GENERATIVE ARTIFICIAL INTELLIGENCE IN SECONDARY EDUCATION: A PEDAGOGICAL FRAMEWORK FOR DIGITAL STORYTELLING AND COMPETENCE DEVELOPMENT

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Double Blind Peer Review

Citation
Moccia, M., & Barbato, A. (2026). Generative artificial intelligence in secondary education: A pedagogical framework for digital storytelling and competence development. *Italian Journal of Health Education, Sport and Inclusive Didactics, 10*(3).

Doi: https://doi.org/10.32043/gsd.v10i3.1755

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gsdjournal.it
ISSN: 3103-5744

ABSTRACT
The rapid development of Generative Artificial Intelligence (GenAI) is reshaping educational systems by transforming instructional design and learning environments. This paper proposes a theoretical-pedagogical framework for integrating GenAI into upper secondary education through Digital Storytelling as an active methodology for competence development. Drawing on recent international literature and policy frameworks (DigCompEdu, DigComp 2.2, UNESCO, OECD), the study introduces the AI-STORY Framework. This model is structured around five dimensions: instructional design, Prompt Engineering, collaborative storytelling, critical output verification, and authentic assessment. The proposed theoretical-projectual framework positions GenAI as a cognitive mediator rather than a substitute for teachers, highlighting how structured pedagogical design and prompt engineering can support critical thinking. As a conceptual framework, the potential educational benefits of AI-STORY are formulated as design hypotheses to be empirically tested and evaluated in future iterative classroom interventions.

KEYWORDS
Generative Artificial Intelligence; AI literacy; digital storytelling; competence development; prompt engineering.

Received 2026-07-13
Accepted 2026-10-26
Published 2026-10-30

1. Introduction

Generative Artificial Intelligence represents one of the most significant technological innovations of recent years and is progressively altering the relationship between knowledge, learning, and teaching. The widespread dissemination of Large Language Models (LLMs) has made available tools capable of generating text, images, code, and multimodal content through the probabilistic processing of natural language. These systems are finding applications across numerous professional and scientific domains, confronting the educational sector with the urgent need to rethink methodologies, competences, and organizational models.

In contemporary pedagogical debate, attention has progressively shifted from the mere adoption of digital technologies to reflecting on their impact on the processes of knowledge construction. Generative AI does not constitute a simple support tool, but rather a cognitive environment with which students and teachers interact during the production, re-elaboration, and evaluation of content. This shift necessitates moving beyond a merely instrumental conception of technology to develop educational models capable of integrating innovation, critical thinking, and ethical responsibility.

International literature highlights that the use of AI in educational contexts presents significant potential in terms of personalizing learning, supporting instructional design, providing formative feedback, and developing digital competences. In parallel, critical issues emerge regarding the reliability of outputs, algorithmic biases, privacy protection, and the risk of over-delegating cognitive processes to intelligent systems. These aspects demand a pedagogical reflection that places the teacher's role at the center as a cultural mediator and designer of learning environments.

It is within this scenario that the present contribution is situated. This paper aims to elaborate a pedagogical model for integrating Generative AI into upper secondary education, adopting Digital Storytelling as a privileged methodology for the development of disciplinary, digital, and transversal competences. The choice of storytelling responds to the need to enhance collaborative knowledge construction processes, promoting authentic activities where AI becomes a supportive tool for reflection, creativity, and argumentation.

Consequently, this article aims to address the following research question: In what way can Generative Artificial Intelligence be integrated into the instructional design of upper secondary education to foster the development of critical thinking, digital competences, and disciplinary competences through Digital Storytelling? To answer this question, a theoretical reflection is proposed, grounded in international scientific literature and major European educational frameworks, followed by the presentation of the AI-STORY Framework.

2. Theoretical Framework

2.1 Generative Artificial Intelligence as an Emerging Paradigm in Educational Processes

Artificial Intelligence (AI) currently represents one of the primary drivers of transformation within educational systems, influencing not only the tools utilized in teaching and learning processes but also the modalities of producing, organizing, and sharing knowledge. Although the discipline's origins can be traced back to the Dartmouth Conference of 1956, current scientific interest is chiefly tied to the development of Generative Artificial Intelligence (GenAI), made possible by the evolution of Large Language Models (LLMs) and Transformer architectures (Russell & Norvig, 2021; Vaswani et al., 2017).

