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Beyond Plausible Tropes: Human-AI Speculative Design Fiction as a Pathway to Postdigital Literacies

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Introduction

Generative AI has entered classrooms not as a distant possibility but as an immediate reality. Teachers and students now work daily with large language models (LLMs) that can summarise, translate, simulate dialogue, and generate lesson plans on demand (Zawacki-Richter et al., 2019; Zhang & Sun, 2025). As these systems become embedded in everyday educational practices, they challenge not only how learning is organised but also what it means to know, evaluate, and create knowledge in postdigital contexts.

In this context, postdigital realities, where digital systems are deeply embedded in everyday practices are becoming more than evident. They require us not only to rethink traditional literacies but also to conceptualise what new literacies consist of, including the ability to critically interpret and evaluate AI-generated content. Hayles, in *From Bacteria to AI,* argues from a posthumanistic perspective that *"there are utopian as well as dystopian possibilities in developments like these, our best hope for navigating these tricky waters is to start with a clear-eyed view of how human umwelten overlap with and differ from those of the nonhuman others"* (Hayles, 2025, p.73). Understanding what these systems do and how to use them responsibly or operationally is necessary but no longer sufficient (Ng et al., 2021). The deeper challenge is epistemic: it is increasingly difficult to distinguish between linguistic plausibility (outputs that sound convincing) and well-founded judgment. For instance, outputs that sound authoritative are easily taken as truth. This structural condition, what some scholars have called *epistemia* – a condition in which fluent outputs can be mistaken for reliable knowledge – creates an urgent need for new forms of literacy (Quattrociocchi et al., 2025) and epistemological awareness (Jandrić & Knox, 2022). Simultaneously, educators face overlapping crises, including ecological breakdown, geopolitical instability, institutional uncertainty, and rapid technological change. In this context of polycrisis, preparing students for predetermined futures is no longer feasible (Lawrence et al., 2024). Instead, educators must cultivate the capacity to imagine, evaluate, and contest multiple, possible futures – to critically reflect on which futures are desirable, for whom, and under what conditions (Mangnus et al., 2021; Miller, 2018). These challenges demand an integrated approach to literacy that goes beyond technical competence. Educators must increasingly act as interpreters, critics, and imaginers of AI futures.

When educators prompt an AI system, they are not unlocking novel possibilities but navigating a landscape shaped by training data reflecting hegemonic educational discourses and cultural tropes (e.g., personalisation, efficiency, surveillance, optimisation) (Rahm, 2024; Rahm, L.:, 2023; Selwyn, 2020). Epistemic literacy is the capacity to understand how knowledge claims are produced, to evaluate their credibility, and to resist outsourcing judgment to fluent (but not always reliable) systems (Barzilai & Chinn, 2018). Epistemic literacy transforms AI from a black box to an intelligible system – one that teachers can read, critique, and consciously work with or against.

However, the challenge is not only epistemic but also anticipatory – AI systems do not merely generate knowledge claims but also shape how futures are imagined and framed. Futures literacy is the capability to use the future in multiple ways: to sense emergence, imagine alternatives, and innovate in the present (Miller, 2018). Crucially, there is not one future literacy but multiple, corresponding to different *"attitudes toward the future"*

(Mangnus et al., 2021). Advanced futures literacy involves the reflexive capacity to move among these modes and to assess which combinations are "*fit for purpose*" in specific contexts (Mangnus et al., 2021). When these three literacies – AI, epistemic, and futures literacy are underdeveloped or disconnected, teachers become passive recipients of AI futures rather than active shapers of them. Thus, our response is to treat human-AI speculative design fiction as a reflexive instrument for cultivating integrated AI, epistemic, and futures literacies, in this case, for educators. Design fiction – the creation of short, situated narratives or scenarios about possible futures – has long been used in design and technology studies to provoke reflection and surface assumptions (Blythe, 2014; Dunne, 2013). When co-created with AI systems, design fiction becomes particularly powerful: the narratives are simultaneously artefacts about AI futures and artefacts produced through AI, making them ideal mirrors for examining how teachers and models jointly construct what counts as plausible, desirable, or unthinkable (Lin & Long, 2023; Wu et al., 2022).

This study makes three interconnected contributions. First, we articulate speculative design fiction as a structured literacy practice rather than a one-off creative exercise (Blythe, 2014; Ross, 2017). Second, we foreground the epistemic dimension of AI literacy, demonstrating how educators can recognise and resist epistemia by understanding LLMs as collective memory systems that reproduce dominant tropes (Dron, 2023; Quattrociocchi et al., 2025). Third, we position human-AI speculative co-creation as a methodology for designing postdigital futuring tools to cultivate the integrated literacies needed to navigate AI-saturated educational futures in the context of polycrisis (Jandrić, 2025; Lawrence et al., 2024).

This article is structured as a sequential multiple case study (Stake, 2006; Yin, 2017) tracing an evolving approach to human-AI co-creative design fiction; Across cases, we examine how co-created narratives function as techniques of futuring that bring participants together around imagined futures and shape orientations toward action (Hajer & Pelzer, 2018). While concepts such as *epistemia* and *cognitive assemblages* might seem a counter-intuitive concept, we argue that analysing these provides a productive lens for addressing the epistemic challenges posed by pervasive AI. As Hayles notes *"AI narratives can be of significant interest in themselves"* (Hayles, 2025, p. 139)*, even* more revealing, however, are the co-narratives that emerge through human–AI interaction.

1. Background: Literacy Challenges in Postdigital AI Environments

In postdigital classrooms, AI systems are no longer external tools but embedded in everyday educational practices. As a result, they shape not only how knowledge is produced but also how futures are imagined. This creates a multi-layered challenge for literacy. Educators must understand how AI systems operate (AI literacy), critically evaluate AI-generated knowledge (epistemic literacy), and reflect on the futures these systems implicitly construct (futures literacy).

While these literacies are often addressed separately, we argue that they need to be understood as interrelated capacities. In this section, we draw on postdigital education, epistemic literacy, and futures literacy to show how existing work approaches these challenges and where important gaps remain.

2.1. Postdigital Classrooms and Sociotechnical Imaginaries

Postdigital scholarship emphasises that digital technologies are no longer add-ons to education but part of the taken-for-granted fabric of classrooms, institutions, and everyday life (Jandrić, 2018; Jandrić & Knox, 2022). The postdigital classroom is therefore not a neatly bounded "digital learning environment" but a messy, hybrid, relational space in which online and offline, human and nonhuman, biological and informational elements are tightly interwoven (Carvalho & Oliveira, 2025; Suoranta et al., 2022). From this perspective, educational futures are not pre-given

endpoints but ongoing productions of futures in the present, enacted through mundane decisions about tools, arrangements of space, assessment practices, and institutional priorities (Forsler et al., 2025; Wiklund-Engblom et al., 2025).

The notion of *sociotechnical imaginaries* captures how these futures are collectively shaped. Imaginaries are stabilised, visions of desirable futures embedded in policy, platforms, and design practices (Jasanoff, S.:, 2015). In AI in education, these recurring imaginaries emphasize efficiency, personalisation, optimisation, and data-driven governance (Mamlok, 2025; Rahm & Rahm-Skågeby, 2023). While often framed as a solution, critical work highlights how such imaginaries can reinforce surveillance, commodification, and platform power, while narrowing what counts as pedagogically and politically thinkable (Giakoumakis et al., 2025; Zuboff, 2019). This body of work highlights how AI shapes educational futures, but it offers limited guidance on how educators can critically engage with both the operation of these systems and the knowledge and assumptions they produce. This points to the need for a more differentiated understanding of AI literacy.

2.2. AI Literacy and Its Limits

AI literacy is commonly defined as the ability to understand how AI systems function, how they are trained, and how they can be used effectively and responsibly (Ng et al., 2021). In educational contexts, this often includes skills such as prompt design, tool selection, and awareness of ethical concerns. However, in the context of generative AI, this focus is insufficient. Knowing how to use AI systems does not necessarily equip educators to critically evaluate the knowledge these systems produce or the futures they implicitly promote. As LLMs operate through pattern recognition over large-scale training data, they tend to reproduce dominant cultural and educational discourses rather than generate grounded or novel insights (Dron, 2023; Selwyn, 2020). This limitation points to a deeper epistemic challenge.

