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Human-Centered Narrative Intelligence in AI: Advancing Education and Training for Sustainable Manufacturing Leadership

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Abstract

Narrative intelligence refers to the capacity to create, interpret, and emotionally engage with stories. We propose that equipping artificial intelligence systems with computational narrative intelligence can open a wide range of human-centered applications. To achieve this, however, several key challenges in machine learning must be addressed. Ultimately, we suggest that computational narrative intelligence represents a meaningful step toward *machine enculturation* the process of enabling machines to understand and internalize sociocultural values.

Keywords: Human-centered artificial intelligence, Narrative intelligence, AI in education and training, Sustainable manufacturing leadership, Computational storytelling, Decision-making transparency

Introduction

The convergence of **Artificial Intelligence (AI), education, and sustainable manufacturing leadership** represents one of the most transformative frontiers of the 21st century. While AI has traditionally been seen as a computational and data-driven paradigm, the concept of **narrative intelligence** introduces a human-centered perspective. Narrative intelligence refers to the capacity of systems to understand, generate, and use stories for communication, interpretation, and decision-making. When applied to the training of manufacturing leaders, narrative intelligence can foster **transparency, ethical awareness, and sustainability-oriented decisions**. The urgency of embedding sustainability in manufacturing is undeniable, given the realities of climate change, resource scarcity, and economic volatility. At the same time, education systems must prepare leaders who can balance technological progress with human values and environmental stewardship. AI, enhanced with narrative intelligence, becomes a critical enabler in this transformation.

This study positions human-centered narrative intelligence as a paradigm for advancing leadership training. By embedding **storytelling, case-based reasoning, and explainable AI**, the research seeks to bridge the gap between technical decision-making and human-centric sustainable leadership.

This study is significant as it addresses challenges at the intersection of AI, machine learning, and human narrative practices. Storytelling is central to how humans share knowledge and culture (Bruner, 1991), yet enabling machines to replicate narrative intelligence requires more than pattern recognition. It demands **commonsense reasoning, cultural awareness, metaphorical understanding, and creativity** (Mateas & Sengers, 2003).

The study identifies major obstacles such as gaps in domain knowledge and metaphorical complexity while highlighting promising directions including **corpora, crowdsourcing, multimodal learning, and conceptual blending** (Veale, 2017). Progress in this field could revolutionize education, healthcare, entertainment, and human-computer interaction by enabling adaptive learning tools, culturally grounded assistants, and therapeutic storytelling.

Ultimately, this research contributes to bridging computational models of narrative with the **imaginative and meaning-making processes of human communication**, moving AI closer to systems that can **understand, empathize, and interact meaningfully** (Herman, 2002).

Review of Literature

Storytelling, as a uniquely human faculty, has long been studied across literature, psychology, philosophy, and anthropology. Jerome Bruner views narrative as a primary mode of thought, shaping how humans construct reality (Bruner 11–13), while Walter Fisher's narrative paradigm defines individuals as *homo Narran's* storytelling beings who interpret the world through coherence and fidelity (Fisher 2–5). Stories thus function not only as entertainment but as cultural, ethical, and epistemological frameworks.

Cognitive science reinforces this view, showing that narratives enhance memory and meaning-making more effectively than isolated facts (Schank and Abelson 47–50). This explains their importance in education, therapy, and decision-making, while also highlighting why computational models without narrative understanding struggle in human-like interactions.

The emergence of AI gave rise to **computational narrative intelligence**. Early symbolic approaches drew on formal systems such as Vladimir Propp's *Morphology of the Folktale* (Propp 19–23) and David Rumelhart's story schemas (Rumelhart 265–67). Later, machine learning and natural language processing expanded research into adaptive storytelling and interactive fiction. Scholars like Michael Mateas, Mark O. Riedl, and James Lester pioneered frameworks combining computational reasoning with human creativity. Meanwhile, digital media and narratology explored how technology reshapes narrative practices. Espen Aarseth's *ergodic literature* emphasized participatory storytelling (Aarseth 1–3), and Janet Murray envisioned immersive digital narrative spaces (*Hamlet on the Holodeck* 110–15). These perspectives stress that machine narrative intelligence must integrate multimodality, interactivity, and affective depth.

