GAI Learning Objectives in Science Education in Upper Secondary School

This presentation is based on Joakim Lund Bækgaard's project "GAI in Physics Education at STX"; Master's in Science Education, University of Copenhagen 2026; Supervisor: Jesper Bruun.

Background

Situation

Generative AI (GAI) has become a fixed part of students' schoolwork. In upper secondary school 9 out of 10 students use GAI regularly. 2 out of 3 have used it in a way they themselves regard as cheating (EVA 2026).

Research points in two directions at once: GAI can both support and enrich students' learning and lead to a loss of academic depth if thinking is *outsourced* to the machine. (Dalsgaard and Prilop 2025)

GAI plays a significant role in the world for which we are educating our students.

Claim

The education system should not treat GAI merely as an external factor affecting teaching, but also as a goal in its own right

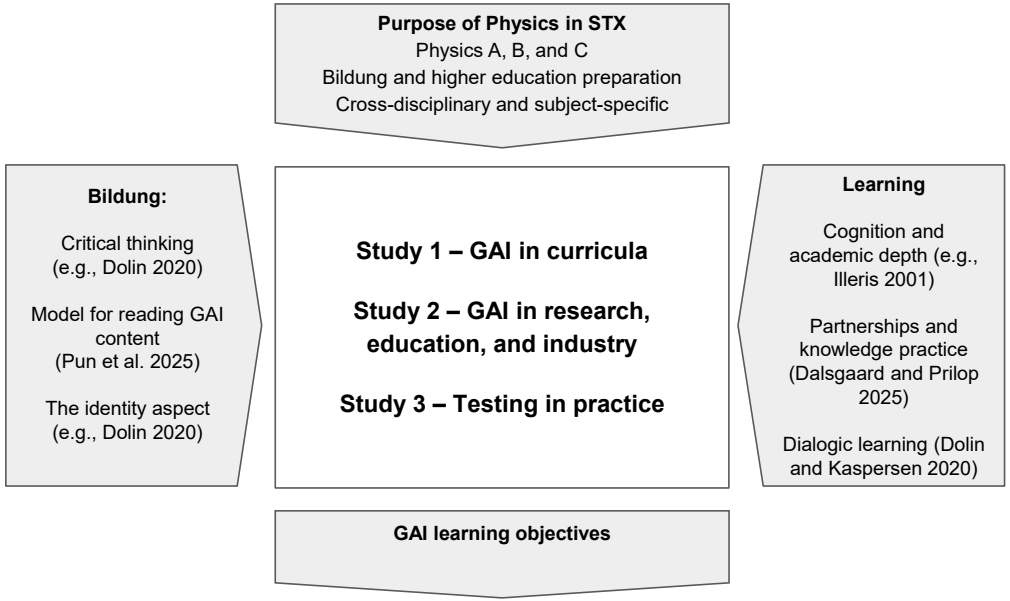
Therefore, it is essential to discuss: What should students actually learn about, with, and alongside GAI?

The seven proposed GAI learning objectives

Students should be able to:

1. Search for physics-related information with GAI and verify it by drawing on both physics knowledge and knowledge about GAI.
2. Use GAI to search literature and summarise texts in order to gain an overview of a new topic or problem.
3. Use GAI when producing texts and other products.
4. Use GAI to assess and qualify ideas, texts, and analyses.
5. Use GAI in data analysis and modelling.
6. Use GAI as support in project work.
7. Use GAI as support for acquiring new competencies, e.g. when programming simulations.

The goals are intended to follow a progression: goal 1 belongs early (physics C / first year), goals 2–5 relate to physics B, goal 6 to larger interdisciplinary projects (SRP/SRO), and goal 7 to physics A.



Methodology inspired by Educational Design Research (McKenney & Reeves)

Other important findings

- Two concepts are central for the analyses (after Dalsgaard & Prilop 2025): **partnership**, where the student uses GAI reflectively and critically and engages more deeply with the material, and **outsourcing**, where the task is handed over to GAI at the expense of the student's own learning.
- The students who enter into a genuine *partnership* with GAI experience the greatest benefit.
- The professional physicist employed many of the same approaches to working with GAI as the students, but at an expert level. (e.g. explanation, feedback, producing, inspiration...)
- The GAI learning objectives are a natural extension of the existing objectives in the STX curricula. BUT there is a conflict between the GAI and current examination regulations.
- The GAI objectives can be implemented in practice without compromising the subject's other aims
- Factual knowledge and polished products are losing value, because GAI makes them available to everyone. Deep *physics understanding* becomes what truly distinguishes the capable from the not so capable.
- A central insight is that students are strongly motivated when teaching makes their new understanding and mastery visible — and that they then more often choose partnership over outsourcing.

