STIAEM

Slow Tech Innovation

AI, Ethics and

New Teaching Methods

Safeguarding Adolescent Cognitive Effort against Algorithmic Dependency

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Università di Foggia

Studi Umanistici, Lettere, Beni Culturali, Scienze della Formazione

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Scienze della Formazione

OER 3.3.2: Safeguarding Adolescent Cognitive Effort against Algorithmic Dependency
Reference Module: Module 3 - AI Ethics and Systemic Biases
Related Video-Pill: Video 3.3 - Fairness, Biases and Cognitive Effort
Authoring partner: Directorate of Secondary Education of Dodecanese - Greece
Topic / Thematic Focus: Safeguarding cognitive effort, adolescent algorithmic dependency and cognitive offloading

Introduction and Learning Objectives

This resource completes the path of Module 3 and accompanies video-pill 3.3 "Fairness, Biases and Cognitive Effort". After discussing the biases of systems, attention here shifts to the student: what happens to adolescents' cognitive effort when a generative assistant is always available to supply the ready-made answer? The thesis is that effort is not an obstacle to be eliminated, but the very mode of learning.

The text connects to DigComp 3.0 (Cosgrove & Cachia, 2025), in particular to the verification responsibility of the person using an AI system, and to the UNESCO (2021) perspective on human impacts. The ALTAI (European Commission, 2020) and the framework for teachers (Miao & Cukurova, 2024) offer the references for a use that returns to the student, and not to the machine, the labour of understanding.

By the end of the reading, teachers will be able to:

- recognise the difference between the "Google" effect on memory and the qualitative leap introduced by generative models;
- distinguish automatic delegation, which replaces the learning process, from desirable difficulties, which strengthen it;
- design activities that introduce deliberate friction, protecting adolescents' cognitive autonomy.

1. From the Google effect to the qualitative leap of generative models

Even before generative AI, cognitive psychology had documented a transformation in the relationship with knowledge. The study by Sparrow, Liu and Wegner (2011) shows that, when we know that information is easily retrievable online, we tend to remember it less in itself and to remember better where to find it: memory leans on an external source. This is the so-called "Google" effect: not an absolute loss, but a redefinition of memory's task, which shifts from content to access.

Generative models, however, take a further step. A search engine returns a list of sources and requires choosing, comparing, synthesising: the effort remains with the student, who must assess the relevance of the results. A generative assistant delivers the synthesis, the connection, the conclusion directly. It does not indicate where to find the datum: it provides it. This eliminates not only the retrieval of information, but also the cognitive operation that turned it into knowledge.

The difference compared with the past is one of degree, but the threshold has been crossed. If once the tool provided the map - and the student had to traverse it -, today it provides the destination. For an adolescent, who is building their own structures of self-regulation, this uninterrupted availability is a new environment, for which they are prepared neither by evolution nor, often, by education. This is why the question concerns not only the learning of content, but cognitive development itself.

2. What is lost when one delegates

The operations that are replaced are precisely those that produce learning: selecting relevant information, comparing perspectives, formulating a hypothesis, synthesising, arguing. If these operations disappear, the illusion of competence remains: the student possesses the product - the text, the solution - but not the process, and has therefore not built the cognitive structures that they would have built by carrying it out.

This dynamic has a counterpart in the question of bias discussed in OER 3.3.1. If learning is assessed through wrong proxies - such as time spent on the platform or the number of clicks -, the system optimises that parameter and not actual learning. Mehrabi and colleagues call this measurement bias: "Measurement, or reporting, bias arises from how we choose, utilize, and measure particular features" (Mehrabi et al., 2021). Choosing to measure engagement with clicks means measuring what is easy to count, not what counts: real cognitive effort remains invisible.

"CS1.2.10: Recognise that AI systems may produce inaccurate outputs, even when apparently plausible, and that final responsibility for verifying the quality and validity of the information and content generated lies with the person using the AI system" (Cosgrove & Cachia, 2025).

The DigComp 3.0 descriptor shifts verification onto the person: it is the student, not the machine, who must check. But verifying requires competence, and competence is built only through exercise - that is, through the very effort we are trying to protect. There is a short circuit here to break: if AI eliminates the effort that would be needed to use its results critically, it undermines precisely the condition of its own conscious verification.

The literature shows that automatic systems can distribute error unequally across groups of students (Buolamwini & Gebru, 2018).

