THE ALGORITHMIC HEARTBEAT IN PROMPT ENGINEERING: EDUCATING FOR NEW DIGITAL LITERACIES THROUGH THE PROMPT BATTLE

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ABSTRACT
Within the framework of emerging digital literacies and global citizenship, Prompt Engineering is evolving from a mere procedural command-input technique ("natural language coding") toward a comprehensive Prompt Literacy grounded in semiotic and cognitive mediation as well as the critical scrutiny of algorithmic responses. To address this transition, this study aims to formalize an instructional model for lower secondary education by operationalizing the Prompt Battle methodology within the architecture of Episodes of Situated Learning (ESL/EAS), while conducting an exploratory action-research intervention to investigate how semantic transcoding between visual content and analog textual descriptions influences students' metalinguistic reflection and critical awareness. Pedagogically, the research focuses on how this technical skill can be leveraged to explore students' affective and identity dimensions, thereby redefining the synergy between human intelligence and artificial systems. The study pursues a dual objective: establishing the technical foundations for algorithmic communication while employing digital outputs as 'mediating objects' for deep introspective reflection.

KEYWORDS
Generative artificial intelligence; prompt engineering; prompt battle; data literacy.

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1. Introduction

In the contemporary landscape of emerging technologies, Prompt Engineering is predominantly framed in the scientific literature as a theoretical and practical discipline focused on the mechanical, rigorous, and iterative optimization of textual instructions designed to guide generative artificial intelligence models toward producing coherent outputs. Although recent scholarly contributions and institutional frameworks advocate for a shift from mere technical execution to a broader Prompt Literacy, the literature reveals a distinct theoretical gap: interaction with language and visual models is often reduced to a procedural command-input technique ("natural language coding"), thereby overlooking its role as a cognitive interface, a semiotic space of mediation, and a catalyst for the user's metalinguistic and affective reflection.

1.1 Prompt Engineering, a new digital literacy skill

In the field of Generative Artificial Intelligence (GenAI), Prompt Engineering is defined as the theoretical-practical discipline focused on the design and optimization of inputs to guide large language models (LLMs) towards the generation of coherent and desired outputs (Google Cloud, 2025). This skill is frequently described in the literature as a “linguistic mediation” skill, highlighting how natural language programming is currently the primary interface with computational systems. Conceptually, it is important to distinguish prompt engineering from prompt design: while the term “design” evokes a high-level planning and ideational dimension, the use of the term “engineering” refers to a rigorous, technical-scientific approach. Although this

semantic distinction is not yet fully consolidated in the Italian-language scientific literature, international literature identifies iterativeness as the distinguishing factor; Prompt engineering is, in fact, configured as a distinctly mechanical and iterative process, aimed at the progressive refinement of the output (Google Cloud, 2025).

From an operational perspective, a prompt consists of an instruction formulated in natural language and transmitted to a linguistic model (Gadesha, 2026). The effectiveness of this interaction cannot be reduced to mere conversational activity (chattering) with a conversational agent (Oppenlaender et al., 2025). Instead, the process requires specific training, encompassing advanced linguistic and logical-argumentative skills. Formulating an effective prompt presupposes an analytical and thoughtful approach, typical of the prompt engineer, a professional specialized in structuring queries that allow the model to correctly interpret not only the explicit command, but also the semantic nuances and the designer's heuristic objective (Google Cloud, 2025). Although authoritative exponents of the software industry argue that prompt engineering does not necessarily require the background of a data scientist and is potentially accessible to anyone (Boonstra, 2024), empirical evidence demonstrates the need for specific technical and methodological skills to produce high-quality output (Google Cloud, 2025): added to this is the ethical and deontological imperative regarding the responsibility in using GenAI tools. Rigorous prompting helps mitigate the inherent criticalities of LLMs, minimizing algorithmic confusion and the onset of biases (Boonstra, 2024), understood as systematic deviations caused by distortions in the training datasets or implicit assumptions introduced during the algorithm design phase (Holdsworth, 2025). Correct formulation also counteracts the phenomenon of hallucinations, i.e., the system's generation of factually incorrect or logically inconsistent outputs (Treccani, 2025). As highlighted by the Google Workspace guidelines (2025),

GenAI must be understood exclusively as a collaborative aid for humans, with the user remaining solely responsible for the scientific validation of the final product.

1.2 From coding to prompting: form media literacy to AI literacy

Often described as the "new coding", Prompt Engineering has its roots in Natural Language Processing (NLP) and works by breaking natural language into tokens, applying statistical and probabilistic logic to predict text sequences. Unlike human intelligence, which retains the primacy of semantics and deep understanding, AI systems act as extraordinary syntactic mechanisms devoid of consciousness or intentionality, processing streams of encoded information. Understanding how these streams are processed requires linguistic, creative, and iterative skills to effectively communicate with the machine (Gadesha, 2025; Baldassarre et al., 2024). Prompt Literacy goes beyond the simple formulation of instructions, including interpretative negotiation and evaluation of the generated results (Hwang et al., 2023; Dalsgaard, 2025). Prompt engineering is therefore defined as the art and science of designing, testing, and optimizing textual instructions (queries) to guide generative AI models, particularly Large Language Models (LLMs), towards producing accurate, relevant, and creative responses.

