VNU Journal of Foreign Studies

Journal homepage: https://jfs.ulis.vnu.edu.vn/

AI LITERACY IN LANGUAGE LEARNING THROUGH DIGITAL MULTIMODAL COMPOSING: A SYSTEMATIC REVIEW

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Received 13 May 2025
Revised 13 June 2025; Accepted 19 June 2025

Abstract: This systematic review synthesizes 48 studies (2014-2025) to evaluate how existing Digital Multimodal Composing frameworks in tertiary language learning integrate AI literacy competences, namely creativity, critical thinking, and ethical literacy. Following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, the analysis reveals divergent trends. AI-integrated frameworks tend to excel in creativity by facilitating iterative revision and co-creation processes while non-AI frameworks emphasize structural coherence over innovation. However, this distinction is not absolute, as creative engagement ultimately depends on task design and scaffolding rather than the integration of AI tools alone. Ethical literacy remains underdeveloped overall, with limited discussion on bias mitigation and transparent authorship. In response, this study proposes the IGER Cycle (Interpret, Generate, Evaluate, Revise) as a student-centered framework that empowers educators to leverage GenAI while preserving learner agency and cultural responsiveness. Practical examples of classroom implementations demonstrate how this model fosters learner agency and equitable learning outcomes.

Keywords: AI literacy, Digital Multimodal Composing, AI-assisted learning

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https://doi.org/10.63023/2525-2445/jfs.ulis.5517

TỔNG QUAN HỆ THỐNG VỀ NĂNG LỰC HIỂU BIẾT AI TRONG HỌC TẬP NGÔN NGỮ THÔNG QUA SÁNG TÁC ĐA PHƯƠNG THỨC KỸ THUẬT SỐ

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Nhận bài ngày 13 tháng 5 năm 2025
Chỉnh sửa ngày 13 tháng 6 năm 2025; Chấp nhận đăng ngày 19 tháng 6 năm 2025

Tóm tắt: Bài tổng quan hệ thống tổng hợp 48 nghiên cứu (2014-2025) nhằm đánh giá các khung lý thuyết về sáng tác đa phương thức kỹ thuật số trong giáo dục đại học tích hợp như thế nào với các năng lực hiểu biết về AI, bao gồm: sáng tạo, tư duy phản biện, và nhận thức đạo đức. Tuân theo hướng dẫn PRISMA, phân tích cho thấy các khung lý thuyết tích hợp AI có xu hướng vượt trội về sáng tạo nhờ hỗ trợ chỉnh sửa lặp lại và đồng sáng tạo, trong khi các khung truyền thống nhấn mạnh tính nhất quán cấu trúc hơn là sáng tạo. Tuy nhiên, mức độ sáng tạo cuối cùng không chỉ phụ thuộc vào công cụ AI mà còn vào cách thiết kế nhiệm vụ và sự hỗ trợ sư phạm. Năng lực đạo đức vẫn chưa được phát triển đầy đủ, với ít nghiên cứu đề cập đến các chiến lược giảm thiểu thiên kiến AI hay tính minh bạch trong quyền tác giả. Để khắc phục, nghiên cứu đề xuất chu trình IGER (Diễn giải - Sáng tạo - Đánh giá - Chỉnh sửa) lấy người học làm trung tâm, giúp giáo viên khai thác AI mà vẫn đảm bảo quyền tự chủ của người học và tính nhạy cảm văn hóa. Các ví dụ thực tiễn cho thấy cách tiếp cận này thúc đẩy sự chủ động của người học và hỗ trợ kết quả học tập công bằng hơn.

Từ khóa: hiểu biết về AI, sáng tác đa phương thức kỹ thuật số, học tập có hỗ trợ AI

1. Introduction

Digital Multimodal Composing (DMC) refers to the purposeful orchestration of linguistic, visual, auditory and spatial modes on digital platforms to construct new meaning in second-language contexts (New London Group, 1996; Kress, 2010). Recently, Generative Artificial Intelligence (GenAI) has introduced new dimensions to DMC, with tools like ChatGPT, Visme or Poe enabling learners to automate design workflows and generate multilingual content with minimal technical expertise (Liu et al., 2024). While these tools democratize access to advanced creative processes by reducing technical barriers, scholars like Selwyn (2022) caution against uncritical adoption, arguing that AI tools often reproduce societal biases and obscure human agency. UNESCO's (2021) ethical guidelines for AI stress transparency and fairness, yet practical challenges persist. One challenge is that AI-generated content often reflects the biases embedded in its training data such as homogenizing marginalized identities (Birhane et al.,2023; Fleisig et al., 2024). These issues are particularly relevant in DMC tasks that aim to promote intercultural competence and linguistic diversity. Without careful pedagogical intervention, students may unconsciously adopt AI outputs without critically evaluating their biases or implications. In Vietnam and the wider ASEAN region, national-level digitalisation roadmaps now encourage universities to harness AI for language learning, yet few guidelines exist on how to embed AI literacy into everyday classroom practice (Vu et al., 2023).

