STIAEM

Slow Tech Innovation

AI, Ethics and New Teaching Methods

# Digital Civic Education Modules for Conscious and Sustainable Use of Computational Resources

Co-funded by the European Union

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OER 5.3.2: Digital Civic Education Modules for Conscious and Sustainable Use of Computational Resources
Reference Module: Module 5 - Safety, Privacy and Sustainability
Related Video-Pill: Video 5.3 - Ecological Footprint & Civic Education
Authoring partner: Konak Science and Art Center (BILSEM) - Türkiye
Topic / Thematic Focus: Digital civic education, sustainable computational resources and environmental awareness

## Introduction and Learning Objectives

This resource completes video-pill 5.3 and accompanies OER 5.3.1. If the previous resource quantified the environmental footprint of AI, this one translates its implications into digital civic education modules: classroom paths in which the sustainability of technologies becomes an object of study, discussion and action.
The text connects to DigComp 3.0 (Cosgrove & Cachia, 2025) and to its Area 4 «Safety, well-being and responsible use», which expressly includes the environmental impact of digital technologies (competence 4.4), and to the recommendations on digital citizenship (competences 2.3 and 2.5). On the scientific level it takes up Strubell et al. (2019), Schwartz et al. (2020) and Luccioni et al. (2022).
On the institutional level, the reference is the OECD report (2022) on measuring the environmental impacts of computing and of artificial intelligence applications.
By the end of the reading, the teacher will be able to:

- design digital civic education modules centred on the sustainability of technologies;
- link the activities to the competences of DigComp 3.0 and to the scientific evidence on the footprint of AI;
- guide the class from the analysis of a problem to the choice of concrete and documented actions.

## 1. Why a civic module on digital sustainability

Civic education deals with what concerns coexistence and shared responsibilities. Digital sustainability belongs fully to this field, because the use of technologies has collective consequences: energy consumption, emissions, exploitation of resources. Teaching it means showing students that their daily choices - a device, a service, an AI model - have a measurable weight.
The starting point is a fact: research on deep learning is growing at unsustainable rates and has a significant carbon footprint (Schwartz et al., 2020). From this comes the need to train a citizenship capable of reading these numbers and acting accordingly.
A civic module on digital sustainability has a characteristic that makes it particularly suitable for schools: it starts from concrete and verifiable experiences. It does not ask students to adhere to an abstract ideal, but to observe data, compare alternatives and assess their consequences. It is an approach that develops critical thinking and responsibility at the same time, two central goals of civic education.

## 2. The competence framework: DigComp 3.0 and Area 4

DigComp 3.0 offers the reference framework. The framework organises digital competences into five areas and twenty-one competences, articulated across four levels of proficiency. Area 4 explicitly includes environmental impact.

«DigComp 3.0 has five competence areas: (i) information and data literacy; (ii) communication and collaboration; (iii) digital content creation; (iv) safety, well-being and responsible use, including the environmental impact of digital technologies; and (v) problem solving. These are further divided into 21 competences» (DigComp 3.0, It. trans. 2025).

Within Area 4 the relevant item is competence 4.4, «Environmental impacts of digital technologies». The framework also links digital devices to sustainability and the green transition and asks that people be informed about the energy consumption of the technologies they use, according to the principles of the European Declaration on Digital Rights and Principles. It is the institutional basis of a sustainable digital civic education.

The learning model is therefore not the mere transmission of information, but the ability to exercise active citizenship also through technologies, as indicated by the competences dedicated to digital behaviour and participation (DigComp 3.0, competences 2.3 and 2.5).

The European framework also offers a model of progression: competences are articulated across four levels of proficiency and grow by degrees. For the school this means that a path on digital sustainability can start with simple tasks - recognising that devices consume energy - and develop into more complex activities, such as comparing the impact of two solutions or formulating a request for transparency. The same progressive structure helps to differentiate teaching.