3. Desirable difficulties: effort as the mode of learning

The psychology of learning has shown that certain difficulties - precisely called desirable difficulties - favour more lasting memorisation and more effective transfer, because they force active retrieval and deep processing. Retrieval from memory, reformulation, comparison of alternative hypotheses: these are efforts that slow down in the short term and strengthen in the long term. Systematically eliminating these efforts in order to make the task "fluent" does not help the student: it takes away their exercise.

The pedagogical point is therefore to overturn the current intuition. The obstacle to be removed is not cognitive labour, but accessory labour - that due to confusing instructions, poorly defined tasks, useless overload. Productive labour, the one that accompanies understanding, must instead be protected. The principle that follows can be formulated thus: effort is the mode of learning, not the obstacle.

Distinguishing productive labour from accessory labour is a delicate but necessary operation. Accessory, and to be removed, is the labour that arises from unclear instructions, from confusing interfaces, from tasks overloaded with irrelevant elements. Productive, and to be protected, is the labour that accompanies understanding: trying to remember, reformulating in one's own words, identifying an objection, comparing two theses. The same activity can contain both; the teacher's craft is to separate them and lighten only the first.

4. Designing friction: operational guidance

If protecting effort is the objective, designing deliberate friction is the method. A first device is the order of operations: the student formulates their own hypothesis, judgement or synthesis first, and only afterwards compares with the AI. In this way the machine does not replace the process, but verifies it. A second device is use agreements: shared rules that establish for which tasks AI is allowed and for which it is excluded, turning prohibition into an educational agreement.

A third device is metacognition: asking the student not only for the result, but for a description of the process followed - how they selected, what they verified, where they changed their mind. Bringing one's own control strategies to the surface is the most direct way to train self-regulation, which in adolescence is still under construction. A fourth device is process assessment: observing and assessing how the student selects, compares and argues, not only the final outcome.

There is then a relational dimension that must not be neglected. For many students the digital assistant is perceived as a competent and always-available voice, which does not judge and does not tire: an apparently ideal interlocutor. The teacher, by comparison, may appear slower and more demanding. Recognising this dynamic allows it to be named with students, without moralising, and to value what the machine does not offer: the educational relationship, the question that opens up thought, personalised feedback.

5. Adolescents and self-regulation: the role of the school

Adolescence is the phase in which the functions of cognitive control are consolidated: planning, inhibiting the impulsive response, monitoring one's own learning. An environment that always offers the ready-made answer does not train these functions; indeed, it bypasses them. This is why the theme is not only didactic, but one of protecting development: protecting adolescents' cognitive effort means protecting the possibility that they become adults capable of thinking autonomously.

The school has a specific responsibility here, consistent with the UNESCO principles (2021) and with the framework for teachers (Miao & Cukurova, 2024): educating for a use of AI that increases the capacity to think instead of replacing it. Concretely, this means providing for AI-free moments, teaching students to recognise the temptation of automatic delegation, and making explicit the criteria for distinguishing when assistance helps and when it hinders. The aim is not to demonise the tool, but to return control of it to the learner.

Assessment too must be rethought coherently. If we reward only the finished product, the rational student - and today also the one who uses AI - will be led to optimise the product, not the process. Assessing the process means asking for the reconstruction of the path, the justification of choices, the description of errors encountered and corrected. This is not gratuitous complication: it is the way to make the effort we wish to protect worthwhile again, also in terms of school results.

Phase	Risk of dependency	Teaching safeguard	Success indicator
Before the activity	Operating without one's own hypothesis	Formulating your own hypothesis or judgement first	The student has a position to compare
During the activity	Accepting the output without verification	Protocol of verification and comparison	The output is checked, not merely copied

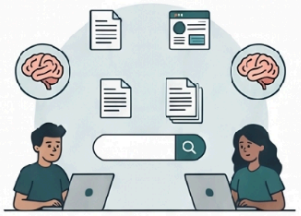
After the activity	Loss of the memory of the process	Metacognitive reconstruction of the path	The student can explain how they arrived at the result

Visual Scaffolding

Safeguarding Adolescent Cognitive Effort Against Algorithmic Dependency

Generative AI transitions technology from providing information access to delivering automated synthesis, risking the loss of critical thinking in adolescents. To protect cognitive development, educaturs must embrace "desirable difficulties," separate productive struggle from accessory labor, and integrate deliberate pedagogical friction into instructional design.

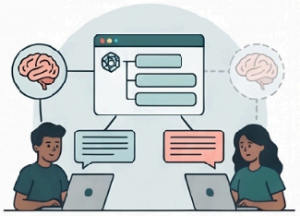
1. The Cognitive Challenge: From Access to Delegation



SEARCH

The Shift from Search to Automated Synthesis:

Search engines required source selection, generative AI delivers pre-packaged conclusions, bypassing mental processing.