The effectiveness of prompt engineering lies in its ability to bridge the gap between raw queries and meaningful outputs, minimizing the need for manual post-processing and mitigating systemic risks such as algorithmic bias and hallucinations (generation of plausible but incorrect content). An effective prompt structure is generally based on four fundamental pillars: persona (assignment of a specific role or profile), activity (clear definition of the task), context (the reference scenario), and format (the structure of the output). Application techniques range from zero-shot prompting, without guided

examples, to few-shot prompting, which provides the model with samples of the expected result to clarify expectations, to the Chain-of-Thought (CoT) method, which breaks complex tasks into intermediate logical steps to enhance the system's reasoning ability, dramatically improving model comprehension and accuracy. Even more sophisticated techniques include Prompt Chaining, where the output of a previous response serves as a stimulus for the next input, and Tree of Thoughts (ToT), an agentic strategy that allows the model to simultaneously explore and evaluate multiple branches of reasoning. Implementing these techniques requires an iterative and reflective approach, aimed at mitigating systemic risks such as algorithmic bias and hallucinations. Beyond its technical dimension, prompting is interpreted as a creative and reflexive practice, also referred to as "promptism", in which human intentionality acts as an "activator" of the algorithmic dataset to generate new meanings.

In the educational field, this evolution is leading to the development of Prompt Literacy, an emerging skill that integrates the ability to develop instructions with critical evaluation and interpretative negotiation of the generated results. The development of these linguistic and technological skills is now essential to develop informed citizens in the on-life world and to meet the demands of a labor market that sees analytical thinking and artificial intelligence as the main drivers of future innovation. In this regard, the Ministry of Education and Merit (which we will henceforth refer to by the acronym MIM) emphasizes the importance of formulating prompts while respecting privacy, avoiding the inclusion of personal identifying data and promoting a Prompt Literacy that integrates technical expertise with the critical evaluation of results (2025). Ultimately, mastery of these methodologies is now a fundamental requirement for navigating the on-life world and meeting the demands of a labor market

that sees analytical thinking and artificial intelligence as the main drivers of innovation.

2. Theoretical Framework

As previously discussed, moving beyond the reductionist view of prompting as a mere procedural command-input technique ("natural language coding"), recent pedagogical and computational research calls for a structural shift toward a more nuanced Prompt Literacy (Hwang et al., 2023). This emerging literacy goes beyond simple technical execution by integrating input formulation with interpretative negotiation and critical evaluation of generated outputs, aligning with international and institutional guidelines for digital citizenship and AI literacy.

From a cognitive and semiotic perspective, when stripped of aesthetic or philosophical digressions, prompting reveals itself as a distinctly metacognitive and metalinguistic practice. It operates across three structural dimensions: semantic projection (guided by user intent), compositional structuring (concerning lexical and syntactic selection), and interpretative negotiation (defined as the reflective and recursive evaluation of algorithmic output). Indeed, strategic input planning requires careful selection of lexical register and rigorous syntactic-semantic analysis, while the computational feedback provided by the algorithm compels the user to maintain continuous critical scrutiny over the machine's responses. Such methodological control is essential for identifying and mitigating structural limitations inherent to language and visual models, such as factual hallucinations and algorithmic biases arising from training dataset distortions.

Within this theoretical framework, the Prompt Battle methodology derives its specific pedagogical value from translating theorized cognitive mediation into

an experiential, collaborative instructional format. By introducing a gamified, competitive dynamic into human-machine interaction, the semantic transcoding between visual content and textual description fosters active engagement and converts algorithmic querying into a practical workshop for metalinguistic reflection—guiding students from passive technology consumption to a critical, conscious, and responsible decoding of generative AI resources.

2.1 Prompting as a creative act

Interaction with generative AI systems simulates the dialogic dynamics typical of human communication, configuring a structured alternation between questions (input) and answers (output). This paradigm, however, risks generating an anthropomorphic fallacy, elevating the machine to a sort of "oracle" holding universal knowledge (Monti, 2022). It is therefore necessary to scale back this pseudo-Socratic approach: although automated conversation presents significant heuristic potential, it is actually based on a purely mechanical, algorithmic practice devoid of conscious intentionality. In this context, the prompt engineer works in close synergy with computational models to structure queries capable of maximizing the accuracy, relevance, and creativity of the outputs (Gadesha, 2025).

The ability of models to generate complex expressive artifacts requires theoretical reflection on the very nature of creative processes. In the contemporary paradigm, the user's ideational act, expressed through prompting, is mediated and translated by an act of computation, understood as an exquisitely mathematical gesture performed by the algorithm (Monti, 2022). The intersection of the creative and computational planes introduces the variable of so-called AI Art, within which textual input acts as an activator

of the dataset, that is, the deep data structure from which the expressive capacity of the generative model emerges (Monti, 2022). Prompting thus emerges as a liminal practice, located precisely at the intersection of human conscious intentionality and the machine's probabilistic automatism, delineating a novel form of "creative automatic writing" (Monti, 2022).