Example of tasks

GAI objektive 1

Search for physics-related information with GAI and verify it by drawing on both physics knowledge and knowledge about GAI.

- The activity worked as intended.
- The students were engaged during both the first and second tasks.
- There was great dialogue with the students, both regarding the use of GAI and the academic topic itself.
- For example, the students received different answers regarding the size of the atom. This led to a discussion about whether one of the answers was incorrect, or if the discrepancy could add nuance to our understanding of the atom.
- Even engaged students often take the easy route and skip verification when it feels cumbersome.

1. Research on Atomic Structure with AI

Task 1 - Research on atomic structure using AI, Physics book, etc.
We need to master some basics about atoms:

1. Copy the list of questions below into your preferred AI.
2. Paste the response into column 2 (Individual).

Questions	AI Response	Verification, Adjustment, and Source
1. What does an atom consist of?		
2. What is a nucleon?		
3. How large are atoms?		
4. How large is an atomic nucleus?		
5. What is a "unit"?		
6. What is the mass of an atom in units and in kg?		
7. What are Z, A, and N, and how do we use them to describe atoms?		
8. Which formula describes the relationship between Z, A, and N?		
9. What are isotopes? (Use Z, A, and N in the explanation)		
10. What are elements? (Use Z, A, and N)		
11. What does ^{12}H mean?		

Next steps:

1. Compare answers with your partner.
2. Use your *physics book* (pages 216 and 221-223) to verify and supplement your answers.
3. Supplement with Wikipedia if necessary.

Task 2 - Draw and present a model of an Atom
Draw a model of an atom on a whiteboard. Include as much information as possible from the previous task. Present your model to another group.

Example of tasks

GAI objektive 6

Use GAI as support in project work.

- This task did not work as intended.
- The students politely completed it the first time, but did not continue to use the logbook throughout the course.
- The task was too far removed from established practices.
- GAI was introduced too early in the course.
- The task should have been more elaborated.
- The objective should have been more elaborated.

2. SRO Assignment Formulation

You are about to start your SRO (Specialized Study Project). In your paper, you must address the overarching research question:

How can differential equations be used to model radioactivity?

Your response must, among other things:

- Explain the most important physical concepts and mechanisms associated with radioactivity.
- Explain what a first-order differential equation is, and outline the general solution to this type of differential equation.
- Based on the above, establish a model for the number of parent nuclei in a radioactive sample as a function of time.
- Test the established model experimentally using Ba*-137.
- Discuss the real-world applications and limitations of the model.

Log: Questions and Answers on Nuclear Physics

Use this log to continuously record questions and answers regarding your investigation. You are encouraged to use AI as part of your research. When doing so, it is crucial to verify that the information you receive is accurate. To help you with this, the table below is divided into three columns:

1. **First column:** Record your questions.
2. **Second column:** Paste the response generated by the AI.
3. **Third column:** Document your verification process, note any corrections needed to ensure accuracy, and cite your sources.

Questions	AI Response	Verification, Adjustment, and Source
e.g., what is radioactivity?		

GAI in exam questions

GAI objektive 1

Search for physics-related information with GAI and verify it by drawing on both physics knowledge and knowledge about GAI.

- A new initiative
- I hope to gain some experience with the task tomorrow.

3. Part of exam resource:

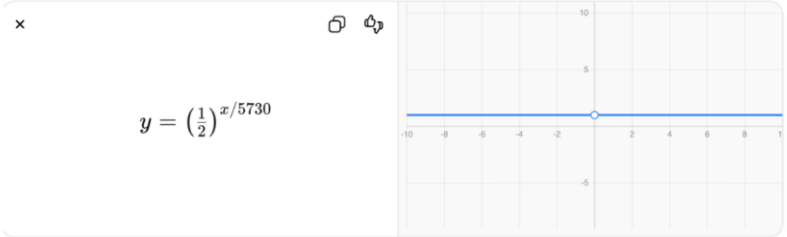
Here is ChatGPT's response to the prompt: *"Give a very brief explanation of the carbon-14 dating method. The response must include a graph."*

How would you evaluate the accuracy and precision of the text and graph?

"The carbon-14 method is used to determine the age of dead organic material.

When an organism dies, it ceases to absorb new carbon-14. Consequently, the substance's activity (the number of radioactive decays per second) decreases over time. By measuring the remaining activity, the age of the material can be calculated.

The graph illustrates the exponential decay of carbon-14:



The half-life of carbon-14 is approximately 5,730 years, meaning the activity is halved every 5,730 years. This method is widely used in fields such as archaeology to date historical findings."