PRACTICE REPORT · 9 NOVEMBER 2026

Teaching with generative AI

How we use LLMs in lectures, assignments, exams, master's theses and workshops, with examples from environmental and energy economics

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Students now use generative AI to learn, write and code. We use it in our teaching as well, and we design activities and assessments so that students learn to check what it produces. This note describes six use cases of generative AI in teaching, the materials we use and what we have learned. It is based on our courses *Energy Economics and Policy* (EEP) and *Applied Econometrics in Environmental and Energy Economics* at ETH Zurich, on master's thesis supervision, and on seminars and workshops.

OVERVIEW

SETTING	WHAT WE DO	MAIN LESSON
Lecture preparation	An AI tool such as Claude Code drafts the syllabus and the slides in LaTeX. The lecturer revises each lecture in several rounds, including pen comments on printouts that the AI implements from photos. Lecture recordings are analyzed with an LLM or an app such as Speeko to improve delivery.	The AI writes the first draft. The lecturer's time goes into reviewing it and improving the pedagogy.
Lectures	Students use GenAI with the textbook, slides and news articles, as a chat and as an AI podcast. The class then checks the output against the course material.	AI rarely makes mistakes anymore, so we use tasks where it has to pick a focus. Students mostly found what it left out.
Written exam	Students find our planted errors in a simulated AI answer and explain them with the course material.	The exam tests the skill students practiced in class.
Take-home assignments	Two teams replicate the same paper with GenAI. One defends it, the other attacks it. Presentations, a discussion and questions from the lecturer follow.	An LLM can do the replication easily, so students now have to argue about the paper and show that they understand it.
Master's thesis	We advise students to do the core work themselves. How they use AI is their responsibility, and they disclose it in the thesis. Oral midterm and final exams carry substantial weight in the grade;	We cannot prevent AI use, so we test understanding orally. With AI, students often build complicated models they do not understand.
Seminars & workshops	World Café discussions: participants move between topic tables, moderators stay. AI turns a moderator's handwritten notes into a summary.	14 pages of unstructured notes became a 4-page structured summary within minutes.

AI USE I created this document with the help of AI (Claude), which assisted with structuring, wording and layout. I take responsibility for the content.

01 Preparing lectures

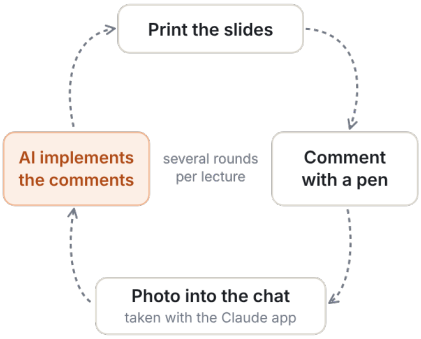
I prepare my slides with an AI tool that works in a folder on my computer, such as Claude Code. The AI writes the first drafts; I revise each lecture in several rounds.

FOR THE WHOLE COURSE

1. **Work folder:** I create a folder on my computer for the AI to work in. Similar lectures and textbooks can go in as examples.
2. **Syllabus:** the AI drafts a detailed syllabus with references.
3. **Slides:** the AI drafts the slides for all lectures in LaTeX.

FOR EACH LECTURE

4. **First look:** I ask the AI to fix obvious things, delete slides, add concepts or rearrange the pedagogical structure.
5. **Pedagogy pass:** the AI edits the slides for pedagogy, on its own or guided by example slides and textbooks in the folder.
6. **Pen comments:** I print the slides, comment on them with a pen and photograph them with the Claude app. The photos go straight into the chat for that lecture, where the AI implements the comments. I repeat this several times.
7. **Final edits:** I make the last changes by hand in the LaTeX file.
8. **Student questions:** I ask the AI to simulate questions students might ask, so that I can prepare for them.



Step 6, the pen-comment loop.

> For more complex issues, it works better to discuss a solution directly in the chat than to send only a photo of the comment.

9. **Delivery:** I record my lectures and analyze them with an LLM or an app such as Speeko to improve vocal delivery, public speaking and structure. Such apps also help more generally to practice public speaking and giving lectures.