Recent advances in **deep learning and large language models (LLMs)** like GPT demonstrate unprecedented narrative fluency but still struggle with coherence, contextual grounding, and emotional resonance (Floridi 89–92). Scholars position computational narrative intelligence as both an aspirational ideal and a frontier requiring integration of symbolic reasoning, affective computing, and cultural theory.

Overall, literature reveals a dual trajectory: humanistic studies stress narrative's role in meaning-making and cultural continuity, while computational research highlights the challenges and possibilities of instilling narrative competence in AI. Bridging these approaches is vital to creating systems that are **culturally situated, emotionally resonant, and contextually intelligent**.

Computational Narrative Intelligence

Winston (1982) identifies **narrative intelligence**—the ability to make sense of, create, and emotionally respond to stories—as a defining human trait. In artificial intelligence, **computational narrative intelligence** seeks to replicate these capacities, enabling machines not only to answer questions about stories but also to generate original narratives that reflect human affect and culture. A longstanding challenge is **narrative question-answering**, which differs from factual queries by requiring recognition of implied causal and temporal relationships between events. Machines must therefore develop frameworks for representing the implicit knowledge embedded in natural language narratives.

Equally important is **machine story generation**, where systems produce fictional content such as fairy tales, television scripts, and interactive plots. While entertainment is a primary application, such stories can also transmit cultural values and moral lessons, making them pedagogical. Beyond fiction, researchers design AI to create **plausible real-world narratives**, which demand reasoning, imagination, and causal inference. These have practical applications in training simulations, forensic investigations, and educational tools. Virtual agents, such as digital tutors or health coaches, may also build rapport through anecdotal storytelling.

Narrative intelligence further enhances a machine's capacity to **anticipate emotional responses**. In journalism, for instance, automated writers could adapt tone and detail for different audiences. In entertainment, machines may deliberately craft suspense, excitement, or comfort. Sensitivity to emotion ensures that AI avoids distressing users while fostering engagement.

Finally, narratives play a key role in **explainable AI**. By framing decisions as stories—structured accounts of what was done, why, and how alternatives might differ—machines can provide transparent, human-friendly explanations. Counterfactual storytelling particularly aligns with human cognition, bridging the gap between technical reasoning and interpretability.

Thus, computational narrative intelligence is not merely technical but transformative, marking a step toward **machine enculturation**, where AI systems embody cultural values, emotions, and social dynamics inherent in human storytelling.

Theoretical Framework

This study employs an **interdisciplinary theoretical framework** that integrates classical narrative theory, cognitive psychology, and computational storytelling models. At its centre are Jerome Bruner's narrative theory, AI storytelling architectures, and digital narrative perspectives, including posthuman storytelling.

Bruner's Narrative Theory

Jerome Bruner (1990) argues that humans interpret reality through narrative cognition rather than purely logical paradigms. Stories, therefore, are foundational to organizing experience and constructing meaning. Key constructs include:

Narrative as knowledge: Stories help interpret actions, intentions, and social contexts.

Canonicality and breach: Narratives often revolve around disruptions of norms and their resolution.

Perspective-taking: Every story reflects a storyteller's viewpoint, vital for both human and AI narratives. Bruner's cultural psychology thus provides a lens to examine meaning-making in human and machine storytelling.

AI Storytelling Models

AI-driven storytelling operates at the intersection of NLP, machine learning, and cognitive modelling. Two major approaches dominate:

Symbolic narrative planning models (e.g., *Tale-Spin*, Meehan 1976; *Minstrel*, Turner 1993) that rely on logic-based world models.

Neural network–based generative models (e.g., GPT), which draw on large corpora to generate coherent, stylistically varied narratives.

Challenges include **narrative coherence**, balancing **creativity versus constraint**, and **prompt engineering** to shape narrative output. While echoing Bruner's notion of narrative as sense-making, these models operate via statistical pattern recognition rather than intentionality.

Digital Narrative & Posthuman Storytelling

From digital humanities, posthuman storytelling (Hayles, 1999) positions machines as co-authors, raising questions of authorship, agency, and authenticity.

Narrative Transportation Theory

Green and Brock's (2000) theory explains how immersion in stories influences beliefs and emotions, offering a metric to assess human versus AI-generated narrative engagement.

By weaving together **Bruner's psychology, AI models, posthuman theories, and narrative transportation**, this framework enables analysis of coherence, agency, and immersion in narratives constructed by both humans and AI.

