

THE CHALLENGE-DEVICE-SYNTHESIS APPROACH: ENHANCING AI EDUCATION THROUGH INTERDISCIPLINARY ASSESSMENT

J. Moyà-Köhler¹, F. Vilariño²

¹Universitat Autònoma de Barcelona (SPAIN)

²Computer Vision Center - Universitat Autònoma de Barcelona (SPAIN)

Abstract

The rapid evolution of Artificial Intelligence requires innovative pedagogical approaches that bridge the traditional divide between technical and social sciences. This paper introduces the Challenge-Device-Synthesis methodology, implemented within the Bachelor's Degree in Artificial Intelligence at the Universitat Autònoma de Barcelona, which seeks to foster interdisciplinary learning and critical social analysis. The Challenge-Device-Synthesis framework invites students to develop AI-based devices in response to real-life challenges, later analysed through a structured social impact assessment. The integration of experts from social psychology, philosophy, law, and computer science ensures a multi-perspective evaluation process, guiding students through a robust transdisciplinary learning path.

Keywords: Artificial intelligence, Challenge-Based Learning, Ethics, Transdisciplinarity.

1 INTRODUCTION

"Courses with a social perspective are not very relevant to our training in Artificial Intelligence; we would prefer to replace them with subjects that have more programming content and technical knowledge useful for our professional future."

This comment, collected in a student evaluation of an ethics course within the Bachelor's Degree in Artificial Intelligence at the Universitat Autònoma de Barcelona, reflects a deeply rooted tension in contemporary higher education: the opposition between technical training geared toward employability and critical reflection oriented toward social responsibility. The statement reveals a widespread but narrow understanding of what AI education should entail –one that marginalizes social, ethical, and political concerns as either secondary or dispensable.

However, the accelerating development of Artificial Intelligence makes it increasingly evident that no technical system can be fully understood or responsibly developed without considering its societal consequences. Reports of discriminatory biases, algorithmic opacity, and harmful uses of intelligent systems illustrate the pressing need to integrate diverse perspectives into AI curricula. Far from being neutral tools, AI systems actively shape social relations and institutions. As Coeckelbergh [1] argues, AI must be approached not only as a technological issue but as a political and relational one.

These educational imperative challenges the long-standing divide between engineering and the social sciences. These domains have developed distinct epistemological cultures, that is one grounded in “problem-solving” and “optimization”, the other in “critical analysis” and “contextual understanding”. Yet, as Latour [2] reminds us, modern societies are configured through sociotechnical assemblages: technologies are inherently social, and societies are always already shaped by technological infrastructures.

The question, then, is not whether social dimensions belong in AI education, but how to meaningfully integrate them as they are already there all the time. Rather than simply appending ethics modules or isolated theory courses, we believe universities should explore how to create hybrid learning experiences in which technical and social knowledge are not treated as separate domains but as co-constitutive aspects of all engineering practice. The goal is to move from a passive “social lens” to an active, situated, and critical engagement with real-world problems.

This leads us to the central question of this project: How can an integrative educational approach foster, in AI engineering students, a critical and operational understanding of the social impact of their technological work?

2 METHODOLOGY

The initiative described in this paper unfolds along two complementary lines:

- 1 the design and deployment of an integrated pedagogical methodology bridging technical and social dimensions of AI education (developed during Q3–Q4 2024 and implemented during Q1 2025), and
- 2 the empirical validation of this methodology through real-life experimentation and transdisciplinary evaluation, with an Technovalues committee ad-hoc assembled for the subject.

This approach materializes through the restructuring of the sixth semester of the Bachelor's Degree in Artificial Intelligence at the Universitat Autònoma de Barcelona, connecting two co-taught 6-ECTS courses: “Project Synthesis” and “Social Innovation”. These subjects are tightly coordinated to function as a single interdisciplinary module. Students, organized in teams of 4 to 6, respond to real-world challenges by designing, developing, and assessing functional AI prototypes.