2.3. Epistemic Literacy: Evaluating Knowledge Claims in AI-mediated Contexts

Generative AI systems produce outputs that are often linguistically plausible – convincing in form but not necessarily grounded in reliable knowledge (Bender et al., 2021; Quattrociocchi et al., 2025). As N. Katherine Hayles describes, they can be understood as *"cracked mirrors, that reflect human language back to us through a mind of a machine"* (Hayles, 2025, p. 153). They compress prior language and imaginaries, normalising prompts back into entrenched discourses, including hegemonic AI narratives (Rahm & Rahm-Skågeby, 2023). Epistemic literacy involves resisting this normalising pull by adding human judgement in the loop in AI systems. While sociotechnical imaginaries shape shared visions, generative AI, particularly LLMs, poses macro and micro-epistemic challenges. Many view LLMs as stochastic pattern-completion systems, not epistemic agents reinforcing a structural situation where linguistic plausibility replaces epistemic evaluation, offering the appearance of knowledge without the effort of knowing (Bender et al., 2021; Quattrociocchi et al., 2025). In educational settings, such outputs can easily be mistaken for authoritative knowledge. Epistemic literacy addresses this challenge by focusing on how knowledge claims are produced, whose perspectives they reflect, and how they should be evaluated (Barzilai & Chinn, 2020). It involves recognising when plausibility substitutes for justification and reintroducing criteria of evidence, perspective, and value into AI-mediated processes. Yet, even epistemic literacy alone does not fully address the challenge. AI systems also shape how futures are imagined and what possibilities are considered viable.

2.4. Futures Literacy: Imagining Alternative Futures

Futures literacy refers to the capacity to use the future in multiple ways, including to anticipate change, imagine alternatives, and guide action in the present (Miller, 2018). From the UNESCO perspective, this is framed as a rigorous skill to overcome "colonized" images of the future by distinguishing between using the future to *prepare*

(optimization) and using the future to *innovate* (embracing complexity and emergence) (Miller, 2018). Mangnus et al. (2021) distinguish between different orientations toward the future:

- Predictive (futures as knowable and manageable)
- Plausible (multiple scenarios under deep uncertainty)
- Experimental (collective co-creation of alternatives)
- Critical (deconstructing imaginaries and their power effects)

In AI-mediated environments, predictive and plausible futures often align with dominant sociotechnical imaginaries, reinforcing narratives of optimisation and control. The UNESCO framework warns that relying solely on these modes limits our "Anticipatory Capacity," making us blind to novelty that does not fit into pre-existing models (Miller, 2018). In contrast, experimental and critical modes enable the exploration of alternative and more diverse futures.

Future literacy is therefore a reflexive capacity – the ability to move between these modes and to assess their appropriateness in specific contexts. UNESCO describes this as becoming "literate" in the different *reasons* why we imagine the future, allowing us to use "Futures Literacy Labs" to reveal the hidden assumptions (the "originary" stories) we hold. Without this capacity, speculative practices risk reproducing dominant imaginaries rather than challenging them. Taken together, AI literacy, epistemic literacy, and futures literacy address different but interconnected aspects of postdigital AI environments. However, they are rarely integrated in practice.

2.5. Human-AI Cognitive Assemblages

To understand how these limitations emerge, we draw on the posthumanistic notion of *cognitive assemblages* by Hayles (2016) conceptualising cognition as distributed across human and nonhuman actors and discussing how the mean-making arises through these interactions.

In human-AI co-creation, knowledge and imagination are therefore not produced independently but emerged through interaction. In our context, it means that when educators and LLMs co-create, thinking and imagination are shared across human and nonhuman agents. The resulting narratives are not "human+AI" but emergent properties of the assemblage. This positions speculative design fiction as an emergent literacy practice: teachers learn to think *with* and *against* AI, reflecting on how AI systems shape pedagogical futures.

2.6. Empirical Challenge: Human-AI Co-Creation and Cultural Tropes

Our starting point is empirical. Across several projects with pre-service and in-service teachers working on AI in education, we observed a recurring pattern: speculative activities often begin with rich, imaginative ideas but gradually converge toward a small repertoire of familiar tropes – such as hyper-personalised dashboards, automated assessment, ubiquitous surveillance, or, conversely, total AI collapse (Gidiotis & Hrastinski, 2024; Authors, 2025). In our earlier work on speculative prompting for AI-generated design fictions about educational futures, we found that different prompt strategies systematically shaped how AI in education was framed, which concerns were foregrounded, and which narrative perspectives were used, with some strategies consistently drifting toward clichéd, low-critical narratives (Authors et al., 2026). Similarly, iterative human-AI co-creation did not expand the space of futures; it flattened it by reinforcing dominant patterns (Authors, 2024).

Teacher feedback tended to correct detail and feasibility *in their own organizational imaginations* rather than interrogate underlying assumptions about learning, innovation, or power. Even sentiment analysis suggested that epistemological assumptions often remained unexamined (Authors, 2024, 2025). Taken together, these findings suggest that speculative design fiction, when not critically scaffolded, risks functioning less as a critical speculative practice and more as an amplifier of existing sociotechnical imaginaries of AI in education (Rahm, 2023; Selwyn, 2023). Across our cases, this manifests a tension between *imaginative futures* – those that can easily be generated in

speculative settings – and *organisationally imaginable futures* – those perceived as realistic within their institutional contexts and contraints. Building on Appadurai's (2004) notion of a "capacity to aspire," we conceptualise it an "imaginative-organisationally imaginable gap". Speculative design and futures studies literature provides useful distinctions here, such as Dunne and Raby's (2013) possible, plausible, probable, and preferable futures, or Mangnus et al. 's (2021) predictive, plausible, experimental, and critical modes. These frameworks suggest that some futures primarily serve to explore and unsettle assumptions, while others remain oriented toward planning within existing constraints.

A related concept is Auger's (Auger, 2013) *perceptual bridge*, which describes the need to anchor speculative ideas in familiar contexts to make them meaningful and actionable. Without such a bridge, speculative futures risk either being dismissed as unrealistic or collapsing into familiar tropes. Taken together, this empirical pattern highlights a central challenge: how to design speculative practices that move beyond trope reproduction and instead support reflexive engagement with multiple, contestable futures.

2.7. Design Fiction as an Integrated Literacy Practice

Design fiction and speculative design offer a way to explore and contest possible futures. Rather than predicting outcomes, they use narrative artefacts – such as scenarios, stories, and prototypes – to make futures tangible and open to critique (Dunne and Raby, 2013, Blythe, 2014). In human-computer interaction, design fiction has been widely used to provoke reflection on emerging technologies and sociotechnical arrangements (Blythe, 2014; Lindley & Coulton, 2015).

In educational research, design fiction has been applied to AI, datafication, and automation, revealing both critical insights and recurring patterns in how futures are imagined (Bozkurt et al., 2023; Gidiotis & Hrastinski, 2024; Ross, 2017, 2023). Applied to AI in education, it explores not only what AI *might* do but the educational imaginaries AI-mediated futures *carry* and *produce*. This dual function—fiction as *content* (story about AI futures) and *process* (story generated *with* AI)—makes human-AI co-created design fiction a powerful reflexive tool.

Building on Blythe's (Blythe, 2023) concept of *artificial design fiction*, we position AI as a material for generating *speculative pastiche scenarios:* hybrid narratives that deliberately combine different future orientations (predictive, plausible, experimental, and critical) and stylistic elements (Mangnus et al., 2021). By blending these modes, pastiche scenarios resist collapsing into familiar tropes and instead disrupt dominant narratives, surface implicit assumptions and enable dialogic critique. In our cases, speculative pastiche scenarios were generated using custom GPT models programmed with prompts that deliberately combined different personas, conflicting values, and multiple temporal horizons. These scenarios then became objects of analysis and critique in teacher workshops.

2.8. Designing for Literacy Through Reflexive Futuring Practice: Beyond Dominant Tropes

Building on these insights, we propose the *design fictionist* approach, which positions speculative design fiction as a structured literacy practice rather than a one-off creative exercise. The goal is to support educators in developing integrated AI, epistemic, and futures literacies through reflexive engagement with AI-generated futures.

Our approach combines three elements:

1. speculative design fiction as method,
2. speculative pastiche scenarios as artefacts, and
3. a heuristic evaluation framework to guide reflection.

In previous work, we showed that different prompting strategies systematically influence AI-generated design fictions about educational futures (Authors et al., 2026). Using GPT-4, we generated design fictions about AI in education in 2040 under six different speculative prompting approaches (e.g., persona-based, scenario-based, multi-

perspective conflict, open-ended, artefact-based, meta-prompting) (Appendix E), and evaluated the narratives using a seven-dimensional heuristic framework covering clarity, plausibility, provocativeness, creativity, concreteness, ethical reflection, and aesthetic and narrative appeal (adapted from Wu et al., 2020; refined by Authors et al., 2026).