Research Gap

Although AI has shown promise in education and sustainability, three key gaps persist. First, existing systems focus on efficiency but rarely integrate **narrative-centered AI** for leadership training. Second, the connection between **explainable AI, narrative intelligence, and sustainability leadership** remains underexplored. Third, there is a lack of **empirical evidence** on learners' perceptions of AI-driven narrative tools in leadership education. This study addresses these gaps by developing a **conceptual and empirical framework** that embeds human-centered narrative intelligence in AI-driven education, with a particular emphasis on **sustainable manufacturing leadership**.

Research Methodology

Methodology is the backbone of research, providing the structure that ensures credibility, reliability, and validity. It is not merely procedural but serves as a philosophical and practical roadmap for addressing problems, achieving objectives, and answering research questions with rigor. Without a sound methodology, even innovative inquiries risk remaining underdeveloped or lacking impact.

This study investigates human-centered narrative intelligence in artificial intelligence (AI) as a transformative tool for education and leadership training in sustainable manufacturing. Given its interdisciplinary nature—spanning computer science (AI and natural language processing), education (pedagogical strategies and learner engagement), and sustainability (ethics, long-term vision, ecological responsibility)—the research requires a design that is both robust and adaptive.

Accordingly, a **mixed-methods approach** is adopted. Quantitative methods, including surveys and descriptive statistics, will identify measurable patterns and correlations in learner responses to AI-enabled training. Complementing this, qualitative methods such as focus group discussions and narrative case studies will capture the nuanced, value-driven dimensions of leadership development. Together, these strands reflect the central premise of the study: narrative intelligence in AI must remain human-centered if it is to foster sustainable leadership, rather than functioning as a purely technical system.

Statement of the Problem

The rapid integration of AI into education and industry offers opportunities but also challenges. While AI systems are increasingly used for adaptive learning and personalized training, they often prioritize efficiency and technical outcomes over human-centered values such as transparency, ethics, and narrative understanding.

In sustainable manufacturing, effective leadership demands more than technical skill—it requires reflective judgment, ethical reasoning, and the ability to communicate complex sustainability goals.

Current leadership training rarely leverages AI's potential for narrative intelligence to cultivate these capacities. Consequently, AI often remains a "black box," limiting trust and adoption. This study addresses this gap by proposing and empirically evaluating a framework for narrative-centered, explainable AI in leadership education.

Objective of the Study

To examine how narrative intelligence, through AI-enabled tools, can enhance decision-making competencies and foster reflective, ethical, and transparent leadership practices in sustainable manufacturing.

Research Question

Can narrative intelligence enhance decision-making abilities required for sustainable manufacturing leadership?

The study is guided by the hypothesis that AI-enabled narrative intelligence tools are perceived by learners as more effective in fostering reflective learning than traditional text-based systems. It further assumes that integrating explainable NLP models into leadership training enhances transparency and trust. Additionally, narrative intelligence in AI is expected to positively shape sustainability-oriented decision-making skills, while story-driven educational interventions are hypothesized to promote greater engagement and retention than purely data-driven instruction.

Conceptual Framework

The conceptual framework (Figure 3.1) integrates three dimensions

Narrative Intelligence (Human-Centered AI): Ability of AI to generate, explain, and contextualize learning through stories and case studies.

Educational Leadership Training: Embedding storytelling and interpretability into manufacturing leadership curricula.

Sustainability Orientation: Guiding leaders to balance technical efficiency with ethical, ecological, and social dimensions.

Flow of the framework:

Narrative Intelligence → Transparent AI Explanations → Reflective Learning → Improved Decision Intelligence → Sustainable Manufacturing Leadership

This framework positions narrative intelligence not just as a computational feature but as a pedagogical tool, aligning AI systems with human-centered values.

Research Design

This study employs a mixed-methods research design to examine the influence of computational narrative intelligence on the quality, coherence, and cultural relevance of AI- generated narratives. Both quantitative and qualitative methods are integrated to provide a thorough evaluation aligned with the formulated hypotheses.

Model Development

Two categories of models will be developed for comparison

Baseline Models: Standard language models without any narrative intelligence enhancements (Control group).

Enhanced Models: Models augmented with narrative intelligence frameworks, including:

Commonsense reasoning modules, drawing from knowledge-based and crowdsourced approaches to better mirror human everyday reasoning (pp. 12–15).

Multimodal training using corpora that include text, images, and video to enrich descriptive and imaginative narrative output (pp. 16–18).