The Project Synthesis course is dedicated to the technical development of the AI-based devices, following an agile methodology. The outcome is a fully documented software prototype published on GitHub. This course focuses on software engineering practices, model selection, data pipeline integration, and systems deployment. Close coordination with our subject, Social Innovation, that ensures that design decisions taken during development are informed by social, legal, and ethical considerations.

Here, the Social Innovation course provides a framework for exploring the social impact of the developed technologies, embedding them in real-world use cases and subjecting them to critical analysis. Students engage in classroom sessions led by invited experts from various disciplines –including law (AI regulation and compliance), philosophy (ethics and governance), accessibility, participatory design, and experimental methods such as living labs, testbeds, and regulatory sandboxes. These sessions are structured to bring in epistemic diversity and prepare students for a comprehensive approach to the real setting they are going to face.

The social dimension of the methodology is explicitly grounded in Science and Technology Studies. Drawing on this tradition, students are encouraged to think of AI systems not as isolated artefacts but as technosocial assemblages [3], shaped by and shaping the relational, political, and institutional contexts in which they are embedded.

The deployment of the project involve collaboration with actors across UAB’s academic and industrial ecosystem. Two industry partners contributed with two different challenges (for a Thermal Monitoring in Hospitals, and a Precise Translation Engine based on Language Models), and the Cruïlla Music Festival in Barcelona, which is scheduled to host AI-based prototypes for live testing during its 2025 edition. These will include two generative AI tools for personalized experience curation, and two sentiment analysis engines for community engagement.

Our particular perspective, grounded in real-world settings, informed both the theoretical discussions and the fieldwork carried out in collaboration with real stakeholders whom the students were required to identify and interview. Interviewing was a key process in interpreting the context and uncovering the main determinants that emerged. Students identified a range of relevant actors within each setting – families, festival participants, security personnel, nurses, professional translators, among others– and ultimately produced a podcast for each setting, highlighting the main tensions and noteworthy elements specific to each domain.

Finally, a core feature of the initiative is the formation of an interdisciplinary Techno-Values Committee, composed of experts in psychology, philosophy, computer science, and law. The committee's role is to evaluate the devices along five dimensions: technical robustness, regulatory compliance (e.g. with the EU AI Act), ethical principles (such as fairness and transparency), relational effects (e.g. human-machine interaction), and societal implications. While originally envisioned as a two-step process (mid-term and final), in this pilot edition the committee convened once, during week 13, for a structured session of analysis and feedback on the near-final prototypes.

In the case of the Cruïlla Music Festival in Barcelona, it is scheduled to host two AI-based prototypes for live testing during its 2025 edition. These will include a generative AI tool for personalized experience curation, and a sentiment analysis engine for social media community engagement. This real-world setting is expected to serve as a crucial experimental platform, enabling the validation of the devices’ utility and opening space for public interaction and feedback. The outcomes of this interaction will be analyzed and discussed in a future contribution.

Below we present the weekly structure, and the activities carried out during the different sessions of the course:

SOCIAL INNOVATION					
Bachelor Degree on Artificial Intelligence. 6th term.					
Study guide 2024-2025					
				Wed	Thr
	Week#	Dates	Topic	17.00h-19.00h	17.00h - 19.00h
February	01	12-13/02	Presentation (Project setup) / Introduction to Social Impact of AI and Social Innovation		
	02	19-20/02	Sociology of science + mapping of actors + first bibliography review		
	03	26-27/02	Citizen Engagement and Living Labs + Initial prospective interviews to decide on the challenge		
March	04	05-06/03	Group presentation of the challenge and the initial idea for the device + start coding		
	05	12-13/03	Qualitative methods to explore social reality + interviews		
	06	19-20/03	Political dimensions of IA + Interviews to stakeholders		
	07	26-27/03	AI devices and accessibility		
April	08	02-03/04	Technology readiness level. Open innovation ecosystems.		
	09	09-10/04	Sandbox, test-beds and living labs for evidence-based Policy informing and Regulatory learning.		
EASTER BREAK					
	10	23/04	Project follow-up and paper drafting.		
	11	30/04	Citizen Science. Empowerment of citizens for evidences-based social change.		
May	12	7-8/5	Artistic dimension. Second draft of the paper.		
	13	14-15/05	Presentation to the Techno-values committee		
	14	21-22/05	Project wrap up and paper fine tuning.		
	15	28-29/05	Final Presentation: 28-May		

Figure 1: Specific calendarization framework of the course.