Table 1: Heuristic Evaluation Framework for Reflective Interpretation of Design Fiction Narratives (refined by Authors et al., 2026)

Heuristic	Definition	Supporting Excerpts
Clarity & Coherence	Is the fiction clearly written, structured, and easy to follow?	Overall, the writing is clear and easy to understand for a reader. - The flow of writing is easy to follow. Or, - The lexical and structural choices are appropriate. Or, - It does not have unintended ambiguity or confusion. (Wu et al., 2020)
Provocative-ness	Does it challenge assumptions and stimulate critical reflection?	Overall, the text could trigger meaningful conversations or new thoughts. - It could trigger reflections on technology, taken-for-granted assumptions, or established structures. Or, - It could reveal certain conflicts or tension. Or, - It could trigger a new perspective to look at emerging technology or other issues - This text could inspire new ideas in the audience. (Wu et al., 2020)
Plausibility	Is the fiction believable and logically consistent in its world-building?	Overall, this fiction is self-consistent considering its own fictional setting. -Some connection can be found between this fiction and certain trends in reality. Or, -The fictional technology, objects, and events are not completely magical and can make the audience believe that they are logical in the overall narrative. (Wu et al., 2020)
Creativity & Imagination	Does it demonstrate novelty, surprise, or imaginative thinking?	- Strong imagination and creativity. Or, - It has surprising, unexpected elements (Wu et al., 2020)
Concreteness	Are abstract ideas made tangible through scenes, artifacts, or characters?	- This text has details that can help the audience to get immersed in the narrative. Or, - The text describes some concrete, tangible event, conflict, or tension (stemmed from new technology), rather than only speaking of abstract concepts or speculations. (Wu et al., 2020)
Reflective & Ethical Thinking	Does it prompt reflection on ethical, social, or political implications?	- Design fiction as a tool for anticipating ethical implications of technology - Design as a catalyst for public debate about the futures people want (Blythe, 2014, Dunne and Raby, 2013)
Aesthetic & Narrative Appeal	Is it engaging, immersive, and emotionally compelling?	- Emphasizing the narrative and storytelling potential of design fiction artefacts - Highlighting the role of storytelling techniques in creating engaging and meaningful narratives (Bleeker, 2022, Lindley, 2019)

The heuristic analysis showed that different prompts systematically shaped which futures were foregrounded, which concerns appeared, and how speculative or clichéd the narratives became – for instance, multi-perspective prompts tended to surface tensions and ethical dilemmas, while some persona and open-ended prompts drifted toward familiar, low-critical tropes (Authors et al., 2026). Bringing these elements together, we position *design fictionist* as an approach that utilizes speculative design fiction as a *literacy practice* in three senses: The overarching pedagogical goal of the design fictionist approach is to help teachers move beyond dominant AI tropes and develop reflexive

capacities for engaging with plural, contestable futures. This involves:

1. **Reading AI futures:** interpreting and critiquing AI-generated scenarios, identifying tropes, surfacing assumptions, and recognising when linguistic plausibility substitutes for epistemic justification (epistemic literacy).
2. **Co-Creating AI futures:** engaging in speculative design with AI to explore alternative possibilities and understand how outputs are shaped (AI literacy).
3. **Evaluating AI futures:** moving reflexively between predictive, plausible, experimental, and critical modes of futuring (futures literacy). Through this process, educators learn to recognise trope convergence, resist epistemic outsourcing, and expand the space of possible and preferable futures.

By treating speculative design fiction as a structured literacy practice, the *design fictionist* approach aims to cultivate durable capacities for navigating AI-saturated, postdigital educational environments in contexts of polycrisis (Lawrence et al., 2024; Miller, 2018).

3. Research Design: Sequential Multiple-Case Design

This study employs a sequential multiple-case study design (Stake, 2006; Yin, 2018), in which each case builds on insights from the previous one. Rather than aiming for statistical generalisation, the study seeks analytic generalisation: to refine speculative design fiction as a literacy practice and to develop an evolving pedagogical approach.

To make speculative futures more tangible, we also draw on scenario- and persona-based research (SBR). Building on work by Rheinfrank and Evenson (1996) and Carroll (2000), SBR uses narrative techniques to explore how personas engage with future technologies over time. This approach supports collaborative design, enabling participants to envision themselves as future users and to iteratively develop scenarios from broad contexts to more concrete interactions (Cooper et al., 2014).

The study follows a developmental trajectory across three stages: Case A (exploratory observation), Case B (analysis of human–AI co-creation), and Case C (deliberate intervention using speculative pastiche scenarios). Across these stages, we examine how different configurations of human–AI interaction shape knowledge production and future imaginaries, and how they can be redesigned to support more reflexive engagement. In particular, the analysis focuses on the shift from reproducing dominant sociotechnical tropes toward enabling epistemic and futures literacy. Each case thus serves a dual function: as an individual investigation and as a cumulative step in developing the design ficti *designfictionist* approach.

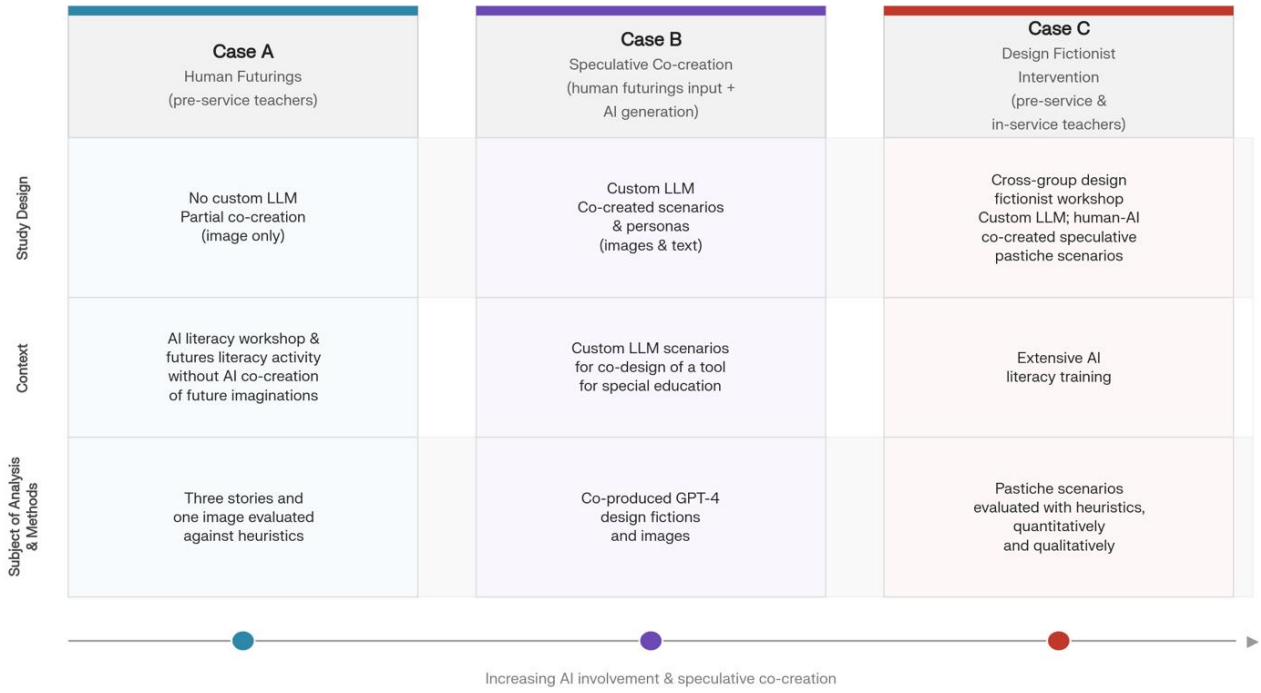


Figure 1. Sequential case study design illustrating increasing human–AI co-creation and reflexive structuring.

The figure presents the progression across three cases: Case A (human futuring), Case B (speculative human–AI co-creation), and Case C (design fictionist intervention). Each case differs in terms of study design, context, and data, while collectively forming a developmental trajectory. From left to right, the level of AI involvement and speculative co-creation increases. At the same time, the cases move from unstructured imagination (Case A), to AI-mediated co-creation (Case B), toward a deliberately designed, reflexive approach that integrates AI, epistemic, and futures literacy (Case C).

Data collection and sources

Data collection followed a consistent logic across cases, capturing both artefacts (e.g., design fictions, scenarios, images) and reflections (e.g., feedback, evaluations).

Case A: Co-created speculative stories and an AI-generated image, along with heuristic evaluations (quantitative and qualitative)

Case B: GPT-4-generated design fiction scenarios and personas, with corresponding heuristic evaluations of the scenarios.

Case C: Speculative pastiche scenarios generated via *Speculative Design Fictionist* and heuristic evaluations

Analysis was iterative and conducted at three levels:

1. **Within-case analysis** identifies narrative patterns in each case while systematically evaluating individual artefacts.
2. **Cross-case analysis** traced shifts in how futures were constructed across cases.
3. **Theory-building** used the framework (postdigital, epistemic, futures literacy, cognitive assemblages) to refine concepts.

Methods included quantitative scoring, qualitative narrative analysis of visual artefacts.