From a linguistic and performative perspective, the interaction can be validly interpreted in light of Austin's speech act theory (Monti, 2022). The text string entered into the system constitutes the locutive act (the act of speaking itself); the user's communicative intention and heuristic goal represent the illocutive act (the intention behind the message); finally, the output generated by the model is the perlocutive act (the effect on the recipient), that is, the concrete consequence produced by the utterance on the machine. Although this is an analogical conceptualization, given the artificial system's total absence of subjectivity or psychological intentionality, the act of generating the prompt proves to be a performative act capable of producing aesthetic and cultural outcomes. The prompt thus ceases to be a mere static interface and becomes a dynamic semiotic and interpretative space, a place of epistemic reflection in which the user actively reworks their thinking through technological feedback.

At the same time, attributing expressive potential to an inanimate instrument requires a profound renegotiation of the concept of authorship. AI takes on the role of a "pseudo-author", whose intrinsic ambiguity causes an effect of identity estrangement that cultural criticism has yet to grapple with (Monti, 2022). Recognizing an aesthetic value to this experience becomes possible when the device is conceptualized as a "technical subject", redefining the boundaries of artistic production in the era of the democratization of art, in which the generation of texts, images, songs, and videos is made widely accessible to anyone capable of providing input.

As previously discussed, recent years have witnessed a shift from media literacy to data literacy and algorithmic pedagogy: in the current technological landscape, this corresponds to the need to extend information literacy towards emerging forms of prompt literacy (Baldassarre et al., 2024). As theorized by Hwang and colleagues (2023), prompt literacy is not limited to the technical ability to formulate text strings, but encompasses the critical skill of evaluating the generated results and managing recursive interaction to optimize output. From this perspective, AI ceases to be a simple provider of answers and becomes an agent for co-designing the learning experience.

From a semiotic and cognitive perspective, prompting acts as a structured mediation interface. Dalsgaard (2025) categorizes its action through three fundamental dimensions: the semantic projection of language, defined by the communicative intentions that guide the drafting of the input; compositional structuring, i.e., the syntactic and formal configuration of the prompt; and interpretative negotiation, which is identified with the reflective evaluation of the output. Consequently, the prompting activity requires rigorous preliminary work of methodical planning, concerning the selection of lexical register, tone, and pedagogical objectives (De Mutiis, 2024). To guide teachers in this transition, Baldassarre (2024) proposes an operational model articulated in eight sequential phases:

1. analytical clarification of the teaching objective;
2. using clear, structured and unambiguous language;
3. accurate specification of the context and assignment of specific roles to the model;
4. definition of the style and expressive register of the output;
5. application of a simple and descriptive syntax;

6. iterative management of refinement prompt;
7. encouragement of creative experimentation;
8. constant critical evaluation of the prompt and its response.

Implemented according to these criteria, prompt engineering proves to be an effective catalyst for the development of critical thinking, creativity, and problem solving, increasing student inclusion and engagement through the personalization of learning content (De Mutiis, 2024). Conversely, formulating inadequate or superficial prompts carries the real risk of generating ambiguous, incomplete, or factually incorrect responses (Boonstra, 2024). Teachers therefore find themselves having to manage systemic risks such as algorithmic biases and hallucinations. Algorithmic biases, in particular, are structural in nature, originating from the introduction of stereotypes and social prejudices into training datasets during the engineering design phase (Numerico, 2024). Countering such information biases is an integral part of today's educational priorities in combating misinformation (Troia, 2025).

Ultimately, prompting is a reflective practice of a metacognitive, metalinguistic, and critical nature. The metacognitive dimension comes into play when the user plans their communication strategy when faced with the interface; metalinguistic reflection guides the careful selection of lexical and semantic structures drawn from their own skill set; finally, critical thinking presides over the validation of the output (Troia, 2025). This evaluative rigor is essential to mitigate the psychological and cognitive risks associated with the use of technology, such as confirmation bias and the Dunning-Kruger effect, which act latently, conditioning students' thought processes (Troia, 2025). The teacher's action cannot therefore be limited to the mere supervision of the contents delivered, but must extend to the monitoring of the cognitive processes

underlying the construction of students' knowledge (Troia, 2025), within a teaching ecosystem in which transversal skills (soft skills) and technical abilities (hard skills) merge synergistically (Baldassarre et al., 2024).

2.2 The Prompt Battle

The Prompt Battle is an innovative and interdisciplinary teaching methodology that transposes the format of rap competitions into the context of strategic human-machine interaction, transforming prompting into a truly artistic and reflective practice.