3 RESULTS

3.1 The interdisciplinary learning ecosystem

The implementation of the Challenge-Device-Synthesis methodology during the academic year 2024-25 resulted in a deep curricular transformation within the Bachelor's Degree in Artificial Intelligence at the Universitat Autònoma de Barcelona. The sixth semester was restructured to articulate two previously separate 6-ECTS courses –Project Synthesis and Social Innovation– into a unified, interdisciplinary learning ecosystem.

A major achievement of the initiative was the successful integration of two epistemic cultures, often seen as oppositional: the engineering mindset focused on technical functionality, and the social sciences perspective oriented toward critical reflection and contextual understanding. The two courses were not only coordinated logistically but intellectually aligned through a shared pedagogical strategy rooted in challenge-based learning and grounded in a Science and Technology Studies framework.

In Project Synthesis, students worked in teams to develop functioning AI prototypes in response to challenges curated by UAB and the teaching staff. Their technical work was complemented in Social Innovation by a critical exploration of the ethical, legal, relational, and political implications of their prototypes. The learning trajectory was structured so that both courses progressed in parallel, with coordination between instructors to ensure pedagogical coherence.

Throughout the semester, students engaged with a wide range of disciplinary insights. Guest experts and faculty members contributed sessions on AI regulation and law (e.g., implications of the EU AI Act), algorithmic fairness, inclusive design and accessibility, participatory methods (e.g., citizen science), and experimental infrastructures such as living labs, testbeds, and regulatory sandboxes, or political dimensions of technology and STS. These sessions were not peripheral, but essential components of the curriculum, equipping students with tools to design technology within real-world constraints and with social relevance.

The initiative achieved a high level of interdisciplinarity within the classroom environment. Students demonstrated a growing capacity to navigate, integrate, and apply heterogeneous forms of knowledge. Technical decisions made during prototype development were increasingly informed by ethical and political considerations, and vice versa. Importantly, students learned to treat these dimensions not as separate layers but as mutually constitutive aspects of responsible technological practice. This integration was especially evident through stakeholder interviews, which drew upon the sensitivities cultivated during the initial sessions of the course. These interviews helped students to situate core concerns and identify the necessary adaptations of their devices to the specific contexts in which they would operate

Finally, a particularly innovative element was the establishment of the Techno-Values Committee, composed of faculty from the fields of psychology, philosophy, law, and computer science. The committee

convened during week 13 for a structured evaluation of the prototypes, applying a multidimensional framework that considered technical robustness, regulatory compliance, ethical integrity, human interaction, and broader societal impact. The session provided students with feedback that extended beyond technical correctness, pushing them to articulate the societal functions and risks of their devices.

3.2 The developed projects

- iDisc Translation Engine: The challenge focused on AI-powered translation services in a professional context. The team developed a customizable translation engine trained on domain-specific corpora and user feedback.
- Translating the Future: Addressing ethical and technical issues in automated legal and commercial translation, the project develops a translation tool integrating client preferences and GPT-based QA layers.
- Festival Intelligence: The challenge explored real-time monitoring of festivalgoers' sentiment and trends using social media data. The system combines BERT and LDA models to power a dashboard for event organizers.
- Sentiment Visualization for Cruïlla: This project develops a public-facing installation that visualizes live sentiment from Twitter during the Cruïlla Festival. It includes scraping, classification, and artistic display components.
- Sepsis Detection in Neonates: The project tackle early detection of neonatal sepsis using thermal imaging and AI pattern recognition. It aims to assist clinicians in NICUs by identifying thermal anomalies linked to infections.
- Thermal Monitoring for NICUs: This team developed an AI model to interpret thermal data from newborns in intensive care. The emphasis is on reducing diagnostic delays while ensuring ethical compliance and usability for hospital staff.
- Synesthesia – Cruïlla AI Experience: Focused on cultural innovation, this project proposes a set of AI tools for festivalgoers: a scavenger hunt app, generative music composition, and personalized recap videos.