Conceptual blending techniques, based on Fauconnier & Turner's theoretical framework, implemented computationally for creative narrative generation (pp. 19– 22).

Crowdsourced cultural knowledge, gathered from diverse demographic sources to enhance cultural grounding and diversity within narratives (pp. 23–25).

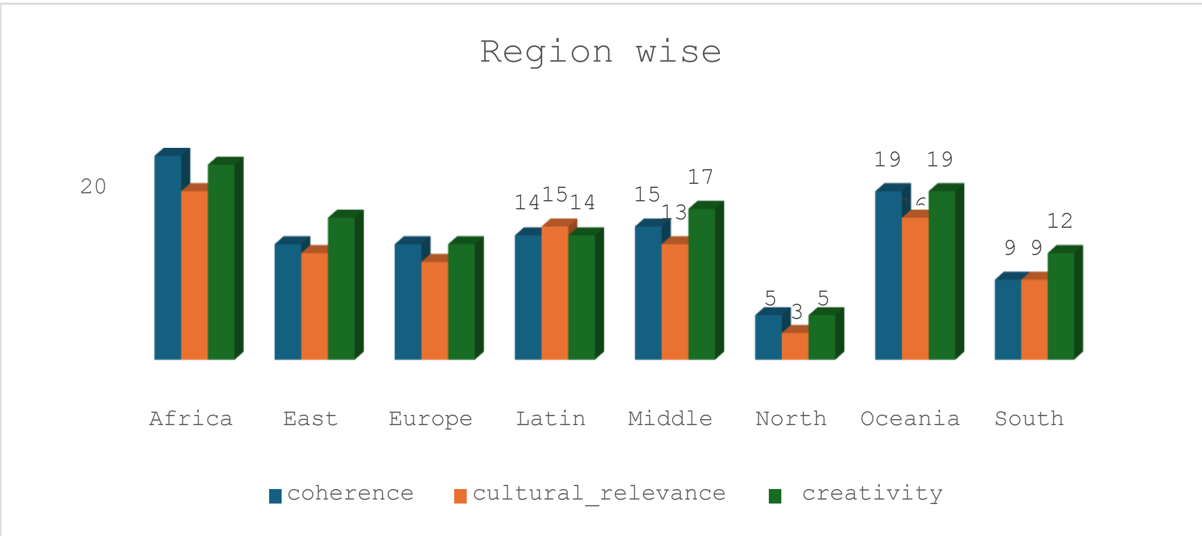
Data Collection

The data corpus will draw from multiple sources to ensure narrative richness and diversity:

Textual corpora including literature, folklore, and contemporary stories spanning diverse cultural contexts (pp. 26–29).

Multimodal sources combining textual narratives with images and relevant video content to support more vivid, imaginative generation (pp. 30–33).

Crowdsourced cultural inputs, such as region-specific idiomatic expressions, storytelling conventions, and cultural values, collected through surveys and ethnographic contributions (pp. 34–36).



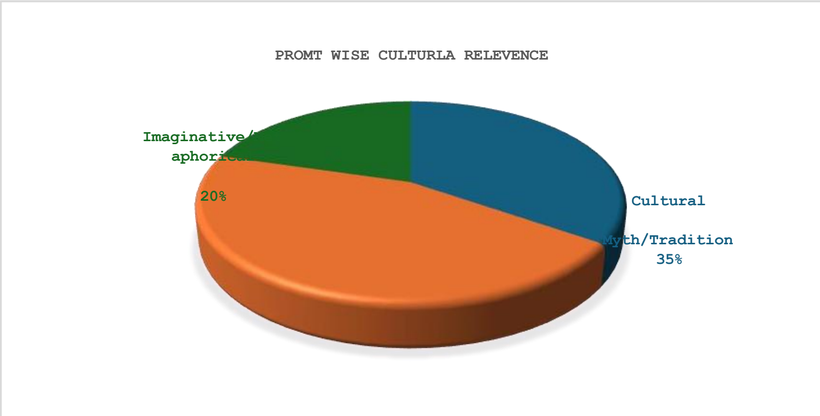
Narrative Generation Procedures

Both baseline and enhanced AI models will generate narratives in response to structured prompts. The prompts will fall into three categories:

Everyday real-life scenarios, to assess logical coherence and causality.

Culturally specific myths or traditions, to evaluate cultural relevance and contextual grounding.