AI DELEGATION



Effort is the Mode of Learning

Eliminate accessory labor like confusing instructions, but strictly protect productive cognitive struggle.



Leverage "Desirable Difficulties"

Active memory retrieval and reformulation slow immediate tasks to build durable, long-term understanding.

2. Actionable Framework: Designing Deliberate Friction

Strategies for Deliberate Friction



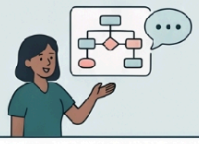
Mandate hypothesis-first workflows.



Establish clear usage agreements.



Assess metacognitive reflection over outputs.

Phase	Risk of Dependency	Teaching Safeguard
Before Activity 	Operating without an initial position	Formulate student hypothesis or judgment prior to AI exposure
During Activity 	Uncritical acceptance of output	Apply systematic verification protocols and source comparison
After Activity 	Loss of cognitive process memory	Require metacognitive reconstruction explaining how results were reached

Gemini Notebook

Conclusions and Metacognitive Reflection Prompts

Protecting adolescents' cognitive effort does not mean rejecting AI, but placing it in the right position: after thought, not in its place. The "Google" effect had already shifted memory from content to access; generative models risk shifting understanding too, if not safeguarded. Desirable difficulties remind us that productive labour is the mode of learning. Designing friction, through order of operations, use agreements, metacognition and process assessment, returns to the student the autonomy that belongs to them.

To design a use that protects cognitive effort:

- In which activity of your subject could you reverse the order, having the hypothesis formulated first and using AI only afterwards as verification?
- How would you distinguish, with your students, productive labour from accessory labour?
- What use agreement - clear and shared - could you propose to establish when AI is allowed and when it is not?

Technical Metadata Sheet

Metadata Field	Specification / Parameter Value
Identifier	OER 3.3.2
Title	Safeguarding Adolescent Cognitive Effort against Algorithmic Dependency
Creator	Directorate of Secondary Education of Dodecanese - Greece
Description	Closing Module 3, the resource shifts attention to the student: what happens to adolescents' cognitive effort when a generative assistant is always ready to supply the answer. It distinguishes the Google effect on memory from the qualitative leap of generative models, and contrasts automatic delegation with desirable difficulties. The practical focus is on designing activities with deliberate friction that protect cognitive autonomy and self-regulation.
Keywords	cognitive effort; algorithmic dependency; desirable difficulties; Google effect; cognitive autonomy; self-regulation; deliberate friction; adolescence
Language	EN (English)
Affiliation	Directorate of Secondary Education of Dodecanese - Greece
Contributor	STIAEM Transnational Scientific Board (peer review, Rhodes validation protocol)
Media Format	Text; Infographics
Genre	Training Manual; Educational Guide
URL	
Citation	Cosgrove, J., & Cachia, R. (2025). DigComp 3.0: European digital competence framework (Fifth edition). Publications Office of the European Union. https://data.europa.eu/doi/10.2760/0001149 European Commission. (2020). Assessment list for trustworthy artificial intelligence (ALTAI) for self-assessment. https://digital-strategy.ec.europa.eu/en/library/assessment-list-trustworthy-artificial-intelligence-altai-self-assessment Mehrabi, N., Morstatter, F., Saxena, N., Lerman, K., & Galstyan, A. (2021). A survey on bias and fairness in machine learning. ACM Computing Surveys, 54(6), Article 115. https://doi.org/10.1145/3457607 Miao, F., & Cukurova, M. (2024). AI competency framework for teachers. UNESCO. https://doi.org/10.54675/ZJTE2084 Sparrow, B., Liu, J., & Wegner, D. M. (2011). Google effects on memory: Cognitive consequences of having information at our fingertips. Science, 333(6043), 776-778. https://doi.org/10.1126/science.1207745
Educational Level	Secondary School
Associated Module / MOOC Video Lesson	Module 3 - AI Ethics and Systemic Biases / Video 3.3 - Fairness, Biases and Cognitive Effort
Learning Objectives	recognise the difference between the 'Google' effect on memory and the qualitative leap introduced by generative models; distinguish automatic delegation, which replaces the learning process, from desirable difficulties, which strengthen it; design activities that introduce deliberate friction, protecting adolescents' cognitive autonomy.
Rights	Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0)
Date Available	14/09/2026
Date Modified	

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