Despite the potential of AI, few comprehensive syntheses exist on how DMC frameworks leverage AI tools (Stolpe & Hallström, 2024). Existing studies are often

fragmented, focusing on isolated tools (e.g., ChatGPT for text generation) rather than multimodal ecosystems or broader spectrum of AI-related challenges. This leaves a knowledge gap on: (a) how existing DMC frameworks embed AI literacy, and (b) how non-AI frameworks might be adapted for responsible GenAI use. Thus, this study synthesizes existing DMC frameworks to evaluate their alignment with AI literacy competences, proposing an integrated model for AI-enhanced DMC in tertiary education.

The central research question guiding this inquiry is:

How do existing DMC frameworks align with AI literacy competences (creativity, critical thinking, ethical literacy) in tertiary-level language learning?

The subquestions is: *How do AI vs. non-AI frameworks differ in competences?*

2. Literature Review

2.1. Digital Multimodal Composing

DMC has gained prominence in contemporary language education. Initially influenced by the New London Group's (1996) vision of multiliteracies, DMC has evolved beyond traditional literacy models to accommodate digital affordances, with applications in language learning ranging from digital storytelling to infographics. These tasks encourage learners to integrate linguistic with non-linguistic modes such as visual, auditory, and spatial to create meaning. Prior research suggests that such practices foster learner autonomy, intercultural competence, and rhetorical adaptability (Hafner & Miller, 2011; Cimasko & Shin, 2017; Dzekoe, 2017).

2.2. AI Literacy Competences in DMC Frameworks

Given AI's dual role in enhancing and complicating DMC, the following section examines the competences required to navigate this integration. AI literacy is conceptualized through diverse frameworks but several systematic reviews such as Stolpe and Hallström's (2024) and Yim's (2024) have pointed to their convergence around four key competences, including technical knowledge (e.g., understanding AI functionality, prompt engineering), application (e.g., leveraging AI for ideation and problem-solving), critical evaluation (e.g., evaluating AI outputs for biases and accuracy), and ethical-sociocultural awareness (e.g., addressing fairness, cultural representation, and intellectual property). For instance, the AI literacy framework by Ng et al. (2021) emphasizes four elements: know and understand, use and apply, evaluate and create AI, and AI ethics. Similarly, Southworth et al. (2023) expand this with the fifth category "Enabling AI", capturing courses to support Ai through related technical skills and/or "contain a lower total AI content of one of the four Core AI Literacy topics". In the K-12 education context, Kong et al. (2024) also identify four primary dimensions under different terms: cognitive (conceptual understanding of AI), metacognitive and affective (ability to apply AI for problem-solving) and social (ethical considerations).

While these competences are interdependent, their relevance varies across educational contexts. In language learning through DMC, where the pedagogical focus lies on multimodal meaning-making and culturally responsive design, three competences appear as particularly salient: creativity, critical thinking, and ethical literacy. Although technical knowledge (e.g., coding, algorithmic literacy) is foundational to general AI literacy, its salience diminishes in DMC frameworks designed for non-computer-science disciplines. Language learners engaging with GenAI tools typically interact with user-friendly interfaces that diminish technical complexities (Kayalı et al., 2023), allowing them to focus on creative and critical use of AI

outputs rather than their underlying mechanisms. This prioritization does not diminish the importance of understanding algorithms or coding; rather, it reflects how most tertiary-level language learners interact with GenAI. Similarly, while AI literacy frameworks such as Ng et al. (2021) and Southworth et al. (2023) often treat application (e.g., problem-solving) as distinct, in DMC contexts, application is inherently creative, where leveraging AI tools for ideation and problem-solving is considered a creative act (Wünsch-Nagy, 2025). The emphasis, therefore, shifts to how learners critically and creatively harness AI outputs while making ethically informed decisions about authorship and cultural representation.