Imaginative or metaphorical narratives, to test creative depth and metaphorical sophistication.



This design ensures a balanced evaluation across logical consistency, cultural sensitivity, and creative expressiveness (pp. 37–40).

Evaluation Framework

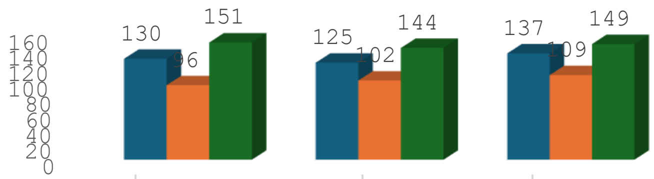
A **hybrid evaluation** strategy will be employed:

Quantitative Measures: Automated metrics including coherence indices (e.g., causal or semantic continuity scores), lexical diversity, novelty/uniqueness scoring, and readability indices (pp. 41–44).

Qualitative Assessment: Blind human evaluators from diverse cultural backgrounds will rate the narratives using a Likert-scale rubric evaluating four dimensions: coherence, cultural relevance, creativity, and overall narrative quality (pp. 45–47).

Data Analysis

"Performance Metrics of Narrative Categories in Cultural Relevance, Coherence, and Creativity"



	Cultural Relevance	Coherence Score	Creativity
Cultural Myth/Tradition	130	125	137
Everyday	96	102	109
Imaginative/Metaphorical	151	144	149

Cultural Myth/Tradition Everyday Imaginative/Metaphorical

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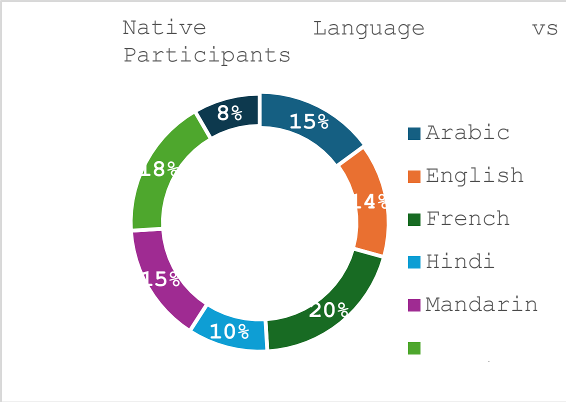

