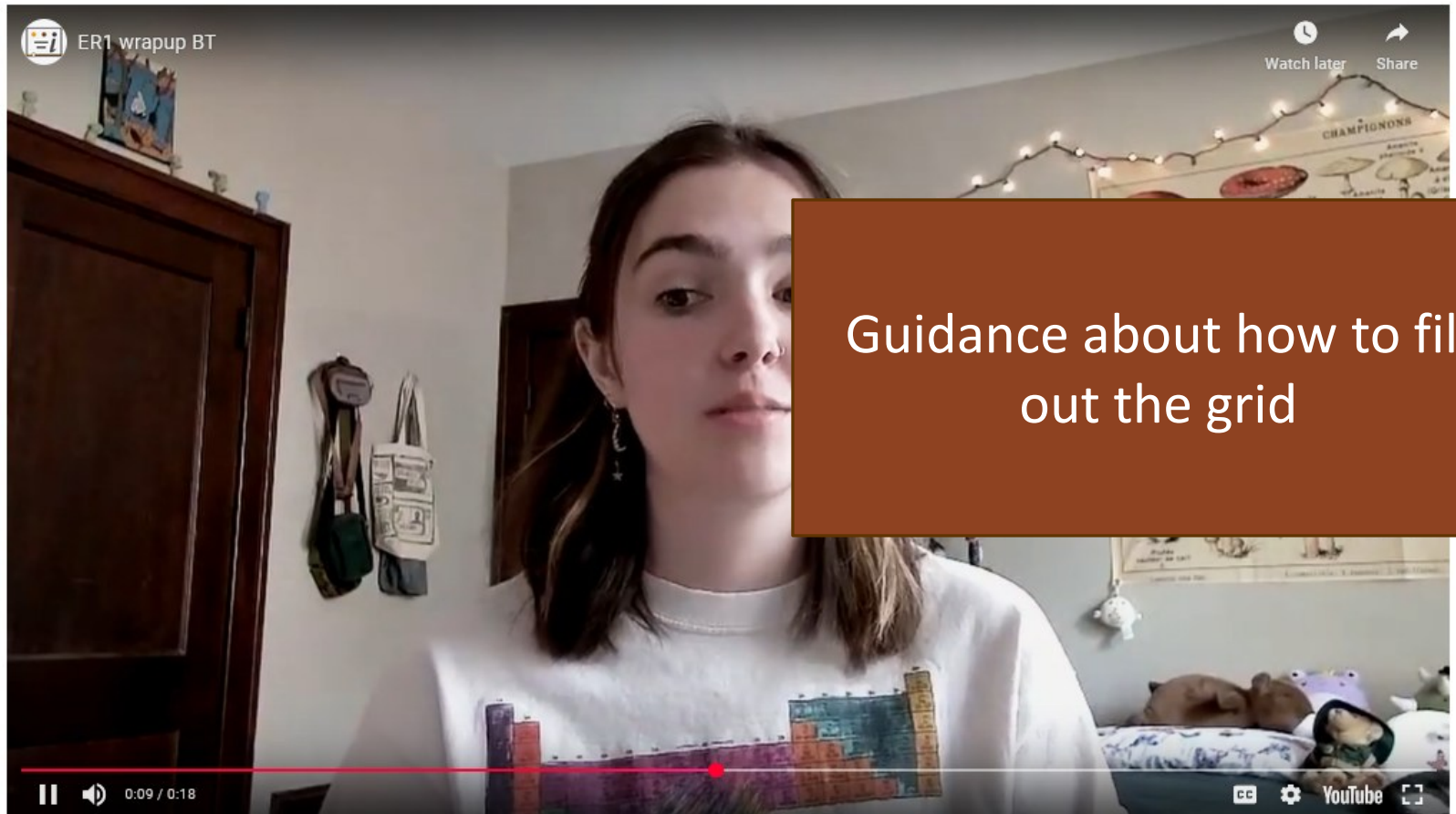
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Wk15: End of semester reflection

End of Course Reflection

Interactive Online Interventions



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Wk15: End of semester reflection

End of Course Reflection

Interactive Online Interventions



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Feedback and improvement

- Students answer questions, meaningfully engage with writing prompts
- Students watch only portions of the videos
- Future:
 - Break up “long” videos (2+ min)
 - Include more engagement, e.g., multiple-choice questions, more reflection prompts
 - Learn from popular science communicators on youtube, e.g., Hank Green

Feedback and improvement

- Students answer questions, meaningfully engage with writing prompts

More detailed results: Kathy Koenig's talk
(next)

- Learn from popular science communicators on youtube, e.g., Hank Green

Questions/comments?

Thank you!

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