The first official event of this type of competition took place in Dresden on October 30, 2022, coinciding with the global dissemination of cutting-edge computational models such as ChatGPT and DALL-E, led by professors Florian A. Schmidt and Sebastian Schmieg, together with design students at HTW Dresden (Schmidt & Schmieg, 2022). This event formalized the transition of prompting to the rank of a true artistic practice: in its original configuration, the challenge was structured as a live event in which participants competed in real time to demonstrate their technical expertise in designing text strings capable of guiding Text-to-Image (TTI) models towards the generation of aesthetically striking, complex, or unsettling images, under the direct observation and final evaluation of the audience.

Prompt Battle can prove to be an extremely effective pedagogical tool for AI literacy, as it transforms the technical discipline of prompt engineering into a laboratory practice based on learning by doing and critical reflection. Defined as the art and science of optimizing instructions to guide language models (LLMs) toward desired outputs, prompt engineering is now considered the "new coding," requiring skills ranging from linguistic precision to strategic

planning (Gadesha, 2025). Integrating this skill into a competitive format inspired by rap battles allows us to move beyond the perception of prompting as a mere technical command, elevating it to a cognitive interface that requires constant interpretative negotiation between human intentionality and algorithmic computation (Dalsgaard, 2025). Within a training course, the Prompt Battle activates metacognitive processes, forcing the student to organize their thoughts for specific objectives, and stimulates a deep metalinguistic reflection in the choice of the most effective terms to describe the semantic reality of an image (Rivoltella, 2023).

3. Methodology

This study adopts a qualitative, descriptive research design based on an action research model to analyze a short-term teaching project in detail. Positioned as a participant-observer, the teacher-researcher systematically monitored and facilitated the class's cognitive, interpersonal, and metalinguistic dynamics. Using non-probability, convenience sampling, the project was conducted during regular class hours combining Italian literature, civics, and digital citizenship in a middle school class (Lower Secondary School). The class originally comprised 20 enrolled students (12 female, 8 male), including two students with Special Educational Needs (SEN) who were supported by a specialized co-teacher. However, only 13 students participated in the experimental session. Among them, 10 reported prior familiarity with generative AI systems, mostly through passive social media use.

The instructional intervention used a segmented lesson strategy organized into Pier Cesare Rivoltella's Episodes of Situated Learning (ESL: EAS in italian)

framework, which consists of three phases: preparatory, operational, and restructuring.

- *Preparatory Phase*: Students first completed a 15-minute anonymous diagnostic questionnaire to map their prior tech knowledge and baseline understanding of prompt terminology. This was followed by an interactive lecture on AI fundamentals supported by accessible slides.

- *Operational Phase*: Students completed a hands-on task: translating the visual and semantic details of a photo of their schoolyard into an optimized text prompt. In compliance with official regulations prohibiting personal mobile devices in primary and lower secondary education (Ministry Circular no. 5274/2024), students wrote all prompts by hand on paper.

- *Restructuring Phase*: The teacher-researcher entered the student-written prompts into image generation tools and displayed the resulting images side-by-side on an interactive whiteboard (IWB). This setup sparked a whole-class debate and brainstorming session focused on vocabulary precision and critical detection of algorithmic errors, such as visual hallucinations and bias.

In the ESL framework, the restructuring phase is critical for turning hands-on work into reflective thinking, debriefing, and conceptual understanding. Projecting the generated images anonymously helped depersonalize the critique. Although students initially showed a team-focused bias, guided discussion led them to evaluate the results objectively based on semantic and syntactic accuracy. Through teacher-guided brainstorming, the class analyzed how word choice and descriptive syntax directly shaped the AI's output, turning algorithmic feedback into an intensive language lab. As designed in the ESL model, the lesson concluded with a teacher-led recap ("fixing") that connected student successes and mistakes to core theoretical concepts. Finally, students completed self-assessment logs to evaluate their descriptive precision, reflect

on their emotional engagement during the activity, and build a critical perspective on generative AI.

Although the activity was integrated into the school's standard curriculum, it was conducted with parental consent and student assent to ensure full ethical compliance for data collection. Additionally, using an entirely paper-based method for collecting responses and writing prompts guaranteed complete student anonymity and privacy. This approach ensured that no personally identifiable information was entered into the generative AI models.

3.1 A School Prompt Battle

Following the methodological framework of Episodes of Situated Learning (ESL), the proposed activity fosters cooperative learning, leading students to collectively analyze the generated results to identify systemic limitations such as algorithmic biases and hallucinations (MIM, 2025). This approach not only enhances engagement and motivation, but also educates students to become responsible prosumers, capable of critically evaluating the veracity and ethics of digital content in an on-life context (Floridi, 2017; MIUR, 2019). From this perspective, the Prompt Battle can meet the needs of the future labor market, where AI-supported analytical and creative thinking are among the most sought-after skills, while also ensuring an anthropocentric vision in which humans remain the guarantors of the creative process (World Economic Forum, 2025).