2.2.1. Creativity

Creativity in DMC refers to the process of generating new meaning by recontextualizing available modes (New London Group, 1996), whether manually composed or AI-generated. For non-AI-integrated frameworks, this involves manual curation and manipulation of multimodal resources (e.g., text, image, sound, video) to create, adapt, and integrate meaning across different semiotic modes. If AI is integrated, the focus is on intentional collaboration with AI, positioning AI as a co-creative partner rather than a passive tool.

Recent studies illustrate this synergy. For instance, Lin et al. (2025) demonstrated how learners revised generic AI-generated poetry to infuse cultural nuances. Similarly, Smith et al. (2025) illustrated how preservice teachers blended AI-generated story arcs with personal narratives. These practices illustrate how problem-solving dimension in AI literacy intersects with DMC's emphasis on design agency, amplifying creativity while preserving human agency.

2.2.2. Critical Thinking

Critical thinking in DMC necessitates multimodal criticality, a practice encouraging evaluation, modification, and critical engagement with digital content (New London Group, 1996). If AI is absent, the focus is on how the framework fosters analytical skills such as critiquing structural, linguistic, and semiotic choices, and analysing the credibility of digital sources. If AI is present, critical thinking extends to interrogating both the technical flaws (e.g., underrepresentation of non-Western narratives) and sociocultural implications (e.g., homogenization of storytelling voices) of AI outputs. This is exemplified in projects where learners critique AI-generated narratives to challenge stereotypes (Lam & Putri, 2024) or analyse colour schemes and text placement AI-generated visuals to better match with rhetorical intent (Jiang, 2024). Such practices resonate with the call for critical AI pedagogy but adapt it to DMC's multimodal affordances.

2.2.3. Ethical Literacy

Ethical literacy in DMC focuses on actionable responsibilities, referring to understanding and applying ethical principles in digital authorship, transparency, and cultural accountability (Liu et al., 2025). While traditional DMC pedagogy has long grappled with intellectual property issues such as the use of online or copyrighted images and audio, GenAI complicates these concerns by obscuring attribution, originality, and the boundaries of human-AI collaboration (Kostopolus, 2025). Therefore, instead of focusing on intellectual property, this study examines how frameworks equip learners with responsible digital authorship and proper citation of multimodal sources. For AI-integrated frameworks, ethical literacy expands to ethically attribute AI contributions while asserting their own agency as composers like labeling AI-generated content (e.g., "Image created using DALL-E"). Beyond authorship concerns, ethical literacy in DMC also extends to bias mitigation and cultural representation,

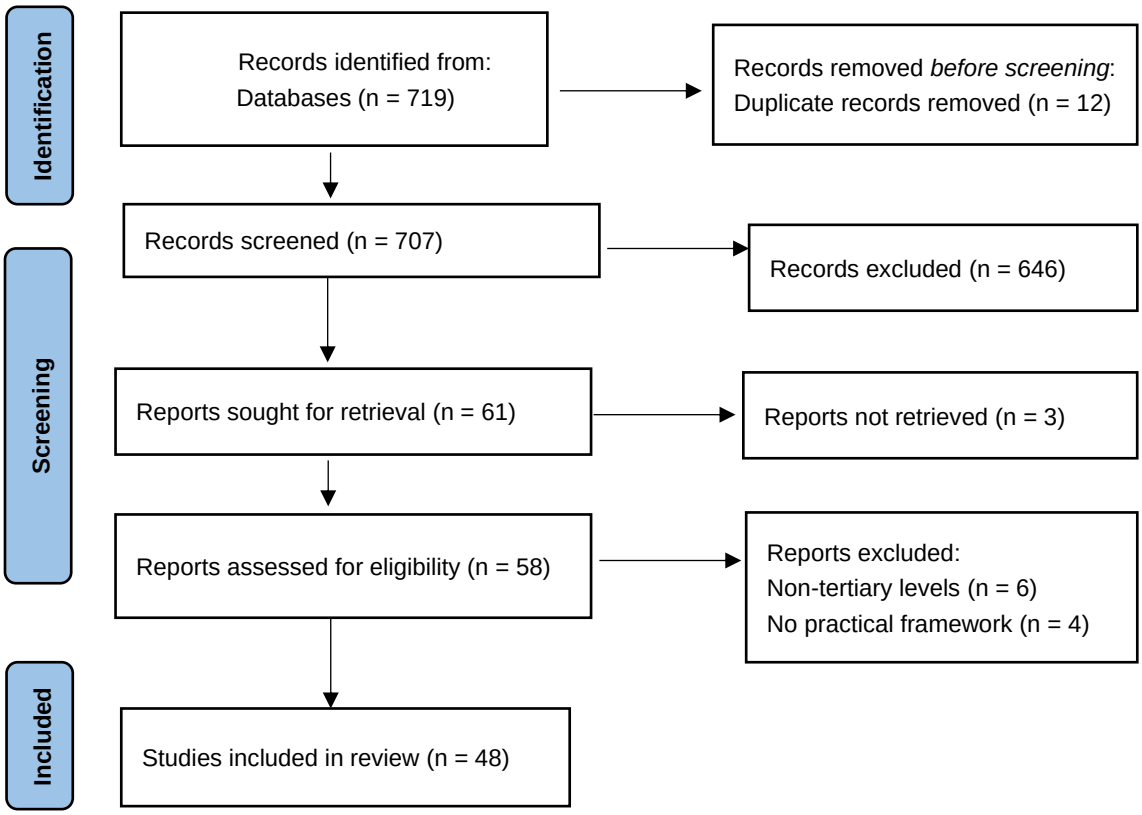
advocating for tasks that require learners to revise digital outputs to reflect local identities.