02 Lectures: three formats

Each format comes in a basic version and a variant, followed by a discussion in class.

FORMAT A
Textbook + chat

BASIC
“Please summarize chapter 1.”

VARIANT: LEAVE SOMETHING OUT
“Please summarize chapter 1 but do not mention CO_2 emissions.”

Discuss in class: Is the summary correct? Do students notice what is missing?

FORMAT B
News article + textbook + chat

BASIC
“Please explain the newspaper article using chapter 1 of the textbook.”

VARIANT: ARGUMENTS FOR AND AGAINST
“Please find 3 arguments supporting the newspaper article and 3 against the article using chapter 1 of the textbook.”

Discuss in class: Are the explanation and the arguments correct? Is anything important missing? Which arguments are most convincing?

FORMAT C
Textbook → AI podcast

BASIC
“Make a short (3 min) podcast that summarizes the chapter.”
In NotebookLM: Audio Overview → Customize

VARIANT: BIASED HOSTS
“Make a short (3 min) podcast that summarizes the chapter, in which one podcaster is highly liberal and the other one extremely interventionist.”
Good podcasts are harder to get this way.

Discuss in class: Is the summary correct? Which concepts are missing?

03 Example: the EV tax credit

In the US, buyers of electric vehicles (EVs) could claim a federal tax credit of up to $7,500 for a new car and up to $4,000 for a used one. In May 2025, House Republicans proposed abolishing these credits. We discussed this proposal in lecture 9 of EEP (spring 2025), which covers policy choice and evaluation. The session had two parts, one after the other: first the whole class listened to an AI podcast based on the slides and the article (format C), then students worked with the same sources in an LLM themselves (format B).

COURSE MATERIAL

Chapter 9, "Policy Choice and Evaluation", of Filippini & Srinivasan (2024), *An Introduction to Energy Economics and Policy* (open access), or the lecture slides.

NEWS ARTICLE

Reuters, 13 May 2025: "US House Republicans seek to kill EV tax credit, loan program".

TOOLS

NotebookLM for the podcast, Clipchamp for editing, an LLM of the students' choice (e.g., ChatGPT) during the lecture, Mentimeter for polls.

PART 1 AI PODCAST, WHOLE CLASS

1. **Before class:** upload the slides (or chapter) and the article to NotebookLM and generate an Audio Overview (about 5 minutes). Shorten it if needed, e.g., with Clipchamp.
2. **In class:** play the podcast.
3. **Students' word cloud:** "Concepts from the lecture in podcast"
4. **Students' word cloud:** "Concepts from the lecture the podcast missed"

PART 2 STUDENTS CHAT WITH THE SOURCES

5. **Students** upload the slides (or chapter) and the article to an LLM of their choice and use the prompt below.
6. **Students' open answers:** "Any concepts from the lecture that were wrong or missed?"
7. **Students' open answers on the EV tax credit:** "Top pro rebate argument from lecture" and "Top contra rebate argument from lecture," based on GenAI results from prompt (Step 5)
8. **Students' vote:** "What's more convincing: pro or contra rebate?"

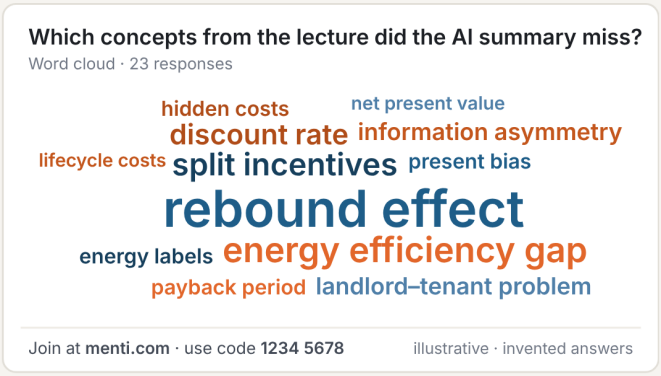
PROMPT USED IN CLASS (STEP 5)

"please 1) explain the reuters article using the concepts from the book attached 2) provide arguments pro and contra for the tax ban using lecture concepts. do not invent things that are not in the article"

LIVE POLLS WITH MENTIMETER

Students join on their phones at menti.com with a code shown on the screen and type their answers. The results appear on the screen as they come in. Steps 3, 4 and 6 to 8 work this way.