The creation of an educational activity based on the Prompt Battle format stems from the scientific need to experiment with playful and educational pathways capable of integrating the critical use of generative artificial intelligence (GenAI) through the practice of Prompt Engineering. Within a social

context pervaded by complex digitalization and automation processes, updating knowledge and developing advanced technological skills are essential pedagogical priorities for contemporary users, constantly challenged by increasingly high-performance and chameleon-like computational systems. The "chameleon-like" nature of these tools is expressed in the progressive sophistication of textual and visual outputs, which are increasingly indistinguishable from the products of human ingenuity, fueling the emergence of distorting phenomena such as deepfakes and fake news. In this scenario, the introduction of AI into formal learning contexts should not be uncritically perceived as an objective risk factor, but rather as an educational opportunity. On the contrary, it is the unconscious and unmediated use of these tools that poses the real danger for adolescent students, who are called upon to navigate an epochal transition. Since the interpretation of digital data and online algorithms is defined as a socially situated action (Numerico, 2021), teaching orientation strategies in media ecosystems is recognized as a macro-skill that must be integrated early in school curricula.

Borrowing the competitive structure typical of the Rap Battle, described in the previous section, this research proposes the transposition of the Prompt Battle into the school environment, framing it as an innovative, digital, and intrinsically interdisciplinary teaching practice. The scientific and educational objective of the study lies in validating a teaching tool capable of generating a high level of active engagement among the student population, translating linguistic interaction with chatbots into an exercise in critical scrutiny of input instructions (queries) and the corresponding algorithmic outputs. Operationally, the experiment requires students to analyze a target photographic image selected by the teacher and translate its semantic and iconic components into an optimized lexical code, aimed at faithfully replicating the source using generative AI. The evaluation is not limited to the final artifact,

but encompasses the entire process of conceiving and negotiating meaning, in which the wording of the prompt acts as a stimulus for enhancing computational thinking, descriptive skills, and logical-lexical precision. The research hypothesis postulates that the playful-creative approach of Prompt Engineering not only facilitates the internalization of the disciplinary content of the relevant subject (e.g., Italian), but also preferentially stimulates metacognitive skills and critical thinking, essential for the informed decoding of contemporary digital messages and media.

3.2 Research Design

Methodologically, the research adopts a descriptive qualitative research paradigm, focusing on the intensive analysis of a single teaching micro-project. The epistemological orientation is identified in Kurt Lewin's action research model, an approach that positions the teacher-researcher in a position of active participant observation within the educational field, positioning him or her as an agent of socio-educational change attentive to the relational and environmental variables of the context (Mantovani, 1998). The research was conducted in a third-grade class at the "Casoria 3 Carducci King" middle school, located in the municipality of Casoria, in the metropolitan area of Naples. The reference class consisted of 20 students (12 girls and 8 boys), including two students with special educational needs (SEN) for whom a personalized Individualized Educational Plan (IEP) is in place, supported by 9 hours of weekly support. Although the class is described by the class council as cohesive and at times competitive, the actual experimental session recorded the actual attendance of 13 students, due to concurrent absences and the school choir's rehearsals. The intervention was part of the timetable dedicated to Italian

narrative, taking on an interdisciplinary focus tied to the conceptual cores of civic education and digital citizenship.

The teaching was structured according to the segmented lesson format, a strategy useful for modulating attention spans that involves the rigorous alternating of theoretical, laboratory, and assessment sessions. To support the activities, technological mediation was ensured through the use of an Interactive Whiteboard (IWB) connected to the teacher's computer, which displayed a digital presentation developed on the Canva platform, combined with the use of a digital stopwatch to time the work blocks. To ensure maximum accessibility and inclusion during the lesson, the visual aids were designed in compliance with guidelines for people with dyslexia, including the use of sans serif fonts, wide line spacing, characters larger than 18 points, controlled color contrasts, and concept maps supported by iconic layouts. The graphics engine selected for visual generation was the proprietary ChatGPT model (version 4.0), chosen due to its widespread use and the greater accuracy observed in pre-testing compared to other alternative applications such as Gemini or Canva AI. In accordance with Ministerial Circular No. 5274 of 2024 regarding restrictions and prohibitions on the use of mobile devices and personal smartphones in the primary education cycle (MIM, 2024), the text generation phase by students was conducted exclusively in analog mode, using paper-based media (pen and paper).

Data collection for the research was structured through a combination of three distinct empirical survey tools: the administration of an initial diagnostic questionnaire aimed at mapping students' technological pre-knowledge, the teacher's participatory and systematic observation of interactive and cooperative learning dynamics during the competition, and the final collection of reflective and metacognitive self-assessment protocols written by the

students. The planning and chronological order of the entire teaching process were modeled on the Episodes of Situated Learning (ESL) structure codified by Pier Cesare Rivoltella, structured according to the classic tripartite division into preparatory, operational, and restructuring phases.