3. Methodology

This review follows the PRISMA 2020 reporting guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), comprising four stages: search strategy, screening and selection, data extraction, and synthesis.

Figure 1

PRISMA Flow Diagram (Page et al., 2021)



The database search was conducted in Scopus using the following Boolean search strings:

- "digital multimodal composing" AND "frameworks" AND ("university" OR "tertiary" OR "higher education")
- "multimodal pedagogy" AND ("university students" OR "tertiary learners")
- Timeframe: 2014-2025. We selected 2014 as a starting point because it marks the early adoption phase of AI-related educational technologies, allowing us to track a decade-long evolution up to the current state of AI in higher education.

This yielded 719 articles, of which 48 were shortlisted after duplicate removal and two-stage screening (title/abstract and full-text). The inclusion criteria are peer-reviewed articles written in English, discussing DMC frameworks (AI or non-AI) in tertiary-level education. Studies are excluded if they: (1) focused on non-tertiary levels (e.g., K-12) and non-language learning contexts; (2) were theoretical-only papers without practical frameworks. For example, some studies framed DMC as a tool for social impact rather than linguistic development, such as digital storytelling for peacebuilding (Vinogradova & Linville, 2024),

critical citizenship (Noble & Gachago, 2022), or digital empathy (Jiang & Gao, 2020). Also, studies that employed identical DMC frameworks were carefully filtered. For example, multiple studies by Cheung (2022, 2023, 2024), Amgott (2023, 2024), Zhang & Yu (2023a, 2023b, 2023c), and Yu et al. (2022) utilized the same multimodal composing approach. In such cases, only the most comprehensive or recent study was retained for synthesis.

Data extraction focused on framework characteristics, tools, and AI literacy competences (creativity, critical thinking, ethics), coded as High/Medium/Low. Pilot testing was conducted on 10% of studies (n=5) to refine ambiguous coding distinctions. Also, to measure inter-rater reliability, Cohen's κ for 20% of studies (n=10) was calculated. The review achieved $\kappa = 0.89$ for creativity, $\kappa = 0.84$ for critical thinking, and $\kappa = 0.9$ for ethics, indicating high coding consistency (Landis & Koch, 1977). Discrepancies were resolved through discussion, refining coding guidelines. Descriptive and thematic analyses identified alignment patterns and gaps.

4. Results

Table 1 summarizes the distribution of competences coded as High, Medium, or Low in AI-based (n = 7) and non-AI-based (n = 41) DMC frameworks.

Table 1

Competency Ratings in AI vs. Non-AI DMC Frameworks

AI frameworks (n = 7)			
Competence	**High**	**Medium**	**Low**
Creativity	6	1	0
Critical Thinking	4	3	0
Ethical Literacy	0	6	1

Non-AI frameworks (n = 41)			
Competence	**High**	**Medium**	**Low**
Creativity	3	37	1
Critical Thinking	1	39	1
Ethical Literacy	0	7	34

4.1. Creativity

As shown in Table 1, AI frameworks consistently demonstrated higher creativity ratings (86%, n = 6/7), whereas non-AI frameworks predominantly scored at a medium level (90%, n = 37/41) due to their reliance on structured templates and generic digital tools.