Unlike traditional Machine Learning systems, which are predominantly designed to classify data or make predictions, generative models are capable of producing original content—such as text, images, code, and multimedia materials—via the probabilistic processing of natural language. This characteristic has driven the rapid diffusion of tools like ChatGPT, Gemini, Claude, and Microsoft Copilot, which are now being applied within instructional design, the production of educational materials, and the support of learning processes. From a pedagogical standpoint, this evolution introduces a momentous shift: AI no longer constitutes merely an automation tool, but an active cognitive environment with which students and teachers interact to co-construct knowledge. Therefore, educational reflection cannot restrict itself to technological aspects; it must interrogate the epistemological, methodological, and ethical implications of the interaction between human intelligence and intelligent systems.

2.2 Opportunities and Critical Issues of Generative AI

Recent literature reveals a dual orientation in the analysis of Generative Artificial Intelligence. On one hand, numerous studies emphasize the potential of generative systems to foster personalized learning, generate immediate feedback, support instructional design, and develop digital competences. On the other hand, concerns emerge regarding the reliability of outputs, the presence of algorithmic biases, privacy protection, and the transparency of decision-making processes.

One of the main limitations relates to the phenomenon of hallucinations, namely, the production of information that appears plausible but lacks any factual foundation. These errors stem from the probabilistic nature of LLMs, which generate the statistically most probable next token without possessing any real semantic understanding of the produced content. In an educational

environment, this characteristic makes it indispensable to promote practices of source verification, critical comparison of information, and assessment of results' reliability. Another element requiring close attention involves algorithmic biases. Because these models are trained on massive datasets harvested from the web, they can reproduce cultural, social, or linguistic stereotypes. Hence, there is a vital need to develop critical competence when using AI, avoiding the attribution of unjustified epistemic authority to algorithms. These considerations confirm that the educational efficacy of AI depends less on technological sophistication and more on the ability to integrate it within consciously designed pedagogical pathways.

2.3 AI Literacy and 21st Century Skills

The integration of AI into educational contexts requires the development of new skills, synthesized under the concept of AI Literacy. This term denotes the ability to understand the functioning of intelligent systems, critically interpret their outputs, recognize their limits and potential, and use them in an ethical and responsible manner. AI Literacy expands the traditional concept of digital competence by incorporating cognitive, methodological, and ethical dimensions. It is not simply a matter of learning how to operate a chatbot, but rather of developing the capacity to formulate effective requests, verify the quality of responses, compare different sources, and reflect on the social implications of AI usage.

This perspective aligns with the evolution of major international frameworks. The DigCompEdu framework attributes a central role to the teacher in designing innovative learning environments, while DigComp 2.2 introduces explicit references to the conscious utilization of Artificial Intelligence systems. Similarly, recommendations from UNESCO and the OECD underscore that training in AI must be oriented toward fostering critical thinking, digital

citizenship, and ethical responsibility. In this scenario, secondary schools are called upon to promote competences that allow students not only to use AI but to comprehend its mechanics and critically evaluate its effects across different disciplinary and professional contexts.

2.4 From Technological Innovation to Pedagogical Innovation

The mere presence of AI in educational settings does not automatically guarantee an improvement in teaching quality. Pedagogical research highlights that innovation depends on the capacity to integrate technologies within instructional models consistent with the principles of active learning, collaboration, and metacognitive reflection. In this view, Artificial Intelligence assumes the function of a cognitive mediator, capable of supporting knowledge construction without replacing the teacher's role. The teacher retains full responsibility for educational design, activity selection, cultural mediation, and learning assessment. This approach is firmly rooted in constructivist learning theories, according to which knowledge is not passively transmitted but actively constructed through the interaction between the subject, the environment, and cultural tools. AI can therefore be interpreted as a new cultural artifact that expands the possibilities for exploring, representing, and re-elaborating content, provided that its use is guided by pedagogically grounded design.

2.5 Generative Artificial Intelligence and Digital Storytelling: Toward an Integrated Pedagogical Model

2.5.1 Digital Storytelling as a Learning Environment

Over the past two decades, Digital Storytelling (DST) has progressively established itself as an instructional methodology capable of integrating

narration, digital technologies, and collaborative learning. Unlike traditional storytelling, DST utilizes different languages—text, images, audio, video, and interactive content—thereby fostering knowledge construction processes where students take on an active role in designing and producing content (Robin, 2008).