The preparatory phase initially involved the anonymous administration of a diagnostic questionnaire (lasting 15 minutes), followed by a participatory lecture supported by slides created with Canva to introduce the key concepts of artificial intelligence, prompting, and visual storytelling. This segment was rounded out with practical examples designed to stimulate the differential analysis of simple and complex inputs. The subsequent operational phase involved the implementation of the Prompt Battle itself: students were exposed to a real visual stimulus (a digital photograph of the school courtyard) and asked to first draft an individual technical description and then collaborate in two cooperative work groups, respectively called “The Lions” and “The Knights of the Court.” Each group negotiated and synthesized a single collective prompt aimed at faithfully replicating the architectural, chromatic, and structural details of the original photograph, activating descriptive and logical-computational skills. Finally, the restructuring phase involved the anonymous and comparative projection of images processed by the algorithm based on the instructions provided by the two teams. Students engaged in a collective brainstorming and metalinguistic reflection activity focused on the causal connection between the vocabulary used and the effectiveness of the generated output. The teaching cycle concluded with a theoretical-critical focus on the systemic dimensions of bias, computational hallucinations, and privacy protection, culminating in the administration of the final metacognitive assessment and self-assessment of the experience. The entire design process incorporated the three inclusive vectors established by the Ministerial Guidelines for School Integration, ensuring the promotion of non-

discriminatory behavior, the activation of multiple channels of discovery learning, and the centrality of each student's developmental rhythms.

4. Data analysis

The implementation of the Episodes of Situated Learning (ESL) focused on the "Prompt Battle" allowed us to collect qualitative empirical evidence through an action research methodology (Mantovani, 1998; Rivoltella, 2021). During the operational phase, classroom observation revealed a high level of engagement and active participation among students in class 3C at IC Casoria 3 Carducci King. Divided into two groups, "The Lions" and "The Knights of the Court," the students collaborated in a cooperative learning regime, demonstrating different internal dynamics: the Lions group demonstrated greater cohesion and operational synergy, managing to complete the descriptive prompt four minutes ahead of the opposing team. The subsequent anonymous screening and comparison of the graphical output generated by ChatGPT triggered a lively metalinguistic and interpretative debate. At first, students showed a competitive and egocentric tendency, oriented towards voting for their own team's image out of pure team spirit; however, the subsequent guided analysis of the prompt texts led the class to an objective evaluation, decreeing the victory of the Lions team thanks to a lexical precision and syntactic structuring more suitable for the semantic transcoding of the real starting image (Baldassarre et al., 2024; Traini, 2020).

Data from the initial diagnostic questionnaire revealed significant prior familiarity among students with Generative Artificial Intelligence (GenAI) systems, albeit mediated almost exclusively through passive use of social media. Of the thirteen students present, ten stated they were familiar with AI

and regularly used ChatGPT for a variety of purposes, ranging from study support to emotional well-being (e.g., requests for personal advice or free conversation). At the same time, a widespread perception of risk and a marked terminological gap emerged: only three students were aware of the meaning of the term “prompt,” confirming the pressing need for structured AI literacy interventions within school curricula (Cuomo et al., 2022; Hwang et al., 2023).



Figure 1: Photograph to be replicated by the AI through the prompt

Table 1: Comparison between the prompts created by the groups

Knights	Lions
Create an image of two brown chickens walking. It's on a dirt field, where the dirt dominates over the green of the grass. Behind the chickens are two murals: on the right, a mural full of people wearing different colored shirts; the other, on the left, has a pink background with circles containing segments of color: red, yellow, white, and blue. Make it as realistic as possible.	It creates a meadow in half the screen, mostly brown with green and yellow blades of grass. In front of the murals are three chickens, but only two are visible, while the third is hiding behind it, the one to the viewer's left, revealing the third chicken's leg. In the background, a painted wall is divided in half. On one side, there are people drawn in profile, dividing the wall by a blue stripe, while on the other half, a pink background with circles divided into red, white, blue, and yellow segments—make it look realistic.

	Knights	Lions
ChatGPT		
Gemini		

Figure 2: Comparison between the prompts created by the groups and the corresponding images produced with AI

Final reflections drawn from the self-assessment questionnaires administered at the end of the ESL confirmed the complete success of the micro-design in terms of pedagogical engagement. Students rated the activity as highly stimulating and inclusive, emphasizing the importance of descriptive accuracy in human-computer communication. The internalization of the concept of lexical detail and the critical awareness of complex phenomena such as algorithmic biases, hallucinations, and risks related to cybersecurity and privacy protection demonstrate how playful manipulation of linguistic code can foster metacognitive skills and informed technoskepticism (Numerico, 2017; Troia, 2025).

The overall analysis of the trial allows for a careful assessment of the intervention's strengths and limitations. The modularity and brevity typical of the ESL format proved to be appropriate methodologies for maintaining constant attention and promoting learning by doing, integrating soft and hard skills through critical reflection (Panciroli & Rivoltella, 2025). On the other hand, the main critical issues lie in the small sample size and the time constraints of a single session, factors that do not allow for statistical generalization of the model or long-term assessment of learning outcomes. Furthermore, the ministerial ban on the use of personal devices in the classroom forced students to operate with the analog aid of pen and paper, excluding the intrinsically iterative nature of prompt engineering (Boonstra, 2024). Nonetheless, the heuristic value of the project remains high thanks to its total flexibility and interdisciplinary replicability, which allows its extension to different knowledge domains or interscholastic challenges.