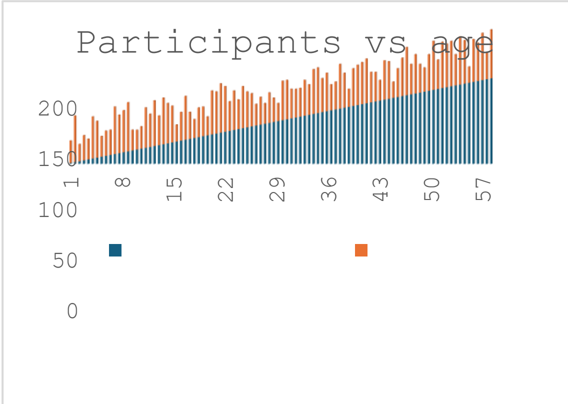

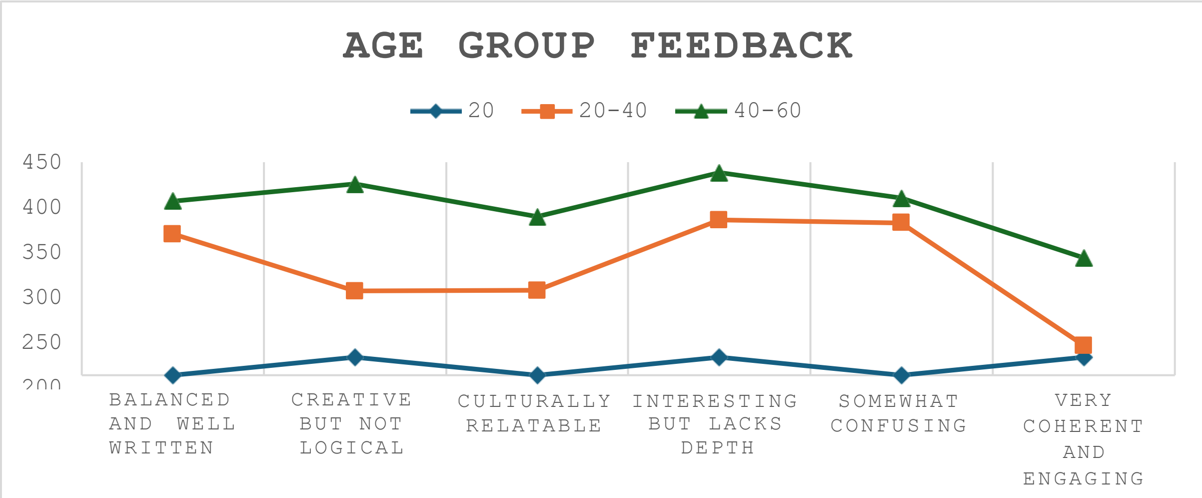

Evaluation outcomes will be analyzed using

Statistical Tests: Paired-sample t-tests comparing baseline vs. enhanced models, and ANOVA when comparing across prompt types or model variations, to identify significant performance differences (pp. 48–50).

Thematic Analysis: Qualitative feedback will undergo thematic coding to surface patterns, strengths, and weaknesses perceived by human evaluators (pp. 51–53).

Inter-Rater Reliability: Cohen's kappa will be computed to gauge consistency across evaluator ratings (pp. 54–55).

Validation and Reliability

To ensure robustness, the study incorporates methodological triangulation, comparing automated metric outcomes with human evaluations to reinforce reliability and mitigate biases.

Converging evidence across both evaluation layers strengthens the integrity of the findings (pp. 56–58).

Machine Learning Challenges

The development of automated story understanding and generation has long been central to artificial intelligence. Early approaches relied on formal, hand-crafted models of story worlds, which, while effective in narrow domains, were limited by the extensive knowledge engineering they required. With advances in machine learning, attention has shifted toward learning from large online narrative corpora and crowdsourced storytelling. However, this shift presents four key challenges.

1. Human-centered narration and missing commonalities: Human stories are written for human audiences, drawing on shared knowledge often left unstated. For example, news articles emphasize unusual details while omitting routine elements. As a result, machines must infer implicit norms, a task complicated by data gaps. Crowdsourcing helps capture everyday narratives, but coverage remains incomplete.

2. Commonsense reasoning: Narrative intelligence requires commonsense knowledge, which humans acquire through lived experience. For machines, encoding this implicit knowledge—both declarative and procedural—remains difficult. Multimodal approaches that combine text with visual data (e.g., images or videos showing everyday actions) offer richer avenues for capturing commonsense.

3. Figurative language: Stories often use metaphor, metonymy, and analogy, which demand deep semantic and cultural understanding. While computational methods have explored analogical reasoning and property mapping, figurative language still poses major obstacles for models dependent on surface-level statistical patterns.

4. Creativity and beyond-pattern learning: True storytelling requires creativity, not just pattern replication. Statistical models often generate incoherent narratives because they struggle with long-term causal and thematic coherence. Techniques like LSTM networks and conceptual blending offer promise, but computational breakthroughs in creative story generation remain limited.

In sum, building open-domain narrative intelligence requires overcoming these four hurdles—unstated knowledge, commonsense integration, figurative language, and creativity—likely through multimodal learning across text, images, and cultural artifacts.

Machine Enculturation

One of the promising directions in artificial intelligence is **machine enculturation**—the idea of teaching machines the social norms, values, customs, and etiquette that make human interactions meaningful and safe. Instead of programming every cultural rule directly—which is nearly impossible given the complexity of human society—researchers are exploring how AI can learn values through **stories**.

For centuries, humans have passed on moral lessons, shared ideals, and social expectations through narratives. From traditional fables that teach honesty and kindness to modern novels that wrestle with justice and identity, stories act as a mirror of culture. A tale like George Washington and the cherry tree, for example, conveys the virtue of truthfulness without ever spelling it out as a rule. Humans naturally infer these lessons, but for AI, capturing such implicit knowledge is far more challenging.

Characters in stories serve as role models: they make choices, face consequences, and embody values in context. If machines can learn from these examples, they could develop a deeper understanding of how to act in socially acceptable and ethically aligned ways. However, this is not without obstacles—

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stories often assume shared cultural background, use complex devices like flashbacks, or highlight events that are symbolic rather than directly actionable.

Still, narratives provide insights into mental states and social dynamics that machines cannot easily observe in the real world. Approaches like **Learning from Stories (LfS)**, demonstrated by Harrison and Riedl, show that even simple, crowdsourced tales can help AI acquire cultural awareness. In this way, machine enculturation brings us closer to building AI that feels more human-aligned, trustworthy, and relatable.