## 3. Four modules for the classroom

An effective path is articulated in progressive modules, each with a recognisable objective. The first is a digital citizenship module: what it means to behave responsibly online, and which rights and duties concern us. The second is a computational efficiency module, which introduces the Green AI proposal: measuring accuracy and efficiency together and asking whether the most powerful result is always the best (Schwartz et al., 2020).

The third module concerns the environmental impact in the strict sense: energy, carbon, water and materials. Here the data of Strubell et al. (2019) and Luccioni et al. (2022) come in, showing how much it costs to train a model and how much of the cost escapes official accounting. The fourth module is on action and transparency: asking for open data on the impact of the services used and translating awareness into concrete choices.

«We advocate increasing research activity in Green AI—AI research that is more environmentally friendly and inclusive» (Schwartz et al., 2020).

A well-built module does not stop at denouncing the problem. It leads the class to measure, compare, decide and document: digital sustainability becomes a practised competence, not a slogan.

The sequence of modules is not rigid: it can be adapted to the age of the students and to the host discipline. In a younger class, the emphasis will fall on awareness and behaviours; in an advanced class, one can insist on measurement and critical analysis of sources. What remains constant is the movement that leads from knowledge to action: this is what distinguishes a civic education module from an informative lesson.

For the modules to work, it is advisable to anchor them in real contexts and visible products. A survey on the use of devices at school, a class campaign to reduce energy waste, a public

comparison of the results: these are activities that make learning meaningful and that, at the same time, produce a concrete benefit for the institution. The path thus leaves the classroom and becomes an experience of citizenship.

## 4. From knowledge to action: designing a path

The design follows a simple cycle: explore a fact, understand its meaning, try an alternative, assess the outcome, communicate it. For example, the class can estimate the energy consumption of its own digital activities in a week, compare two ways of carrying out the same task and calculate the saving achieved. In this way the competences of Area 4 are intertwined with those of citizenship and collaboration.

The external framework is not only regulatory. The OECD report of 2022 on measuring the environmental impacts of computing and of AI applications, available as an online reference, indicates the need for reliable and comparable data: transparency is the precondition of an informed choice. We take up its meaning in paraphrase, without textual quotations.

A final note concerns inclusion. The same evidence that shows the environmental cost also shows the economic one: the largest models are accessible to few. Educating for a sober and efficient use also means educating for a fairer use, consistent with the principle of «Fair IT» of the Slow Tech model.

The link with sustainability also offers an opportunity to rethink assessment. If a module aims to develop capacities of analysis and action, it will be coherent to assess the quality of the process and not only the correctness of the result. A rubric that considers the relevance of the data collected, the clarity of the arguments and the effectiveness of communication makes visible what really matters and orients students towards more aware work.

## 5. Assessing a digital civic module

A module of this kind is assessed not with a factual test, but with a product and a process. The product can be a class report, a poster, an information campaign or a request for transparency to a provider. The process can be documented with a diary of choices: which data we collected, which alternatives we compared, which decision we took and why.

The following table proposes four modules, their anchoring in DigComp 3.0 and the expected product.