Data analysis was carried out using a qualitative, inductive, and recursive approach, aimed at deriving conceptual categories from the empirical corpus collected during the instructional intervention. The analysis process comprised three sequential phases: an initial open coding stage to extract primary

descriptive codes from the responses to the initial diagnostic questionnaire, the field notes from participant observation, and the final self-assessment protocols; a second axial coding stage to group codes into conceptual sub-themes; and a final selective coding stage to formalize the emerging overarching themes. These themes included metalinguistic accuracy in visual–textual transcodification, the critical scrutiny of hallucinations and algorithmic bias, and affective–emotional engagement within a playful, competitive dynamic.

Empirical data collection was ensured through methodological triangulation using three distinct instruments: the initial diagnostic questionnaire, a participant-observation grid prepared by the teacher during group interactions, and final protocols for metacognitive and emotional self-assessment. By systematically cross-referencing these three empirical sources, the study verified the convergence and internal coherence of the interpretations.

The first overarching theme concerns students' prior knowledge and the terminological gap identified through the initial diagnostic questionnaire. Of the 13 participating students, 10 reported a habitual familiarity with generative artificial intelligence models (particularly ChatGPT), mainly conveyed through social media. In their accounts, this familiarity is associated both with academic support and with an informal channel for emotional venting and requests for personal advice. Despite such pervasive use, a clear terminological and conceptual discrepancy emerges: only 3 out of 13 students demonstrate knowledge of the meaning and function of the term "prompt," suggesting an interaction with the technology that is largely passive and lacking metalinguistic awareness.

The second thematic core concerns syntactic–semantic negotiation and group dynamics during the operational phase. Analysis of the handwritten prompts

produced by the two groups shows significant operational differences. The Lions' group displays strong internal cohesion and synergy, completing the analog drafting earlier than the Knights' group. Regarding linguistic structuring, while Knights adopt a linear, focused syntax centered on describing the main subjects, Lions introduce more complex compositional and spatial constraints. Both groups converge in the analytical accuracy devoted to chromatic and geometric details of the background mural (the division into pink, red, yellow, white, and blue sections), whereas the main divergence lies in the attempt of Lions' group to condition the algorithm to represent a partially hidden element, which leads the AI to generate a perspective hallucination.

The third thematic core relates to the critical evaluation of algorithmic errors and overcoming evaluative bias. During the comparative projection of the visual outputs, an initial contradiction appears between group loyalty and analytical objectivity, because students tend to vote for the image produced by their own team based on emotional attachment. However, the subsequent teacher-guided examination of the handwritten texts leads the class toward a rational, de-subjectified convergence, ultimately awarding the Lions' victory due to greater precision in spatial and semantic transcodification. This debriefing phase enables students to critically identify visual hallucinations produced by the algorithm—such as the deformation of human faces in the murals and inconsistencies in the terrain's texture. As a result, students develop the awareness that the AI functions merely as a syntactic coordinator without semantic understanding.

Finally, the fourth overarching theme concerns the affective–emotional dimension and the technological ambivalence revealed in the final self-assessment protocols. The playful, competitive framework generates high emotional engagement and a strong sense of self-efficacy; however, the empirical evidence shows an interesting contradiction in students' perceptions.

As they progressively discover the pervasiveness of algorithmic technologies, they experience a mixed response characterized by surprise and fear. This transforms an initial form of uncritical trust into a cautious stance of technoskepticism. Overall, these findings indicate that the playful, competitive manipulation of linguistic code acts as a catalyst for developing critical, metalinguistic, and media-related maturity within the contemporary school ecosystem.

5. Discussion

The analysis of the qualitative evidence collected during the Prompt Battle trial offers cautious and preliminary interpretative insights into the effectiveness of adapting this playful, competitive methodology to the school context. Consistent with the model of cognitive mediation and the structure of Episodes of Situated Learning, interaction with the visual algorithm prompted students to engage with the semantic projection of a descriptive intention, with the syntactic–lexical structuring of paper-based instructions, and with the interpretive negotiation of graphical outputs. The constraint imposed through the use of analog materials (paper and pen) encouraged students to plan the linguistic code in advance, replacing the usual iterative process of trial and error with a more accurate descriptive analysis. The debriefing phase and the subsequent lesson served as a guided opportunity for students to identify the causes of computational hallucinations and algorithmic bias, thereby supporting an initial awareness of the opacity of generative technologies. The affective and emotional dimension - emerging both from discovering the pervasiveness of algorithmic models and from the rivalry created by structuring

the activity as a team game - generated high levels of participation, which were then directed toward a de-individualized evaluation of the texts.

The research aims to formalize a teaching model for lower secondary school that can operationalize the Prompt Battle methodology through the architecture of Episodes of Situated Learning. As a secondary objective, it involves an exploratory empirical study based on a micro action-research intervention. The experience suggests that the analytical negotiation between analog text and visual images can function as a practical tool to foster metalinguistic accuracy and to stimulate an initial, cautious awareness of the functional limits of generative AI, such as visual hallucinations and algorithmic bias.