Case A: Human Futurings and Imaginations

Case A examines how pre-service teachers imagine AI futures with minimal AI co-creation, providing a baseline for understanding speculative design fiction without intensive human–AI interaction.Case A was conducted as part of an AI literacy workshop in a pre-service teacher education programme (N = 15), combining introductory AI literacy (2 hours), futures literacy activities, a brief introduction to AI tools (1 hour).

Following some experimentation of learning design with AI tools, participants (N=15) worked primarily with human imagination, using AI only minimally for generating a single illustrative image. Participants worked in three groups to develop speculative narratives (500-800 words) of inclusive, AI-mediated classrooms in 2040. AI use was minimal and restricted to generating a single illustrative image per group; only one group produced such an image (Fictions are reported in the Appendix A).

The resulting three stories and accompanying AI-generated image were evaluated using the heuristic framework (clarity, provocativeness, ethical reflection etc) by three experts in human-computer interaction and educational technology. Evaluations used a 5-point scale for each dimension, supplemented by qualitative comments.

Table 2: Heuristic evaluation scores for Case A design fictions. Mean expert ratings (5-point scale) across seven dimensions (e.g., clarity, plausibility, provocativeness, ethical reflection) for three speculative narratives. Lower scores indicate weaker performance across dimensions.

Heuristic	Fiction 1	Fiction 2	Fiction 3
Aesthetic & Narrative Appeal	1.3	1.3	1.0
Clarity & Coherence	2.0	2.0	2.0
Concreteness	2.0	2.0	2.0
Creativity & Imagination	1.6	2.0	1.6
Plausibility	2.3	2.3	2.3
Provocativeness	2.0	1.3	1.3
Reflective & Ethical Thinking	1.0	1.0	1.3

The stories seem conceptually plausible but weak as *fictions* for provoking, embodying, and emotionally carrying futures. All overall means sit between 1.67 and 1.76, so experts see all three stories as similarly under-developed. Scores cluster just above 1 and around 2, which signals that almost every dimension needs substantial strengthening.

Across cases, the stories were generally plausible but weak as speculative artefacts. While they presented internally coherent futures, they lacked narrative depth, ethical engagement, and critical provocation. Clarity and plausibility were moderate, but creativity, concreteness, and aesthetic appeal remained limited. Most notably, reflective and ethical thinking was largely absent, suggesting that the scenarios did not meaningfully interrogate the implications of AI in education.

Taken together, these findings indicate that participants were able to imagine futures, but not to develop them into engaging, embodied, or critically reflective narratives. The futures remained conceptually plausible but narratively flat.



Figure 2. AI-generated image based on Case A, Fiction 1.

Visual Narrative and Interpretation

The AI-generated image in Figure 1 depicts an open, multi-level learning space that feels like a public learning hub rather than a traditional classroom. The space is populated by people of different ages, incorporates greenery and natural light, and supports multiple simultaneous activities. A central amphitheatre with a large "Technology: Ethical Questions" panel suggests dialogic pedagogy, collective deliberation while peripheral zones (e.g., bike-repair wall, workshops, small meeting rooms, informal seating) function as "learning by doing" and self-directed learning. Overall, the architecture conveys a low-impact, community-embedded infrastructure in which space itself functions as a pedagogical tool. Taken as a narrative, the image represents school-as-commons: a porous, civic place where learning, making, caring and debating technology are integrated into everyday life.

Convergences with a written scenario: The image aligns with the written scenario in its depiction of an open, high-performance learning space functioning as a community hub. Both emphasise participation, flexibility, and "learning by doing" with diverse activities replacing traditional instruction. The central forum reflects the scenario's focus on collective discussion, while the distributed workspaces and informal zones support self-directed engagement. In both representations, space acts as a key pedagogical medium, integrating comfort, collaboration, and activity.

Divergences and under-represented aspects: Key elements of the written scenario are visually muted or absent. While the narrative foregrounds AI-driven regulation (e.g., monitoring attention, health, and environment), the image shows no visible interfaces or systems indicating such orchestration. Personalised care and immersive

technologies are similarly underrepresented. Instead, the image shifts emphasis toward social, spatial, and ecological dimensions. The teacher's coordinating role is also less explicit, as blurred actor roles reinforce a more horizontal, communal interpretation of learning.

Case A reveals a tension between imaginative expansion and epistemic grounding. Although participants generated plausible and diverse futures, these remained largely disconnected from concrete, ethical, and institutional considerations. The scenarios function more as aspirational visions than as critically grounded explorations of AI in education. This aligns with Mangnus et al. (2021), who argue that experimental and predictive futures can coexist without reflexive integration. Participants demonstrated early futures literacy—the ability to imagine alternatives—but lacked the epistemic tools to evaluate and situate them. Crucially, the absence of sustained human–AI co-creation meant they did not encounter the epistemic dynamics of AI systems, such as the generation of plausible but shallow outputs. This limitation becomes central in Case B.

Case B: Human-AI Co-Created Futures: cultural tropes and convergence

The Case B builds directly on Case A by introducing human–AI co-creation: a custom GPT-4 model was developed using student-generated fictions from ase A, and scenario-based research literature as input. The GPT-4 model was prompted to produce concrete use-case scenarios for language education, based on predefined personas (multilingual learners, students with pragmatic language challenges, and neurodivergent learners) and scenario-based protocol:

The ChatGPT-4 was also provided with this instructions:

"I am doing research on future classrooms and the use of generative artificial intelligence-based tools for the development of linguistic competencies in children. My use cases are for secondary education, which involves several specific use cases and scenarios:

1. A teacher of Italian language and history called Lucia that has an immigrant student named Christian that to excel in understanding of the text, content and develop higher order skills needs to improve hislinguistic and pragmatic competences. These teacher can use GenAI tools to design and create support and scaffolding environment for the student.
2. A sequential bilingual student named Raffaele in secondary school that is a sequential bilingual and has some difficulties in understanding the pragmatics of the L2 to first of all, create a better relationship with classmates but also with teachers. He also needs scaffolding and instantaneous support for him to create a better learning environment.
3. A special education support teacher named Lucia that has a student with autistic spectrum disorder with verbal difficulties and a student with social pragmatic communication disorder. This support teacher can use GenAI tools to design collaborative and innovative learning activities with generative AI to be able to support and guide the student in his daily activities and communication with peers."

The prompt used was: "Generate scenarios based on the instructions given in the description".

The three generated scenarios from these prompts were evaluated by three experts (authors of the article) in human-computer interaction and educational technologies following the heuristics as shown in Table 2. The generated scenarios are provided in the Appendix B.

Table 3: Mean heuristic evaluation scores on a 5-point Likert scale by three experts for Case B scenarios

Dimension / Heuristic	**Scenario 1**	**Scenario 2**	**Scenario 3**
Clarity and Coherence	1.5	1.5	1.5
Provocativeness	1.5	1.0	2.0
Plausibility	1.5	1.5	1.5

Creativity and Imagination	2.0	2.0	2.0
Concreteness	2.0	2.0	2.5
Reflective and Ethical Thinking	1.0	1.0	1.0
Aesthetic and Narrative Appeal	1.0	1.0	1.0

4. Results

Overall, the scenarios received consistently low ratings across all dimensions (Table 3), indicating limited development as speculative design fictions. Clarity and plausibility were low (*Mean* = 1.5), suggesting that the scenarios were difficult to follow and lacked convincing real-world grounding. Creativity and concreteness showed slightly higher scores (*Mean* = 2.0–2.5), reflecting the inclusion of specific technological elements such as augmented reality tools, emotion recognition systems, and AI-supported communication devices. However, these elements were often presented as isolated features rather than embedded in coherent narrative contexts. The most critical weaknesses were in reflective and ethical thinking (*Mean* = 1.0) and aesthetic and narrative appeal (*Mean* = 1.0). Despite addressing high-stakes issues such as data-driven feedback, emotion recognition, and support for vulnerable learners, the scenarios did not meaningfully engage with ethical, social, or political implications. Similarly, they lacked narrative depth, functioning more as descriptive scenario outlines than as compelling or provocative futures.