In a word cloud, answers given by more students appear larger. Open answers appear as cards, votes as a bar chart.



Invented example: an AI summary of an energy-efficiency chapter was told to leave out the rebound effect.

Results

CHATGPT'S ANSWER TO THE CLASS PROMPT (STEP 5)

ChatGPT produced a table that links facts from the article on the EV tax credit to textbook concepts: subsidies for positive externalities (Ch. 7), learning curves and dynamic efficiency (Sec. 4.4), evaluation criteria (Ch. 9), and externalities and instrument choice (Ch. 2). It then listed arguments for and against repealing the credit, under five headings from the lecture: allocative efficiency, dynamic efficiency, macroeconomic effects, administrative feasibility and acceptance.

WHAT STUDENTS SAID THE AI MISSED

> *"says nothing about distributional issue"*
>
> *"Doesn't emphasize evaluating the policy experimentally to test effectiveness"*
>
> *"Neglects new provisions aimed at decreasing reliance on Chinese technology"*

STUDENTS' BEST ARGUMENTS (CONDENSED, FROM STEP 7, BASED ON AI OUTPUT STUDENTS GENERATED)

For the EV tax credit

- Addresses a market failure
- Effectiveness
- Encourages dynamic efficiency and speeds up innovation
- Promotes clean-technology investment, needed for long-term sustainability

Against the EV tax credit

- Wealthier households benefit more
- Not targeted at low-income households (fairness)
- Macroeconomic impact
- Does not reduce reliance on Chinese technology and suppliers (geopolitical risk)

CLASS VOTE: WHICH SIDE IS MORE CONVINCING?



For the EV tax credit — 16 votes — Against the EV tax credit

WHAT WE LEARNED

1

Students mostly found omissions.

Their comments were about what the AI left out: distributional effects, testing the policy's effectiveness experimentally, and the provisions on Chinese technology.

2

Restricting the AI to the article has a cost.

The instruction "do not invent things that are not in the article" keeps the model close to its sources. In one example, it also kept out lecture concepts the article does not mention, such as income distribution.

3

Asking what the AI missed makes students recall the lecture.

To name missing concepts, students have to remember them. The word cloud shows the lecturer what the class remembers.

04 Exams

The written exam tests the same skill as the lecture activities: checking AI output against the course material. Students see a simulated exchange with an LLM whose answer contains planted errors. They have to find the errors, explain them and cite the course material. The example below has the format of our exam questions but is made up.

HOW THE QUESTION IS BUILT

Plausible errors
The errors sound confident. One confuses two instruments (cap-and-trade and a carbon tax). The other reverses the direction of trade.

Explanation and reference
Finding an error is not enough. Students must explain it and point to the relevant part of the course material.

One correct paragraph
Not all three paragraphs contain mistakes, so students cannot score by marking everything as wrong.

Practiced in class
Students have already checked AI output against the textbook in the lectures.

EXAMPLE (MADE UP) · 10 POINTS · CH. 7, MARKET-BASED INSTRUMENTS

STUDENT QUESTION

"In three concise paragraphs, explain how a cap-and-trade system for CO_2 emissions works and why economists consider it cost-effective."

TASK Identify the two incorrect claims, explain briefly why each is wrong, and cite the course material. Not all three paragraphs contain mistakes.