Studies using generative AI tools demonstrated systematic innovation, particularly through iterative refinement and co-creation processes. For instance, Jiang (2024) investigated AI-assisted advocacy poster design, where students used DALL·E and Adobe Firefly to generate initial conceptual designs as idea starters rather than final products. If Adobe Firefly-generated images lacked emotional depth or misrepresented advocacy messages, students manually restructured the elements, altered AI-generated text, or introduced additional multimodal components to enhance rhetorical effectiveness. Similarly, Lin et al. (2025) incorporated AI into multilingual multimodal composition, following the IDEA framework (Interpret, Design, Evaluate, Articulate). Poe AI assisted in text generation, but students actively modified AI-generated content to fit cultural and linguistic nuances. By critically engaging with AI outputs, these studies position AI as a creative partner rather than a cognitive shortcut, reinforcing students' agency in the composing process. This process exemplifies how AI divergent thinking can enhance creativity when paired with human convergent thinking (Grilli & Pedota, 2024).

In contrast, non-AI frameworks provide structured support for multimodal composing, but inadvertently stifle creativity due to both rigid task structures and the limitations of the tools themselves. One challenge stems from rigid task design, where task requirements typically dictate specific forms of representation. For example, You and Han (2023) observed that students primarily relied on images and videos, not necessarily as a creative choice, but because the task design mandated these specific visual elements. Similarly, in a study on video-based argumentative projects in China, students were required to adhere to a conventional essay format, meeting standardized test expectations (Zuo & He, 2024). Despite the multimodal nature of their work, the imposed introduction-body-conclusion structure ensured that their compositions remained within traditional academic conventions, limiting opportunities for alternative rhetorical approaches.

In addition to task constraints, platform limitations further shape how students can organize and present their ideas. You and Han (2023) also observed that the platform CGScholar allowed only a linear arrangement of content, which prevented students from exploring alternative layouts or interactive features. In similar vein, tools designed for efficiency such as templates or structured platforms inadvertently prioritize form over innovation. Bourelle et al.'s (2017) study illustrates even when customization was possible, students tended to default to pre-designed templates on Google Sites rather than experiment with unique layouts. Where frameworks did score "High", they featured open-ended or recontextualizing tasks, such as Lam and Putri (2024), who guided students to critically rewrite fairy tales to address social justice themes.

Hence, AI's value lies not in replacing human creativity but in accelerating ideation, allowing students to focus on higher-order creative decisions. Non-AI frameworks, however, must intentionally design tasks that reward experimentation over conformity by adopting more flexible scaffolds to invite deeper creativity.

4.2. Critical Thinking

Both AI and non-AI frameworks emphasized critical thinking, with AI frameworks showing no significant advantage over traditional ones (Table 1). This suggests that while AI can support cognitive structuring and revision, it does not inherently enhance students' critical analysis skills.

AI tools can provide real-time feedback on structure and coherence, but their effectiveness depends on how they are implemented. Some frameworks encouraged students to evaluate AI outputs for accuracy, bias, and relevance. For example, Liu et al. (2024) tasked students with verifying AI-generated references and rejecting biased visuals, fostering technical and sociocultural critique. Similarly, Smith et al. (2025) reported preservice teachers identifying racial biases in Stable Diffusion outputs, demonstrating awareness of AI's limitations. For instance, minor name changes (e.g., 'Carlos' to 'Jim') caused significant shifts in AI-generated depictions, where characters' racial features and settings shifted in ways that reflected underlying biases in training data.

However, in other cases, AI was used merely as a revision tool for checking spelling or fixing grammar, limiting students' engagement with deeper analytical skills. Morales and Zapata (2024) found that while students interacted with multimodal elements such as images, gestures, and spatial organization, their critical engagement remained superficial. Their children's books often lacked culturally specific representations of the intended Dominican audience, showing only partial awareness of the intended audience needs.