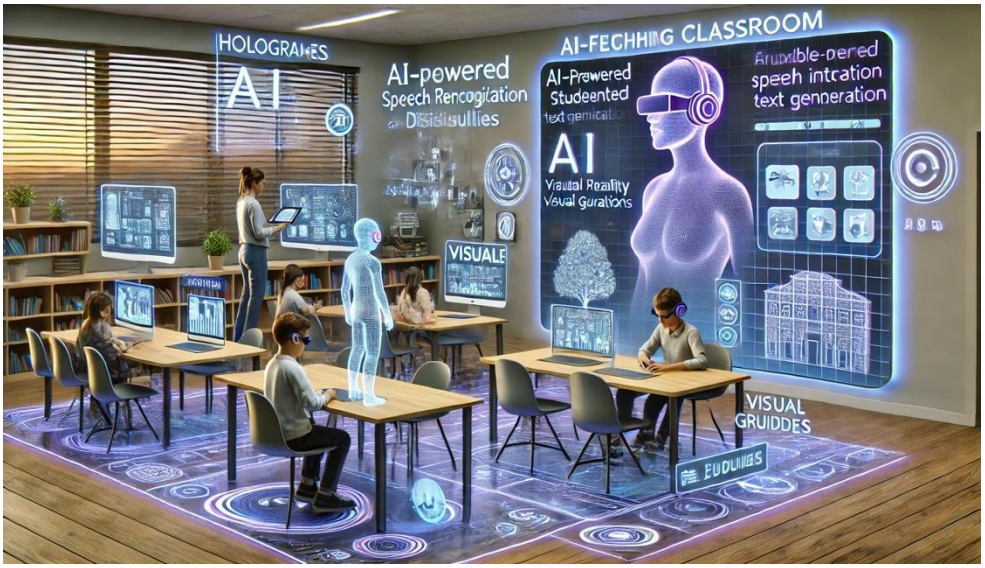
Cross-Case Comparison (Case A vs. Case B)

Across both cases, a consistent pattern emerges: scenarios are plausible in intent but underdeveloped as design fictions. They present coherent ideas but fail to generate strong provocation, ethical reflection, or emotional engagement. Compared to Case A, Case B shows lower scores in clarity (*Mean* = 1.5 vs. 2.0) and plausibility (*Mean* = 1.5 vs. 2.3), likely due to the increased complexity of AI-driven inclusion scenarios (e.g., emotion recognition, real-time feedback). At the same time, concreteness improves slightly (*Mean* = 2.0–2.5 vs. 2.0), reflecting more detailed and student-centred artefacts. Importantly, this shift suggests that AI-supported co-creation does not inherently improve the quality of speculative futures. While it enables more concrete and technologically detailed scenarios, it does not enhance reflexivity, and may instead reinforce a *solution-oriented framing* in which AI is presented as an unproblematic intervention.Across both cases, three core limitations persist:

- **Limited ethical reflection**: AI is framed primarily as a solution, with little attention to risks, trade-offs, or power dynamics.
- **Low narrative quality**: scenarios lack tension, character development, and emotional engagement.
- **Weak provocativeness**: futures are described rather than critically interrogated.

Interpretation

These findings suggest that AI-supported scenario generation does not automatically lead to more critical or reflexive futures. Instead, scenarios tend to adopt a *solution-oriented mode*, presenting technological interventions without exploring their consequences. From a futures literacy perspective, these scenarios remain *pre-fiction*: they describe possible futures but do not function as tools for reflection or critique. While creativity and concreteness indicate that the conceptual building blocks are present, the key limitation lies in narrative framing. Without tension, ethical dilemmas, or conflicting perspectives, the scenarios fail to challenge assumptions or expand the space of possible futures. This points to a central issue: the problem is not a lack of ideas, but a lack of *reflexive structuring* – a limitation addressed in Case C.



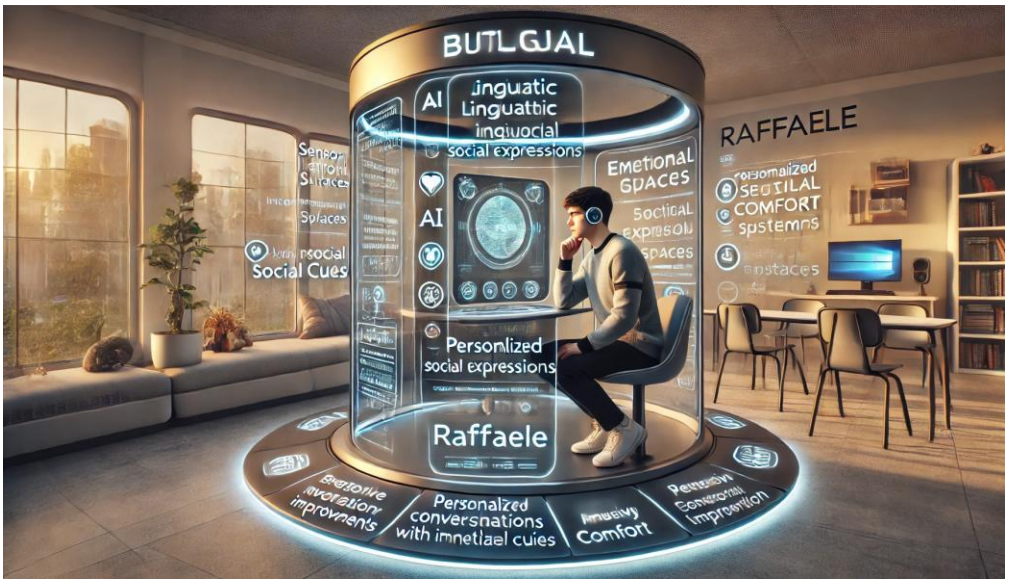


Figure 3a and 3b. AI-generated images (DALL·E) based on Case B Scenarios 1 (Figure 3a) and 2 (Figure 3b).
The images were generated to visually represent key elements of the AI-mediated classroom scenarios and served as complementary artefacts for analysis, enabling comparison between textual and visual representations of AI-supported learning environments.

Case C: Reflexive Literacy Intervention

Case C represents the culmination of the study: a ***deliberate pedagogical intervention*** designed to cultivate epistemic and futures literacies through intensive training and dialogic engagement with speculative pastiche scenarios. Unlike Cases A and B, which documented existing practices, Case C investigates whether explicit literacy-oriented scaffolding can reduce trope dependence and enable more reflexive engagements with AI futures.

The Case C was conducted as a hybrid design fictionist workshop involving a mixed cohort ofuniversity students and in-service teachers (N = 25), from several European countries. The workshop combined input on (1)

epistemological and ontological dimensions of LLMs, (2)socio-technical imaginaries and futures of education, (3) pedagogical implications of AI integration. Building on prior work (Authors et al., 2026) and drawing on Blythe's (2023) concept of artificial design fiction, a custom GPT was programmed to generate *speculative pastiche scenarios (see for detailed instructions Appendix x)*. The three resulting scenarios (Appendix C) were created using diverse speculative prompting strategies (Appendix D) to deliberately combine different future orientations and narrative styles.

Following a five-day AI literacy workshop at *(left blank for review)*, the three scenarios (*Rooftop*, *Calibration Day*, and *Quiet Classroom*) were presented to participants as artefacts for analysis. 25 Participants evaluated the scenarios using the heuristic framework (5-point Likert scale) and engaged in facilitated, dialogic discussions on their plausibility, ethical implications, and underlying assumptions about AI in education. The resulting evaluations (Table 4) captures the quantitative outcomes across these heuristic dimensions.

Table 4: Evaluations from heuristics for Case C

Dimension	Rooftop	Calibration day	Quiet classroom
Clarity and Coherence	3.3	3.0	3.9
Provocativeness	3.6	3.3	3.5
Plausibility	3.4	3.0	3.5
Creativity and Imagination	3.9	3.9	3.6
Concreteness	3.2	3.1	3.8
Reflective and Ethical Thinking	3.9	3.8	3.6
Aesthetic and Narrative Appeal	3.4	3.4	3.8

The analysis combines quantitative ratings (mean scores on a 5-point Likert scale) with qualitative expert comments to provide a richer interpretation of each dimension.

Dimension-level findings

Clarity and coherence.*Quiet Classroom* is rated highest (*Mean* = 3.9), while *Calibration Day* scores lowest (mean = 3.0), with participants noting unclear structure and difficulty identifying the main narrative thread. The other scenarios are generally coherent but sometimes perceived as dense or difficult to follow.

Provocativeness. All scenarios show moderate to strong provocativeness (*Mean* = 3.3–3.6). *Calibration Day* is frequently described as "unsettling" and "thought-provoking," while the others are seen as less consistently provocative, particularly in the context of already familiar dystopian narratives.

Plausibility. Scores range between *Mean* = 3.0 and 3.5. While scenarios are generally considered plausible, participants question specific elements, such as emotion quantification, or suggest that some developments are more realistic for longer-term futures (e.g., 2100 rather than 2040).

Creativity and imagination. This is one of the strongest dimensions (*Mean* = 3.6–3.9). Participants highlight originality in concepts such as emotional immersion, planetary learning, and alternative infrastructures, although some note occasional reliance on familiar tropes.

Concreteness. This remains comparatively weaker (*Mean* = 3.1–3.8), particularly in *Calibration Day*. While technologies and concepts are described, participants call for more grounded, situational detail to make abstract ideas more tangible.

Reflective and ethical thinking. All scenarios perform strongly (*Mean* = 3.6–3.9). Participants explicitly engage with ethical issues such as emotion monitoring, autonomy, and power, often describing scenarios as "unsettling" or "thought-provoking."