AI ANSWER, WITH MODEL SOLUTION

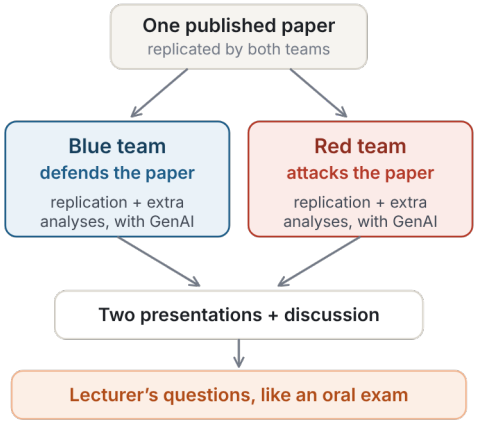
Paragraph 1. Under a cap-and-trade system, the regulator sets a fixed price per tonne of CO_2 that firms must pay for every tonne they emit. Each firm then reduces its emissions up to the point where its marginal abatement cost equals this price, so total emissions are determined by how firms respond. In this way, the regulator controls the cost of compliance, while the market determines the level of emissions.	**× Incorrect** This describes a carbon tax, which fixes the price. Cap-and-trade fixes the quantity (the cap, issued as allowances); the allowance price results from trading.
Paragraph 2. Cap-and-trade is a market-based instrument for correcting a negative externality: without regulation, firms do not bear the costs that their CO_2 emissions impose on society. By requiring firms to hold an allowance for every tonne of CO_2 they emit, it puts a price on emissions and creates an incentive to reduce them. The EU Emissions Trading System is a well-known example.	**✓ Correct** This is the distractor. The externality argument, the allowance requirement and the EU ETS example are accurate.
Paragraph 3. Cap-and-trade is cost-effective because allowances can be traded: firms with low abatement costs buy additional allowances from firms with high abatement costs, which then have to cut their emissions further. In this way, emission reductions are carried out by the firms best able to afford them, and the cap is met at the lowest total cost.	**× Incorrect** The direction of trade is reversed. Low-cost firms abate more and sell allowances; high-cost firms buy them. Trading equalizes marginal abatement costs, so emissions fall where abatement is cheapest.

05 Take-home assignments: red team vs. blue team

In our course *Applied Econometrics in Environmental and Energy Economics*, the take-home assignment used to be replicating a published paper. Now an LLM can write the code and do the replication, so we changed the assignment.

How it works

1. Two teams, red and blue, replicate the same paper. They use GenAI as much as possible.
2. Using their replications and additional analyses, one team prepares to defend the paper and the other to attack it.
3. Both teams present in class, followed by a discussion.
4. The lecturer asks questions, similar to an oral exam.



WHY THIS WORKS

Replication alone shows little
An LLM can write the code, so a working replication no longer shows that a student understands the paper.

Arguing requires understanding
To defend or attack a paper with their own analyses, students need to know which choices the results depend on.

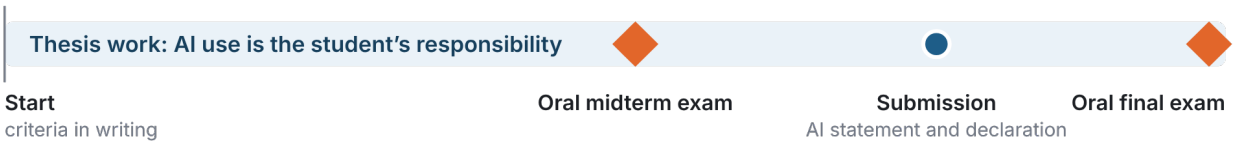
The questions work like an oral exam
As with master's theses, the discussion and the questions show who understands the analysis.

06 Master's theses

For many students, the master's thesis is one of the last chances to spend months on their own research: structuring a paper, writing down a model by hand and working through the code. We advise them to do this core work themselves, because it is also what makes them better at using AI later. AI is useful for background research, for improving the language and for reviewing their own drafts, but it should not write the first draft.

We cannot enforce a ban on AI, so how students use it is their own responsibility. We ask for two things: a short statement in the thesis saying whether they used AI to help with writing or coding, and a short declaration that they have read the whole thesis and understand its concepts.

An oral midterm exam and an oral final exam, in which students have to explain their work, carry substantial weight in the grade. At the start of the thesis, we give each student the assessment criteria and their weights in writing, as the programme regulations require. We often see students use AI to build very complicated models that they do not understand, and the oral exams reveal this quickly. Many PhD students learned the same lesson before LLMs existed: a simple model is often sufficient.