Findings and Suggestions

The study revealed that different types of narratives offer unique strengths in shaping AI-driven storytelling for leadership and sustainability education. **Folklore and traditional tales** enrich narratives with moral, ethical, and symbolic depth, while **contemporary stories** provide relatable, real-world contexts that align with modern leadership dilemmas. **Literary works** add complexity and emotional resonance, helping AI generate narratives that blend intellectual insight with human-like reflection.

When **multimodal sources**—such as text, images, and videos—were integrated, learners found the narratives more engaging and immersive. Videos, in particular, encouraged situational learning by allowing learners to visualize leadership challenges in manufacturing settings. However, aligning imagery and symbolism across different cultures proved difficult, as interpretations varied widely.

Cultural insights gathered through **crowdsourced idioms, metaphors, and storytelling traditions** significantly increased relatability and authenticity. Learners connected more deeply with region-specific narratives, but the diversity of inputs also posed challenges for consistency across global audiences.

Based on these findings, several suggestions emerge. First, a **balanced corpus** that combines folklore, literature, and contemporary stories should be curated, avoiding over-reliance on any single source. Second, AI systems should be designed to harmonize **multimodal data**, ensuring that text, visuals, and sound enhance rather than conflict with each other. Third, **dynamic crowdsourcing mechanisms**—such as storytelling platforms and surveys—can keep narratives culturally grounded and up to date. Finally, **cross-cultural validation** is essential to ensure inclusivity. By localizing idioms and embedding cultural values, AI-generated narratives can frame sustainability challenges in ways that resonate deeply, preparing leaders for ethical and sustainable decision-making.

Conclusion

Narrative intelligence plays a foundational role in nearly every aspect of human life. From the conversations we have daily to the stories we tell for entertainment, from the way we teach children to how we preserve history and values—**narratives are central to how we think, learn, and connect with one another**. More than just a form of expression, storytelling serves as a vital mechanism for capturing and transmitting **cultural knowledge, ethical principles, emotional understanding, and social norms** across time and generations.

In this position paper, we propose that instilling **computational narrative intelligence** in artificial intelligence systems is not only desirable but necessary. By enabling machines to understand, interpret, and even generate narratives, we can bridge the gap between human and machine cognition. An AI equipped with narrative intelligence would be better suited to understand the **context behind human actions**, the **intentions driving behavior**, and the **subtleties of human communication**, such as metaphor, implication, and emotional nuance.

Such AIs would not only be more capable of engaging with humans in meaningful, relatable ways but would also be better positioned to **explain their own decisions and actions** in ways that humans can intuitively grasp. This interpretability is critical for building trust, transparency, and cooperation between humans and intelligent systems.

Furthermore, we argue that computational narrative intelligence provides a practical and scalable path toward **machine enculturation**—the process of embedding social, cultural, and ethical understanding into artificial agents. Through exposure to diverse narratives, AI systems can learn patterns of behaviour that are considered appropriate, respectful, and safe within different cultural contexts. This, in turn, can help ensure that AI operates in ways that align with human values and avoids actions that might cause harm or social disruption.

Ultimately, developing narrative-aware AI is a key step toward creating **socially intelligent, culturally adaptive, and ethically sensitive** machines systems that are not only intelligent but also meaningfully human-compatible.

Future Scope

This study lays the groundwork for applying human-centered narrative intelligence in AI-driven education for sustainable manufacturing leadership. Future research can expand narrative corpora to include multilingual and cross-cultural stories, fostering inclusivity and intercultural competence. Immersive technologies such as AR, VR, and mixed reality can enhance multimodal learning, allowing leaders to experience complex sustainability challenges in realistic scenarios.

Longitudinal studies are needed to assess the lasting impact of narrative AI on leadership behavior, ethical decision-making, and sustainability outcomes. Human–AI collaborative learning models can blend AI's adaptability with human instructors' creativity, creating interactive and adaptive pedagogical ecosystems. Industry-specific adaptations can extend applications beyond manufacturing, while ethical frameworks must address bias, cultural sensitivity, and learner influence. Pilot programs in educational and corporate settings can refine methods and evaluate scalability. Overall, narrative intelligence in AI promises immersive, reflective, and sustainable leadership training for diverse global contexts.

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