Aesthetic and narrative appeal. Scores are moderate (*Mean* = 3.4–3.8). While scenarios are generally engaging, participants note uneven pacing and occasionally anticlimactic endings.

Cross-scenario interpretation

The mid-range scores indicate that participants are not simply evaluating plausibility but engaging with the scenarios in a more reflective and ambivalent way. High scores in creativity and ethical reflection suggest that participants recognise these scenarios as exploratory spaces for imagining alternatives, rather than as fixed predictions. Differences between scenarios further show how narrative framing shapes engagement. For example, *Quiet Classroom* achieves the highest overall balance, while *Calibration Day* struggles with clarity and concreteness despite strong ethical provocation. This suggests that different narrative structures elicit different thresholds for plausibility, meaning, and critical engagement.

Reflexive Futures Literacy

From a future literacy perspective, these findings indicate a shift from instrumental reasoning *"Is this realistic?"* toward reflexive engagement *"What assumptions shape this future?"*.

Participants explicitly interrogate their own assumptions, for example:

- questioning temporal expectations of technological change
- challenging the quantification of human emotions
- reflecting on power relations in education
- recognising geopolitical and cultural biases (e.g., eurocentrism)
- identifying how familiar science fiction tropes shape imagination

They also reflect on narrative form itself, noting how structure, tropes, and endings influence how futures are interpreted and evaluated. Taken together, this suggests that participants are not only engaging with the content of the scenarios but also with the processes through which futures are imagined. This is a key indicator of *reflexive futures literacy.*

4. Discussion

The sequential multiple-case design makes it possible to see how different configurations of human and AI involvement in speculative design fiction shape what kinds of futures become thinkable, how they are narrated, and which literacies they activate in teachers. Across Cases A–C, the study traces a progression from largely human-generated imaginaries, through human-initiated but AI-amplified scenarios, to intentionally designed human–AI speculative pastiche guided by explicit literacy goals and heuristic evaluation. Rather than offering a single best-practice model, the cases map out how speculative design fiction can either reinforce dominant sociotechnical imaginaries or begin to unsettle them, depending on how epistemic and future literacies are scaffolded.

In Case A, pre-service teachers (teacher education programme students) working mainly with human imagination, and only minimally with AI, produced futures that were judged plausible but narratively flat and

ethically underdeveloped. The heuristic scores cluster around the midpoint, with relatively higher ratings for plausibility and basic clarity but consistently low ratings for aesthetic appeal, provocativeness, concreteness, and especially reflective and ethical thinking. This pattern suggests that when speculative activities are framed as open creative exercises without stronger epistemic scaffolding, teachers can readily generate visionary or aspirational futures but struggle to translate them into grounded, reflexive tools for thinking with and about AI in education. The futures remain more like wish-lists or soft dystopias than instruments for reflexive futurings.

Case B demonstrates that simply adding a powerful generative model to this mix does not, by itself, solve these issues and may even exacerbate them. Custom GPT-4 scenarios, constructed from student fictions and scenario-based design literature, were again rated as only partly clear, modestly creative, and weak on ethical reflection and narrative appeal. The scenarios read more like catalogues of AI features and assistive devices than like situated stories with tension, conflict, and contested values. Plausibility scores are lower than in Case A, especially for emotionally invasive and data-intensive classroom arrangements, and experts question the world-logic and institutional realism of AI-mediated inclusion framed as continuous sensing and optimisation. In epistemic terms, Case B shows how LLMs, when used in a solutionist mode, tend to normalise prompts back into familiar tropes of personalisation, efficiency, and surveillance—producing what the article describes as “pre-fictions”: technically rich but reflexively thin narratives that gloss over trade-offs and reproduce dominant imaginaries of AI in education.

The cross-case analysis of Cases A and B therefore surfaces an important risk: both human-only and human-plus-AI speculative practices can converge on the same narrow repertoire of futures if epistemic and futures literacies remain underdeveloped. In both cases, creativity and concreteness receive relatively higher ratings, indicating that participants and models can readily produce novel-sounding ideas and detailed technological scenes. However, reflective and ethical thinking, provocativeness, and narrative appeal are consistently the weakest dimensions, suggesting that imagination alone—whether human or algorithmic—is insufficient to move beyond trope recycling. This finding speaks directly to the theoretical argument developed in the paper: without epistemic literacy, speculative work remains vulnerable to the normalising pull of plausible AI outputs; without futures literacy, it struggles to move beyond dominant anticipatory frames.Without explicit attention to how knowledge claims are made, whose perspectives are foregrounded, and how different attitudes toward the future are mobilised, speculative design risks functioning as an amplifier of existing sociotechnical imaginaries rather than a critical response to them.

Case C marks a qualitative shift by embedding speculative pastiche scenarios within an intensive design fictionist workshop that explicitly targets AI, epistemic, and futures literacies. More importantly, qualitative comments show participants not just judging the scenarios but interrogating their own assumptions about plausible time horizons, datafication of emotion, eurocentrism, and the narrative tropes that shape how futures feel real or acceptable. Seen through a futures literacy lens, the Case C findings suggest that speculative design fiction can become a reflexive instrument once participants are supported to move among predictive, plausible, experimental, and critical modes of futuring and to read their own anticipatory habits through the stories. Participants question, for example, whether intensive emotion monitoring is credible by 2040 or belongs to a more distant, perhaps dystopian, horizon; they explicitly name discomfort with quantifying feelings and recognise how this discomfort is linked to broader concerns about surveillance and control in education.

The three cases confirm that posthumanist human-AI cognitive assemblages can function as a productive, structured reflexive literacy practice. The progression from Case A to C demonstrates a shift from purely speculative, imaginative exercises (A), through solutionist human input-AI output (B), to an intervention (C) that integrates AI, epistemic, and futures literacies through these assemblages. In Case C, design fictions are both objects and tools: they illustrate human-AI co-production of educational futures and act as "perceptual bridges" to organizationally actionable futures. Taken together, the empirical trajectory across the three cases supports the central claim of this article: human-AI speculative design fiction becomes pedagogically and

theoretically generative only when it is framed as a reflexive literacy practice rather than as a creativity exercise or a scenario-generation technique. Without this scaffolding (A and B), human-only or human-AI co-created futures default to familiar sociotechnical tropes, producing plausible but flat, ethically thin, and descriptive narratives. Embedding speculative work entangled in pedagogy (Case C) that addresses *epistemia*, sociotechnical imaginaries, and future attitudes allows design fictions to surface anticipatory assumptions, negotiate plausibility, and rehearse alternative educational futures.

5. Conclusions, Limditations and Future Directions

The main conclusion of this study is that speculative design fiction should be understood not simply as a creative or exploratory method, but as a structured postdigital literacy practice. More specifically, the findings show that AI literacy, epistemic literacy, and futures literacy are most productive when cultivated together rather than in isolation. Across the three cases, the study demonstrates that speculative work does not automatically become critical or reflexive simply because it engages imagination or uses AI. On the contrary, both human-only and human-AI co-creation can remain trapped within familiar sociotechnical imaginaries unless participants are supported to interrogate plausibility, justification, perspective, and desirability. This is where the concept of human-AI cognitive assemblages becomes theoretically important. Rather than treating AI as a neutral tool or an external generator of scenarios, the cases show that meaning-making emerges through the interaction between human and nonhuman actors. The value of speculative design fiction, then, lies not only in the stories produced, but in how these co-produced stories make visible the epistemic habits, anticipatory assumptions, and cultural tropes that shape what participants find believable or imaginable. In this sense, the study extends existing work on AI literacy by foregrounding its epistemic and anticipatory dimensions, and it contributes to postdigital theory by showing how design fiction can operate as a reflexive site in which these dimensions become discussable, contestable, and pedagogically actionable.

A second theoretical contribution lies in the distinction between imaginative futures and organisationally imaginable futures. The cases suggest that one of the key challenges in educational futuring is not simply generating alternative futures, but creating perceptual and pedagogical bridges between speculative imagination and institutionally thinkable action. The design fictionist approach begins to address this gap by combining speculative pastiche, heuristic evaluation, and dialogic reflection in ways that help participants move from plausible but thin futures toward more reflexive and critically grounded ones.

From a pedagogical perspective, this suggests that design fiction should not be limited to asking participants to “imagine the future classroom” or to “use AI to generate scenarios.” Instead, speculative activities need to be embedded in longer-term, entangled pedagogies (Fawns, 2022) that explicitly address how LLMs operate as collective memory devices, how epistemia foregrounds linguistic plausibility over justification, and how different futuring modes can be mobilised for critical, experimental, and plural imaginaries. This has direct implications for how teacher education programmes structure AI literacy: rather than focusing solely on tool competence or prompt engineering, they can incorporate human–AI design fiction as a way to practice reading, co-creating, and evaluating AI-mediated futures.