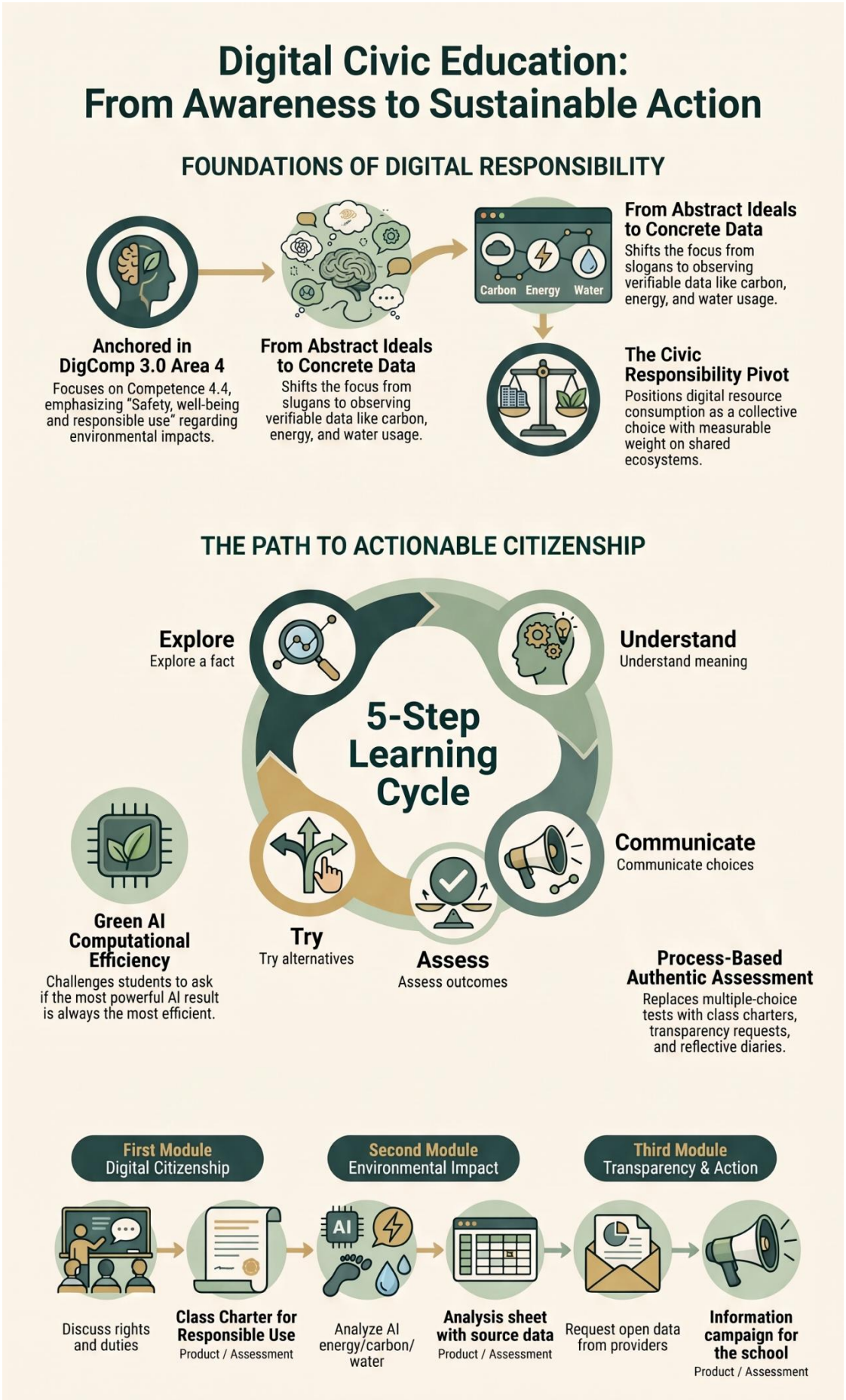
A final recommendation concerns the role of the teacher: a module of this kind works better when the teacher places themselves in the position of one who learns together with the class. They do not possess all the answers on the consumption of digital services, and it is not necessary that they do. Their professional task is to guide the method - how a figure is sought, how it is verified, how it is discussed - letting the conclusions emerge from the common work. It is in this stance that digital citizenship is transmitted as a practice, not as content to be repeated.

For a module of this kind to take root, it is advisable to insert it into a whole-school plan and not into an isolated initiative. If digital sustainability appears in the curriculum, in the educational agreements and in the school's purchasing choices, students perceive it as a shared value and not as the passing enthusiasm of a single teacher. The coherence between

what is taught and what the school practises is, in civic education, the most effective form of teaching.