Pedagogical literature recognizes that storytelling possesses a function that extends far beyond simple communication. Bruner (1990) highlights that narrative thinking constitutes a fundamental mode of organizing experience, through which individuals interpret reality and attribute meaning to events. In a school setting, narration thus becomes a tool to promote meaningful learning, metacognitive reflection, and the development of linguistic, social, and disciplinary competences. The integration of Generative AI further expands these potentials. Systems based on LLMs can support various phases of the narrative process, from brainstorming ideas to constructing storyboards and revising text. However, their deployment gains educational value only when embedded in an instructional design that champions the active contribution of students and the mediating role of the teacher.

2.5.2 Pedagogical Foundations of the Proposed Model

The deployment of AI within Digital Storytelling finds its foundation in three complementary theoretical perspectives. The first is constructivism, which posits that knowledge is built through the interaction between the subject and the environment. In this light, AI represents a tool that broadens opportunities for exploring and re-elaborating content, without substituting the student's cognitive processing. The second perspective is the socio-constructivist one, elaborated by Vygotsky, which assigns a central role to collaboration and

cultural mediation. Interaction with AI systems can encourage peer dialogue, meaning negotiation, and shared reflection, provided that the teacher promotes cooperative activities oriented toward authentic problem-solving. The third perspective concerns competence-based education, in which learning does not coincide with the mere acquisition of information, but with the capacity to mobilize knowledge, skills, and attitudes in meaningful contexts. AI-assisted Digital Storytelling allows for the design of authentic tasks that require research, critical analysis, collaborative production, and source evaluation.

2.6 The AI-STORY Framework

Based on the analyzed literature and guidelines from international frameworks, we propose the AI-STORY Framework (Artificial Intelligence Storytelling Framework), a pedagogical model tailored for upper secondary education. The framework is structured around five integrated dimensions:

1. Instructional Design: The first phase involves defining training goals, target competences, and evaluation criteria. AI is introduced only after the pedagogical meaning of the activity has been fully established.
2. Prompt Engineering: The prompt is interpreted as an educational design tool. Students and teachers collaboratively construct prompts aligned with disciplinary goals, learning to formulate clear, contextualized, and verifiable inquiries.
3. Collaborative Storytelling: Students leverage AI to build disciplinary narratives, comparing different interpretations and developing original artifacts through group work.
4. Critical Verification: Generated outputs are rigorously compared against textbooks, scientific sources, and authentic documents to gauge information reliability.
5. Authentic Assessment: The pathway concludes with a competence-oriented

assessment taking into account the process of knowledge construction, the quality of collaboration, revision capabilities, and metacognitive reflection.

2.7 Operationalization: A Classroom Application Scenario of the AI-STORY Framework

To demonstrate the operational value of the framework beyond a generic sequential workflow, this section presents a concrete instructional scenario designed for upper secondary education (Grade 11/12 History and Citizenship Education).

Scenario Title: "Echoes of Industrialization: Counter-Narratives of the Industrial Revolution"

Duration: 4 sessions (8 total hours).

Target Competences: Historical critical thinking, AI literacy (DigComp 2.2 area 3 & 5), collaborative narrative writing, and ethical digital citizenship.

The operational application of the five dimensions unfolds as follows:

1. Instructional Design:

Teacher Role: Instructional designer. Defines learning outcomes (understanding socio-economic impacts of the Industrial Revolution), sets ethical guidelines for AI use, and prepares primary historical sources (parliamentary reports, factory logs).

Student Activities: Analyze primary sources in small groups to identify different historical perspectives (e.g., factory owner vs. child worker).

2. Prompt Engineering:

Teacher Role: Facilitator. Introduces system prompting mechanics, role-prompting techniques, and constraint-based query design.

Student Activities: Formulate structured prompts instructing an LLM to simulate historical personas (e.g., "Act as a 14-year-old textile worker in Manchester in 1840. Describe a typical workday using vocabulary from provided historical documents"). Students log all prompt iterations in a Prompt Journal.

3. Collaborative Storytelling:

Teacher Role: Mediator. Monitors group interactions and ensures AI is used for co-generation and brainstorming, not passive copying.