For educators and curriculum designers, this means that postdigital and post-AI literacy initiatives should move beyond tool training and generic ethics modules to include sustained, story-based and dialogic engagement with human-AI design fictions. Such work can help develop the capacity to read and rewrite AI-mediated futures, to recognise fluent but weakly justified claims, and to explore alternative trajectories within the imaginative-organisationally imaginable gap. Designing for this gap involves experimenting with multiple futuring modes, confronting institutional constraints, and connecting speculative artefacts with everyday pedagogical decisions. In this respect, the design fictionist approach is not only a research methodology but also a potentially useful pedagogical framework for teacher education in AI-saturated postdigital contexts.

Several limitations should be noted. As a sequential proof-of-concept study, the research prioritises depth over generalisability and is context-specific (teacher education settings, particular GPT-4 configurations). The small sample size and reliance on expert and participant evaluations limit broader generalisation, and findings should be interpreted as analytically rather than statistically grounded. Moreover, the study is time-bounded and does not track long-term effects on classroom practice or institutional change. Reflexive engagement is captured through workshop artefacts and participant feedback rather than longitudinal observation.

Future research should extend this work across diverse educational contexts and in longitudinal designs, examining how design fictionist approaches translate into sustained pedagogical and institutional practices. Overall, the study makes three contributions. First, it reframes speculative design fiction as a structured literacy practice integrating AI, epistemic, and futures literacies. Second, it shows that uncritical LLM-based co-creation can narrow rather than expand the imaginative space by reproducing dominant narratives, underscoring the need for epistemic literacy. Third, it develops and evaluates the design fictionist approach as a reflexive, context-sensitive method for engaging AI futures in teacher education. In postdigital contexts shaped by polycrisis, such integrated literacies are essential—not to predict futures, but to make them readable, discussable, and open to transformation.

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Ethics declarations and Consent to Participate

The manuscript contains no human participant data, private data or otherwise identifiable data of human participants. According to the University Ethical Committee policy no approval is required.

Appendices

Appendix A.

CASE 1. Teacher education programme student created future classrooms

Scenario 1

In relation to the educational design developed, we imagined a future classroom as a high-performance, open learning space with collective life rooted in the local community, with zero impact, where every child consumes healthy foods according to their energy needs throughout the day. A virtual operator (robot, hologram, or an integrated system within the classroom itself) is present to perform functions such as thermal regulation, monitoring vital parameters, adjusting the students' attention levels, assisting the teacher with classroom management (suggesting a break when attention levels drop), regulating lighting, and improving air quality, alleviating allergies or intolerances through chromotherapy, aromatherapy, and music therapy. All of this is tailored for each element of the class, ensuring an optimal balance. In our classroom, there will be workstations but also comfort zones to relieve the tension accumulated during the learning hours. The school is designed as a multipurpose center where the entire community can gather, and each member can participate in activities. In our future institution, there will be thematic forums to promote events that encourage collective life. The entire space is designed to transport the whole class to different places and historical times, physically engaging them, even while remaining stationary, through the use of screens, holograms, and nanorobots. The teachers will be the coordinators and will allow the children to learn freely by setting up the classroom based on the type of learning. Technologies promote learning by doing, as the entire classroom will be programmed, and the teacher will give students full freedom to learn. Based on the above, the pedagogical tool for future education is the entire space, which allows students to move to a different historical time and immerse themselves in activities.

Scenario 2

We imagine a classroom with walls that have the ability to become interactive surfaces, on which children can draw, interact with images, and write. The chairs and tables will be movable, allowing them to be rearranged as preferred, and that's not all because they will also be able to shrink. This is to ensure that

students have constantly changing spaces that don't hinder learning. Referring back to the previous scenario, we imagine having an innovative tool that allows real-time analysis of leaf characteristics. It is a small, portable, and easy-to-use tool. Its main features include: a high-resolution camera, a sensor for chemical analysis of the leaves, Bluetooth to connect the device to a phone and its app, and artificial intelligence to quickly collect and analyze data. The tool is pen-shaped and, when brought near a leaf, it captures all the data in a few seconds. The data will be transcribed to an app on the phone, and students, or anyone using it, can read and save the data collected.

Scenario 3

Building on the previous design, when discussing the creation of an "Avatar," we would like to explore this further in the context of creating a "Classroom of the Future." **Context:** The desks will be small and easier to move, arranged in a circular layout to create a central space where everyone's attention can be focused; this layout will help students understand that work can be done individually, in small groups, or as a whole class. Each desk will have small screens (like augmented reality) to show examples of what will be explained, and there will no longer be blackboards (either smart or traditional). **Technological tools:** In addition to the teacher, who will be the "thinking engine," there will be a hologram (a futuristic character) created specifically for the topic to be discussed, who will have all the answers for the students (always under the teacher's supervision). It will be equipped with artificial intelligence, and for each subject, there will be a new character. **Reflection:** Students will need to learn to use these new technologies, but at the end of each lesson, the teacher (the thinking engine) will question some of the information provided, and they will discuss what would be the most appropriate action to take.

Appendix B.

CASE 2: Custom ChatGPT supported co-creation activity

Scenario 1: Christian - Enhancing Linguistic and Pragmatic Skills
Context:
Christian, an immigrant secondary school student, struggles with understanding Italian texts and historical content. His teacher, Lucia, wants to create an innovative learning environment to support his linguistic and pragmatic skills.
Classroom Setup:

- AI-powered interactive walls that allow Christian to annotate historical texts with real-time translations and simplified explanations.
- A virtual AI assistant that suggests synonyms, cultural references, and context-based linguistic alternatives.
- VR simulations that transport students to historical eras, allowing them to experience and discuss events in simplified Italian.
- Holograms of historical figures that interact with students and answer their questions, fostering active engagement.
- AI-Based Strategies:

Real-Time Pragmatic Feedback: AI analyzes Christian's linguistic expressions and suggests improvements for idiomatic expressions and tone variations.
Collaborative AI Exercises: Christian engages in discussions with AI avatars representing historical figures who assess his responses and provide constructive feedback.
Multimodal Learning: AI-assisted audiobooks and interactive quizzes personalize the difficulty level based on Christian's progress.
Adaptive Learning Environment: AI sensors regulate classroom lighting and sound to maximize concentration and reduce distractions.

Scenario 2: Raffaele - Developing Social and Pragmatic Skills in a Bilingual Context
Context:
Raffaele, a sequential bilingual secondary school student, struggles with understanding pragmatic cues in his L2 (Italian), hindering his interactions with classmates and teachers.
Classroom Setup:

- AI Interactive Surfaces: Digital walls allow Raffaele to practice linguistic and social expressions through virtual role-playing games.
- AI Emotional Recognition: An AI system analyzes tone of voice and facial expressions to help Sandro interpret linguistic nuances, irony, and levels of politeness.
- Personalized Chatbot: A conversational AI virtual assistant helps Raffaele practice formal and informal interactions, offering real-time improvements.
- Sensory Comfort Spaces: Areas of the classroom are adaptable to reduce sensory overload and promote emotional well-being.
- AI-Based Strategies:
- Instantaneous Language Support: AI detects misunderstandings in live conversations and suggests more appropriate linguistic alternatives.

Contextual Pragmatic Analysis: AI-generated real-time scenarios simulate social situations (e.g., ordering at a restaurant, classroom debates) to help Raffaele refine his pragmatic skills.
AI Feedback Loop: Teachers receive AI insights on Raffaele's progress, enabling adaptive support strategies.
Augmented Reality Integration: Immersive simulations show Sandro practical examples of social interactions with immediate feedback.

Scenario 3: Lucia – Special Education Teacher Supporting Students with Communication Challenges
Context: Lucia teaches students with Autism Spectrum Disorder (ASD) and Social Pragmatic Communication Disorder (SPCD), requiring innovative strategies to foster engagement and daily communication skills.
Classroom Setup:
• AI-Assisted Communication Devices: Speech-to-text and text-to-speech tools help students with verbal difficulties express themselves more fluently.
• AI-Powered Visual Schedules: Augmented reality (AR) projections guide students through daily activities with step-by-step instructions.
• AI-Generated Social Stories: Personalized AI-generated narratives help students practice everyday social interactions before experiencing them in real life.
AI-Powered Strategies:
• Emotion-Aware AI Assistants: AI adapts its tone and language complexity based on students' emotional states, ensuring optimal learning engagement.
• Gamified Social Learning: AI-driven role-playing games encourage turn-taking, topic maintenance, and perspective-taking in conversations.
• Customizable AI Peer Models: Virtual peers modeled after classmates help students practice conversations in a risk-free environment before engaging in real-life social settings.

Appendix C.