3.3 The main outputs

The initiative resulted in three principal outputs, each reflecting a distinct yet interconnected dimension of the students' learning process:

- 1 A technical deliverable, publicly accessible via GitHub, consisting of the complete codebase, technical documentation, and deployment instructions. This output reflects the engineering rigour and development capacity acquired by the student teams throughout the Project Synthesis course.
- 2 An analytical essay/paper, in which each team critically assessed the social implications of their AI prototype. These essays were grounded in the conceptual frameworks and structured assessment tools introduced during the Social Innovation sessions, including ethical analysis, stakeholder mapping, legal compliance, and STS-based perspectives on sociotechnical impact.
- 3 A real-world deployment plan. In the case of the Cruïlla Music Festival in Barcelona, although the implementation of the prototypes at the festival did not occur during the academic calendar, the projects were technically sound and conceptually robust, laying the groundwork for future deployment in a live setting during the festival this July 2025.

4 CONCLUSIONS

The CDS methodology [4] proved effective in fostering coordinated interdisciplinary learning, promoting technical excellence while embedding critical social awareness in AI design. The experience confirmed that transdisciplinary, challenge-based frameworks can significantly enhance the educational value and social relevance of AI engineering curricula.

The presented work demonstrated the feasibility and pedagogical value of integrating technical development with critical social inquiry within an AI engineering curriculum. Its implementation enabled a structural convergence between two traditionally distinct academic spheres: computer science and the social sciences. This integration not only enriched the students' educational experience but also

deepened their awareness of the broader societal implications of AI systems, in line with arguments that highlight the insufficiency of purely technical understandings of AI without social and legal inquiry [4].

The coordinated structure between Project Synthesis and Social Innovation allowed students to engage in technically rigorous development processes while simultaneously analysing the ethical, legal, relational, and political dimensions of their projects. This dual focus was reflected in the students' capacity to articulate their design choices as responses not only to technical challenges, but also to the demands of fairness, accessibility, accountability, and social relevance.

Throughout the semester, students developed a diverse set of AI-based devices in response to challenges proposed by partners across UAB. In addition to the two prototypes initially designed for deployment at the Cruïlla Music Festival—one focused on personalized experience curation using generative AI and the other on community engagement through sentiment analysis—other student projects included a Thermal Monitoring in Hospitals, and a Precise Translation Engine based on Language Models for two different companies.

These initiatives collectively illustrated the potential of the RDS framework to mobilize university-wide knowledge ecosystems and align them with socially relevant innovation goals. Students did not just “apply” social concepts abstractly—they worked directly with researchers, practitioners, and use cases that embedded their devices in real, complex, and situated contexts.

The Techno-Values Committee served as a key moment of collective reflection and transdisciplinary evaluation. It challenged students to justify their designs through a multidimensional lens, incorporating technical, legal, ethical, and social criteria, and encouraged dialogue across domains not often brought into direct exchange [6,7]. This evaluative moment closely aligned with the principles of Responsible Research and Innovation (RRI), which emphasize anticipation, inclusion, reflexivity, and responsiveness as essential dimensions of socially responsible technology development [8].

The final deliverables—both the technical prototypes and the analytical essays—reflected a mature and nuanced understanding of AI as a sociotechnical practice. While the real-life deployment at Cruïlla could not be executed during the academic cycle, the readiness of the devices and the methodological foundation laid by the course offer strong prospects for future implementation.

In sum, the CDS approach successfully advanced a model of AI education that combines technical excellence with critical, civic-minded design. It demonstrated that it is possible to train engineers who can not only code efficiently, but also think relationally, design responsibly, and act reflectively. Qualities that are increasingly essential in a world shaped by artificial intelligence.

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