Student Activities: Develop a multimodal digital story (using text, AI-assisted image generation, and audio narration) depicting a fictional dialogue between historical figures. Students critically adapt the AI-suggested plots to align with authentic historical context.

4. Critical Output Verification:

Teacher Role: Scientific supervisor. Guides students in identifying hallucinations, chronological anachronisms, and algorithmic biases in the AI's generated narratives.

Student Activities: Cross-check AI-generated claims against peer-reviewed texts and documentary archives. Produce a "Verification Annotation" highlighting at least two errors or biases corrected by the group.

5. Authentic Assessment:

Teacher Role: Assessor and Evaluator. Evaluates the complete learning process (process + product) using an authentic assessment rubric.

Student Activities: Present the final digital story to the class and write an individual metacognitive reflection on how interacting with the AI influenced their understanding of history and technology.

Table 2. Authentic Assessment Rubric for the AI-STORY Pathway

Dimension / Criterion	Basic (Developing)	Proficient	Advanced (Mastery)
Prompt Design & Iteration	Formulates basic, uncontextualized prompts. Accepts initial output without refining query parameters.	Formulates contextualized prompts with clear roles. Iterates queries based on preliminary AI outputs.	Strategically uses advanced prompting techniques (e.g., constraints, role-playing, multi-shot). Documented systematic prompt log.
Critical Verification & Bias Control	Uncritically accepts AI output. Fails to identify hallucinations or historical inaccuracies.	Identifies obvious factual errors by comparing outputs with course materials.	Rigorously cross-references AI outputs with primary sources. Detects subtle biases, anachronisms, and hallucinations.

Dimension / Criterion	Basic (Developing)	Proficient	Advanced (Mastery)
Historical & Narrative Quality	Story is superficial or relies heavily on AI-generated clichés without deep disciplinary grounding.	Narrative effectively integrates historical concepts with creative digital storytelling.	Synthesizes complex historical perspectives into a compelling, highly original multimodal narrative with verified accuracy.
Metacognitive Reflection	Minimal reflection on the role of AI in the learning process.	Articulates how AI supported brainstorming and where human oversight was required.	Critically analyzes GenAI as a cognitive artifact, discussing its cognitive limits, ethical risks, and personal learning growth.

3. Methodology

This study adopts a theoretical-projectual methodology aimed at constructing a pedagogical framework for integrating Generative Artificial Intelligence (GenAI) into upper secondary education. Rather than presenting an empirical study, a field experimentation, or a completed experimental evaluation, this work proposes a conceptual model (the AI-STORY Framework) grounded in an integrative synthesis of scientific literature and policy guidelines.

To ensure pedagogical rigor and practical relevance, the conceptualization of the framework is guided by the foundational principles of Design-Based Research (DBR) (Design-Based Research Collective, 2003; McKenney & Reeves, 2019). Within the DBR paradigm, educational innovations are developed through an iterative dialogue between theoretical principles and instructional design. Specifically, this paper positions itself within the first phase of the DBR cycle—namely, Analysis, Exploration, and Prototyping/Design—laying the theoretical and operational foundations for future empirical testing and iterative evaluations in classroom settings.

The research is guided by the following overarching research question: How can Generative Artificial Intelligence be pedagogically structured within upper secondary instructional design to foster competence development and critical thinking through Digital Storytelling?

To answer this question, the methodological process followed three main steps:

1. Literature and Policy Analysis: Identification of key theoretical constructs regarding GenAI in education, AI Literacy, and competence frameworks (DigComp 2.2, DigCompEdu, UNESCO, OECD).

2. Conceptual Synthesis & Framework Construction: Integration of constructivist, socio-constructivist, and narrative learning theories with GenAI capabilities to outline the dimensions of the AI-STORY Framework.

3. Operationalization: Development of an instructional workflow and an authentic learning scenario to illustrate the practical implementation of the framework in secondary classrooms.

3.1 Construction of the AI-STORY Framework and Source Selection Criteria

The design of the AI-STORY Framework followed an integrative synthesis method (Torraco, 2016), structured around two primary steps: source selection and qualitative thematic mapping.