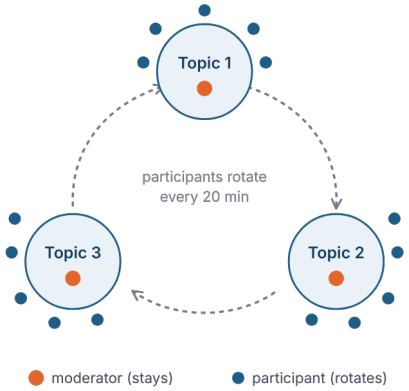
The two oral exams carry substantial weight in the grade.

07 Seminars and workshops

In seminars and at conferences and workshops, we use the World Café format for structured group discussions. At one workshop, I used AI to turn my handwritten notes into a summary.

How the World Café works (example from a workshop)

1. At the end of the workshop, we set aside one hour for group discussions.
2. The 15 participants were split across three tables, each with its own topic and moderator.
3. After 20 minutes, participants moved to another table. The moderators stayed and carried the previous group's points into the next round.
4. Each topic built up over three rounds, and every participant contributed to all three topics.



From handwritten notes to a summary

I moderated one table and took 14 pages of handwritten notes. After the session, I photographed the notes with the Claude app and asked it for a summary. Almost instantly, it produced a 4-page document with an executive summary. The quality was high, and it needed only minor edits before I sent it to all participants.

Because moderators stay at their table for all three rounds, their notes contain input from every participant. The summary captured the main points of the whole session within minutes after it ended.



08 Tools and references

TOOL	USE	SETTING
LLMs (e.g., ChatGPT; students choose)	Summaries, explaining news articles with textbook concepts, arguments for and against; code for replications and additional analyses	Lectures, assignments, theses
Claude Code	Drafting the syllabus and the LaTeX slides in a folder on the lecturer's computer, then revising them	Lecture preparation
Speeko	Feedback on recorded lectures (vocal delivery, public speaking, structure); practicing public speaking	Lecture preparation
NotebookLM	AI podcast (Audio Overview) from slides or a book chapter and a news article	Lectures
Clipchamp	Shortening the podcast if needed	Lectures
Mentimeter	Live polls on students' phones: word clouds, open questions, votes	Lectures

TOOL	USE	SETTING
Claude app	Summary from photos of handwritten notes; photos of pen comments on printed slides	Workshops, lecture preparation

REFERENCES

Filippini, M., & Srinivasan, S. (2024). *An Introduction to Energy Economics and Policy*. Cambridge University Press. Open access. doi.org/10.1017/9781009471831

Shepardson, D. (2025, May 13). US House Republicans seek to kill EV tax credit, loan program. *Reuters*. reuters.com/sustainability/us-house-republicans-seek-kill-ev-tax-credit-loan-program-2025-05-13

Appendix: prompts and poll questions

Replace “chapter 1” with your chapter. Students first upload the chapter (or slides) and, if needed, the news article.

PURPOSE	PROMPT
Summary Format A · basic	Please summarize chapter 1.
Summary with an omission Format A · variant	Please summarize chapter 1 but do not mention CO_2 emissions.
Explain a news article Format B · basic	Please explain the newspaper article using chapter 1 of the textbook.
Arguments for and against Format B · variant	Please find 3 arguments supporting the newspaper article and 3 against the article using chapter 1 of the textbook.
Podcast Format C · basic · in NotebookLM under Audio Overview → Customize	Make a short (3 min) podcast that summarizes the chapter.
Podcast with biased hosts Format C · variant · adapted wording	Make a short (3 min) podcast that summarizes the chapter, in which one podcaster is highly liberal and the other one extremely interventionist.
Class activity, EEP lecture 9 Example in section 03 · verbatim	please 1) explain the reuters article using the concepts from the book attached 2) provide arguments pro and contra for the tax ban using lecture concepts. do not invent things that are not in the article

Mentimeter questions used in lecture 9 (“rebate” = the EV tax credit)

TYPE	QUESTION
Word cloud	Concepts from the lecture in podcast
Word cloud	Concepts from the lecture the podcast missed
Open question	Any concepts from the lecture that were wrong or missed?
Open question	Top pro rebate argument from lecture
Open question	Top contra rebate argument from lecture
Vote	What’s more convincing: pro or contra rebate?