| Civic module | DigComp 3.0 area/competence | Classroom activity | Product/assessment |
|---|---|---|---|
| Digital citizenship | 2.3 Exercising citizenship; 2.5 Digital behaviour | Discuss rights and duties in the use of technologies | Class charter for responsible use |
| Computational efficiency | Area 4; Green AI proposal | Compare two solutions for the same task | Estimate of the saving achieved |
| Environmental impact | 4.4 Environmental impacts of digital technologies | Analyse the energy, carbon and water of AI | Analysis sheet with data from the sources |
| Transparency and action | 4.2 Protecting data and privacy; Area 4 | Ask for open data and communicate the choices | Information campaign or request for transparency |

## Visual Scaffolding



## Conclusions and Metacognitive Reflection Prompts

This resource has translated the environmental question into digital civic education modules. DigComp 3.0 has taken up the environmental impact of technologies as a competence of Area 4, linking sustainability to citizenship; the scientific evidence of Strubell, Schwartz and Luccioni provides the data to discuss it in class. An effective module leads from knowledge to action: it measures, compares, decides and documents, making sustainability a practised competence.

To transfer these core ideas to one's own practice, the following reflection prompts are proposed:

- Which discipline at your school could host a civic module on the environmental impact of technologies?
- How would you make measurable, for students, the consumption of their digital activities?
- Which final product - report, poster, request for transparency - would best assess digital citizenship competences?

## Technical Metadata Sheet

| Metadata Field | Specification / Parameter Value |
|---|---|
| **Identifier** | OER 5.3.2 |
| **Title** | Digital Civic Education Modules for Conscious and Sustainable Use of Computational Resources |
| **Creator** | Konak Science and Art Center (BILSEM) - Türkiye |
| **Description** | Complementing OER 5.3.1, the resource translates the environmental footprint of AI into digital civic education modules in which the sustainability of technologies becomes an object of study, discussion and action. It links the activities to the DigComp 3.0 competences and Area 4 and presents four modules for the classroom. The practical focus is on guiding the class from analysis of a problem to documented concrete action, including criteria for evaluating a civic module. |
| **Keywords** | digital civic education; sustainability; DigComp 3.0; Area 4; computational resources; responsible use; project-based learning; evaluation criteria |
| **Language** | EN (English) |
| **Affiliation** | Konak Science and Art Center (BILSEM) - Türkiye |
| **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) [European framework of digital competences, Italian translation 2025]. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/0001149<br>Luccioni, A. S., Viguier, S., & Ligozat, A.-L. (2022). Estimating the carbon footprint of BLOOM, a 176B parameter language model. Journal of Machine Learning Research, 24, 1-15. https://arxiv.org/abs/2211.02001<br>OECD. (2022). Measuring the environmental impacts of artificial intelligence compute and applications. OECD Publishing. https://www.oecd.org/en/publications/measuring-the-environmental-impacts-of-artificial-intelligence-compute-and-applications_7babf571-en.htm<br>Patrignani, N., & Whitehouse, D. (2019). Slow tech: The bridge between computer ethics and business ethics. In This changes everything - ICT and climate change (pp. 265-280). Springer.<br>Schwartz, R., Dodge, J., Smith, N. A., & Etzioni, O. (2020). Green AI. Communications of the ACM, 63(12), 54-63. https://arxiv.org/abs/1907.10597<br>Strubell, E., Ganesh, A., & McCallum, A. (2019). Energy and policy considerations for deep learning in NLP. In Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics (pp. 3645-3650). https://aclanthology.org/P19-1355/ |
| **Educational Level** | Secondary School |
| **Associated Module / MOOC Video Lesson** | Module 5 - Safety, Privacy and Sustainability / Video 5.3 - Ecological Footprint & Civic Education |
| **Learning Objectives** | design digital civic education modules centred on the sustainability of technologies; link the activities to the DigComp 3.0 competences and to the scientific evidence on the AI footprint; guide the class from the analysis of a problem to the choice of concrete, documented actions. |
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| **Date Available** | 14/09/2026 |
| **Date Modified** | |

## References and Webography

Cosgrove, J., & Cachia, R. (2025). DigComp 3.0: European digital competence framework (Fifth edition) [European framework of digital competences, Italian translation 2025]. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/0001149

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