1. Source Selection Criteria: Literature search was conducted across Scopus, Web of Science, and Google Scholar (covering publications from 2018 to 2024), using query combinations such as "Generative AI in secondary education", "AI Literacy frameworks", and "Digital Storytelling AND competence development". Inclusion criteria targeted: (a) peer-reviewed academic journal articles and conference proceedings; (b) official policy guidelines published by international educational organizations (European Commission, UNESCO, OECD); and (c) studies explicitly focusing on upper secondary or K-12 contexts. Technical papers focusing solely on algorithm architecture or higher education institutional governance were excluded.

2. Derivation of the Five Framework Dimensions: The collected literature and policy frameworks were mapped using thematic analysis to identify recurring core pedagogical requirements:

Instructional Design: Derived from DigCompEdu (Redecker, 2017) and constructivist design models, emphasizing that technology integration must begin with clear learning objectives rather than tool features.

Prompt Engineering: Formulated by synthesizing recent studies on GenAI interaction (e.g., Mollick & Mollick, 2023) and DigComp 2.2 (2022) guidelines on algorithmic interaction, conceptualizing prompting as a metacognitive and linguistic task.

Collaborative Storytelling: Rooted in Bruner's (1990) narrative learning theory and Robin's (2008) Digital Storytelling framework, adapted to co-creativity scenarios with LLMs.

Critical Output Verification: Directly responding to UNESCO (2023) and OECD (2023) recommendations regarding AI hallucinations, bias identification, and source validation.

Authentic Assessment: Grounded in Wiggins' authentic task framework and competence-based assessment literature, ensuring both process and product are evaluated.

4. Discussion

The analysis conducted underscores how the debate surrounding AI in education is progressively turning toward a deep reflection on the pedagogical implications of innovation. In this context, the original contribution of this study consists in the proposal of the AI-STORY Framework, conceived as an integration model between GenAI, Digital Storytelling, and competence-based teaching.

Unlike approaches focused predominantly on the automation of teaching processes, the proposed framework attributes a central role to instructional design and the active mediation of the teacher. AI is interpreted as a support mechanism for knowledge construction processes, while educational responsibility remains firmly with the teacher, who is called upon to design authentic activities, encourage critical thinking, and guide the evaluation of learning. From a methodological point of view, Digital Storytelling represents an exceptionally favorable environment for cultivating transversal competences, since it synthesizes narration, collaboration, creativity, and metacognitive reflection. While the AI-STORY Framework provides a structured synthesis of current pedagogical literature and international competence frameworks, its main limitation lies in the current absence of empirical validation in classroom contexts. The educational benefits discussed herein—such as enhanced critical thinking, improved AI literacy, and deeper narrative engagement—represent theoretical hypotheses derived from sound pedagogical principles rather than empirically verified findings. Consequently, the framework serves as a conceptual blueprint intended to guide teachers and researchers in designing GenAI-supported activities.

5. Conclusion

The integration of Generative AI within educational environments represents one of the most pressing challenges for contemporary schools. The primary theoretical contribution of this article is the AI-STORY Framework, a pedagogical model that seamlessly interlaces instructional design, Prompt Engineering, collaborative storytelling, critical output analysis, and authentic assessment.

The reflections developed herein confirm that introducing AI into schools demands an evolution of professional teacher profiles and a revision of the

skills required of students. In particular, AI Literacy stands out as an indispensable component of digital citizenship, understood not merely as tool mastery, but as the capacity to grasp how algorithms operate, critically evaluate their outputs, and deploy them responsibly. In conclusion, Generative AI does not represent an alternative to the professional standing of teachers; rather, it is a powerful resource that, when integrated within a pedagogically sound design, can significantly contribute to renewing instructional practices and preparing students for the digital society. Future research will focus on the empirical implementation and validation of the AI-STORY Framework through full DBR cycles in upper secondary schools. Subsequent studies will collect qualitative and quantitative data (e.g., student artifacts, prompt logs, rubrics, and teacher interviews) to iteratively refine the framework's dimensions and evaluate its actual impact on competence acquisition and critical AI literacy.

Table 1. The AI-STORY Framework Matrix

Dimension	Objective	Role of AI	Role of the Teacher
Instructional Design	Define competences and goals	Support for planning	Designer
Prompt Engineering	Formulate effective requests	Cognitive interlocutor	Facilitator
Storytelling	Build disciplinary narratives	Content co-generation	Mediator
Critical Verification	Evaluate outputs	Generation of alternatives	Scientific supervisor
Authentic Assessment	Reflect on the process	Formative feedback	Assessor / Evaluator

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