The qualitative data collected do not seek to formally demonstrate the attainment of complex constructs - such as critical thinking, creativity, self-efficacy, or inclusion - which would require standardized and validated measurement tools. The study's goal is rather to provide an exploratory, context-sensitive analysis of the instructional action, offering a clear picture of the level of engagement generated by the conscious introduction of specific teaching devices. From this perspective, the intervention is intended to move beyond the purely passive use of technology by equipping students with the skills and conceptual tools needed for active, guided, and reflective interaction with the algorithmic medium.

This study therefore aims to propose the idea that introducing the practice of prompt engineering in a laboratory and competitive manner can be a valuable teaching tool for teaching digital citizenship and new literacies. The act of prompting, configuring itself as a semiotic and reflective space, can shift the pedagogical focus from mere technical execution to the depth of logical-descriptive thinking, promoting a distinctly anthropocentric and ethical vision

of emerging technologies. In this perspective, aligning schools with emerging digital practices can be not a distraction, but rather a fundamental educational priority for developing citizens capable of critically inhabiting the complexity of on-life reality.

Furthermore, analysis of the Prompt Battle workshop reveals that the emotional dimension is not a marginal element, but is intrinsically linked to learning processes and the construction of informed digital citizenship. From the evidence that emerged, the affective sphere manifests itself primarily in students' prior habits, who tend to use AI as a tool for psychological and relational support, using it to vent, seek personal advice, or engage in conversations in situations where they feel embarrassed to interact with humans. During the workshop, the emotional impact was mediated by the discovery of technological pervasiveness, arousing in the students an ambivalent feeling of surprise and fear; the awareness that AI surrounds their daily lives in often invisibly acted as a catalyst for a profound reflection on the "dangerousness" of the tool, transforming uncritical trust into a more cautious and thoughtful attitude. At the same time, the challenge's playful format generated a high level of engagement and enjoyment, elements that counteracted the boredom typical of traditional lessons, fostering a participatory and stimulating classroom atmosphere. The group dynamics, characterized by competition between factions (as evidenced by the challenge between the "Lions" and the "Knights of the Court"), initially triggered emotional biases related to a sense of belonging, but the subsequent critical evaluation phase allowed for an objective analysis of the outputs, enhancing participants' sense of self-efficacy and satisfaction.

Ultimately, experience shows that AI can become an "ally of reflection" capable of activating metacognitive processes precisely by engaging the emotional

chords, making the student a conscious and critical actor within the hyper-technological reality in which we are immersed.

6. Conclusions

In conclusion, the primary scientific value of the research lies in the effort to formalize a pedagogical model for lower secondary school capable of operationalizing the Prompt Battle methodology (Schmidt & Schmieg, 2022) through the structured framework of Situated Learning Episodes (Rivoltella, 2021; Panciroli & Rivoltella, 2025), and secondarily in conducting an exploratory empirical investigation following the action-research paradigm (Mantovani, 1998). Grounded in the perspective of cognitive mediation (Dalsgaard, 2025) and the conceptual shift from mere technical command execution ("natural language coding") toward a comprehensive Prompt Literacy (Hwang et al., 2023; Baldassarre et al., 2024), the research sought to demonstrate how semantic transcoding between visual content and textual description can transform algorithmic querying (Gadesha, 2025) into a practical workshop for metalinguistic and metacognitive reflection, guiding students from passive technology consumption to a critical decoding of generative artificial intelligence resources in the onlife reality (Floridi, 2017, 2025; MIM, 2025a).

The shared experience revealed that the gamified and competitive manipulation of linguistic code can act as a catalyst for recognizing the functional limitations inherent to computational models -such as visual hallucinations (Treccani, 2025) and algorithmic biases (Holdsworth, 2025; Numerico, 2024) - thereby fostering a cautious technoskepticism and media awareness among learners (Troia, 2025). However, in strict accordance with

the exploratory nature of the study, the qualitative data collected do not claim to formally attest to the stable attainment of complex constructs. Indeed, the heuristic scope and transferability of the evidence remain sharply bounded by the study's primary methodological limitations: the small size of the convenience sample, the absence of a longitudinal design or follow-up assessments to evaluate learning retention over time, the potential occurrence of the Hawthorne effect and social desirability bias in self-assessment responses, the dual role of the teacher as a participant-observer researcher, and the paper-based prompt drafting constraint mandated by Ministerial Circular (MIM, 2024b), which partially suspended the iterative workflow intrinsic to digital prompt engineering (Boonstra, 2024).

In light of these empirical constraints, future research directions should focus on expanding and consolidating the model by conducting multi-center studies with larger and more heterogeneous samples to test contextual transferability, designing longitudinal studies with delayed post-test measurements, integrating quantitative AI literacy scales (AI Literacy Framework, 2025; Cuomo et al., 2022; UNESCO, 2024), and exploring the adaptability of the challenge to other subject areas or alternative educational settings.

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