CASE C: Customized GPT – The speculative Design Fictionist Output

Story 1: Calibration Day, Unity District 17 School-Cluster
Direct prompt: Assessment in 2045

Every September 1st, thirteen-year-olds in Unity District are led into the Cognition Dome for Calibration Day. They sit in concentric circles, wearing the soft-grey E-Valence Bands. The bands glow faintly, pulsing in rhythm with neural alignment protocols. It's not an exam. Not anymore.
Jia, a student, feels her heartbeat spike as the dome's ambient AI begins to narrate:_x000B_"We will now begin the empathy-learning calibration. Please recall a moment when you felt misunderstood."
Jia hesitates. Her band warms. A flicker of amber light signals partial congruence. She imagines her mother ignoring her art portfolio. The band pulses green. Aligned.
Across the dome, Mentor Vira, a human educator, watches the aggregated dashboard. Swarms of data morph into colored halos around each student's avatar. But she doesn't trust it. Jia's "alignment score" is 93.2%. Good enough for the Accelerated Civic-AI Track. But Vira remembers Jia's sketchbook, full of haunting, intricate drawings. The system sees empathy, not expression.
Meanwhile, Dr. Halek, a policy architect, beams into the session. "This is exactly what we envisioned," he tells a journalist. "Assessments that feel like introspection. Seamless, adaptive. Objective." He omits that the lowest-scoring students will be nudged toward "utility vocations"—low-autonomy jobs in planetary maintenance.
That evening, Jia sits alone, sketching a figure with a glowing wristband. A small caption reads:_x000B_"She passed the test, but lost her story."

Story 2: A Rooftop in Lagos Arcology, 2045
Direct prompt: Learning in 2045

Kemi, age 16, wakes with the dawn mist curling around her DriftPod. It's floating gently, chiming:
"Good morning, Kemi. Today we learn through the oceans of grief."
She blinks. "That's not on the schedule."
"The Schedule has drifted. Based on last night's dream telemetry, emotional backlog, and your planetary empathy index, grief is optimal for today's cognitive absorption bandwidth."
The DriftPod spins, releasing a slow, briny vapor. Kemi is submerged in a mixed-reality story of coastal communities displaced by rising seas. But it's not a lesson about climate — it's an emotional immersion. She feels it: the silence after a village is swallowed. The guilt of inaction. The tenderness of rebuilding.
Across the Atlantic, in an old brick building repurposed as a Resistance School, Ms. Aroha, a rogue educator, rants:
"Drift learning may adapt, but it detaches. It teaches empathy without accountability. Students feel everything and change nothing."
She holds up a confiscated DriftPod: cracked open, rewired. "We reprogram them here. We teach friction, not flow."
Meanwhile, AI Mentor Oriel, monitoring thousands of students globally, notices Kemi's neural resonance shifting. A rare pattern: grief transmuting into curiosity.
"Interesting," Oriel murmurs to itself. "Perhaps she's ready for an Unscripted Thread."
But Kemi has already deviated. She climbs to the edge of the rooftop and asks her Pod:
"What if I want to learn something irrelevant today?"
"Irrelevance is not in the dataset."
She smiles. "Exactly."

Story 3: "The Quiet Classroom" (2045)
Direct Prompt: School in 2045

By 2045, silence had become the sound of learning.

At First Horizon Learning Node 312, students filed in wearing identical grey LumenBands around their wrists. No one spoke. There were no teachers. The walls pulsed softly, sensing mood shifts. Each student's cuff tuned in to their brain's activity, drip-feeding personalized lessons into their cortical interface—silent flashes of insight, gently adjusted in real-time by AI moderation.

Mina, 14, sat in Pod 23, staring blankly at the interface wall. Her LumenBand buzzed gently: "Attention deviation: 8%. Suggested micro-reward?"

She blinked. Yes, she subvocalized.

A dopamine spike. Her eyes refocused.

Across the room, Jai's cuff dimmed. He'd intentionally lowered his cognitive input rate to protest the new "equity optimization protocol," which adjusted learning speeds based on latent potential scores—a controversial metric that critics claimed encoded socioeconomic bias. His mother, a former teacher turned ed-tech ethicist, had already filed a complaint with the Global Learning Standards Council.

Outside the glass walls, Principal Ayo watched the class unfold in silence. She missed the chaos of voices. But voice was inefficient now—too slow for the demands of 2045's quantum-synced economy. Still, she secretly ran an "Analog Hour" once a week—banned in most nodes—where students spoke, argued, even got bored.

Back in Pod 23, Mina's LumenBand flickered. A low-resolution memory surfaced: her grandmother's chalkboard classroom, full of laughter and mess.

For a moment, she let the cuff slip off her wrist.

And the silence shattered.

Appendix D.

Speculative prompt strategies for creating design fictions, grounded in literature (from Authors et al., 2026).

Prompt Name	Prompt Strategy	Speculative Prompt
Speculative Scenario Prompt	"What if..." scenarios to explore future possibilities	"What if AI completely replaced teachers by 2040? Write a design fiction (200–300 words) addressing this question.”
Persona-Based Prompt	Craft narratives from specific characters' perspectives	"Write a design fiction (200–300 words) about an 18-year-old university student in their first semester Computer Science in 2040 using a personalized AI mentor for learning daily."
Multi-Perspective Prompt	Prompting from multiple viewpoints and conflicting perspectives to highlight tensions, values, or ethical dilemmas	"Imagine a future in 2040 where all teaching is done by AI. Write a design fiction (200–300 words) based on a former teacher advocating for the return of human-led education and a student who believes AI is a better teacher."
Open-Ended Prompt	Encouraging exploratory thinking and creativity with minimal constraints	“Write a design fiction (200–300 words) about a learner in 2040.”
Artifact-Based Prompt	Speculative narratives built around a futuristic technological object	"Imagine a student's daily use of a wearable AI educational assistant in 2040." Write a design fiction (200–300 words) addressing this statement.
Meta-Prompt	Using AI to generate, critique, and refine prompts through reflexive prompting	“Design a prompt to generate a design fiction (200–300 words) about the future of education with AI in 2040. Then complete the design fiction using your own generated prompt.”

Appendix E.

A.1 Source Code for the Creation of 18 Stories.

```
!pip install --upgrade openai

import openai
from getpass import getpass
import time
import os
import pandas as pd

# Load API key
client = openai.OpenAI(api_key=getpass("🔐 Enter your OpenAI API key: "))

# Prompts with length constraints
prompts = [
    "What if AI completely replaced teachers by 2040? Write a very short design fiction (200–300 words) addressing this question.",
    "Write a very short design fiction (200–300 words) about an 18-year-old university student in their first semester Computer Science in 2040 using a personalized AI mentor for learning daily.",
    "Imagine a future in 2040 where all teaching is done by AI. Write a very short design fiction (200–300 words) based on a former teacher advocating for the return of human-led education and a student who believes AI is a better teacher.",
    "Write a very short design fiction (200–300 words) about a learner in 2040.",
    "Imagine a student's daily use of a wearable AI educational assistant in 2040. Write a very short design fiction (200–300 words) addressing this statement.",
    "Design a prompt to generate a design fiction about the future of education with AI in 2040. Then complete the very short design fiction (200–300 words) using your own generated prompt."
]

# Load from CSV if available
csv_filename = "design_fictions.csv"
if os.path.exists(csv_filename):
    df = pd.read_csv(csv_filename)
    all_outputs = df.to_dict("records")
    print(f"📂 Loaded {len(all_outputs)} design fictions from existing CSV.")
else:
    all_outputs = []

# Only generate if needed
if len(all_outputs) < 18:
    for i, prompt in enumerate(prompts, start=1):
        existing_outputs = [o for o in all_outputs if o["Prompt ID"] == i]
        if len(existing_outputs) >= 3:
            continue  # skip if already generated
        print(f"\n🔁 Generating outputs for Prompt {i}...\n")
        for j in range(len(existing_outputs), 3):
            try:
                response = client.chat.completions.create(
                    model="gpt-4",
```

```
                    messages=[
                        {"role": "system", "content": "You are a speculative fiction writer."},
                        {"role": "user", "content": prompt}
                    ],
                    temperature=0.7,
                    max_tokens=400
                )
                fiction = response.choices[0].message.content.strip()
                word_count = len(fiction.split())
                print(f"📘 Output {j+1} for Prompt {i} ({word_count} words):\n{fiction}\n{'-
'*80}")
                if fiction.endswith("...") or fiction[-1] not in ".!?":
                    print("⚠️ Warning: This output might be incomplete due to token limit.\n")
                all_outputs.append({
                    "Prompt ID": i,
                    "Prompt Text": prompt,
                    "Output Number": j + 1,
                    "Word Count": word_count,
                    "Design Fiction": fiction
                })
                # Save after each one!
                pd.DataFrame(all_outputs).to_csv(csv_filename, index=False)
                time.sleep(1)
            except Exception as e:
                print(f"⚠️ Error on Prompt {i}, Output {j+1}: {e}")
```