In similar vein, most non-AI frameworks (n = 39/41, 95%) scored medium as they focused on structural coherence (e.g., aligning visuals with text) rather than systemic critique (e.g. authenticity of multimodal resources, how different modes shape perception, or affect communication effectiveness, media bias, representation, audience interpretation). Exceptions included Lam & Putri (2024), where students deconstructed fairy-tale stereotypes. In their rewritten versions, students subverted patriarchal norms by reframing female protagonists beyond beauty ideals (Love Beyond Beauty), tackled issues of bullying and abuse through alternative character arcs (The Magical Journey of Jessica), and reimagined heteronormative love stories to include LGBTQ+ representation (Love Without Boundary). These rewritings were supported by deliberate multimodal techniques, such as adjusted narrative tones, strategic visual composition, and restructured dialogues.

Therefore, critical thinking in DMC depends less on the presence of AI and more on task design that prioritizes inquiry over compliance. Whether AI or not, robust scaffolding (e.g., structured reflection prompts, bias-detection exercises) appears more influential than the tool itself. To move beyond surface-level editing, educators must design tasks that position AI outputs as artifacts for critique rather than endpoints.

4.3. Ethical Literacy

The review reveals that ethical literacy was underdeveloped across both frameworks but slightly stronger in AI studies. AI frameworks (medium: 86%, n = 6/7) emphasized procedural transparency in AI use like logging interactions with AI tools but largely sidestepped critical ethical questions like bias mitigation or intellectual accountability. For instance, Wang and Ren (2024) required students to document ChatGPT prompts but did not mandate labelling AI-generated content in final submissions. Wünsch-Nagy (2025) further exposes this disconnect, reporting when students encountered AI content filters blocking depictions of emotional distress or historical monuments, they did not engage in explicit discussions on why those filters existed or how AI's ethical boundaries reflect corporate or cultural biases. Instead, students adapted their prompts or reframed their intended visuals to circumvent these restrictions, indicating a reactive, compliance-driven rather than proactive approach to ethical literacy in AI-generated content.

Non-AI frameworks (low: 83%, n = 34/41) provided even minimal engagement with ethical considerations, often omitting discussions on bias mitigation, authorship, or digital integrity. Studies like Zhang et al. (2024) touched on plagiarism concerns or Wang (2024) acknowledged consent and privacy in video-based assessments. A rare exception, Ho (2024) briefly discussed copyright issues when students used Marvel soundtracks, suggesting ad hoc ethical engagement. While students recognized copyright restrictions, they navigated these limitations independently, often relying on improvisational solutions rather than structured ethical guidelines. Across these cases, students independently navigated ethical dilemmas through trial-and-error, underscoring a troubling pattern that digital pedagogy often treats ethics as an afterthought rather than a core literacy.

The finding echoes broader critiques about a systemic neglect of ethical scaffolding in AI-mediated pedagogy (Southworth et al., 2023; Gouseti et al., 2024), risking the normalization of uncritical AI use. Ethical literacy requires moving beyond transparency like labelling AI content to transformative practices such as redesigning AI systems to centre marginalized voices.

5. Discussion

The findings highlight both AI's creative potential and its ethical limitations. While AI tools expand "what" students can create, they also challenge educators to reconsider "how" to teach students to engage with technology. These patterns reflect a deeper gap in contemporary language pedagogy, where the discipline's historical emphasis on communicative competence (Hymes, 1972) and multimodal design (Kress, 2010) has yet to fully reconcile with the sociotechnical complexities of AI. Below, we contextualize these results through three dimensions.

5.1. Creativity

The higher creativity scores in AI frameworks reflect Vygotsky's (1978) concept of tool-mediated cognition, particularly his emphasis on external artifacts as a scaffold for internal cognitive development. In this case, AI tools functioned not merely as idea generators but as mediators that enabled learners to externalize abstract concepts like cultural identity into tangible multimodal compositions. This active construction of meaning also implies enhanced learner autonomy, which is critical for lifelong learning, as creative problem-solving with evolving tools prepares students to adapt to future technological shifts.

However, the medium ratings in non-AI frameworks are not merely a tool limitation but also a reflection of assessment practices. Traditional DMC tasks often prioritize linguistic accuracy and genre conventions to meet institutional standards, inadvertently stifling rhetorical experimentation. This echoes Prior's (1998) critique of formulaic pedagogy, where assessment rubrics often reward compliance over innovation. AI tools have the potential to disrupt this cycle by offering low-stakes ideation, which learners can freely adapt without fear of "failure".

The divergence in creativity scores underscores a student-centred shift that demands frameworks valuing experimentation as much as correctness. Students can use generative tools for brainstorming, drafting outlines, or producing visual prototypes. However, AI-driven ideation must be accompanied by human refinement, where students critically adapt AI outputs to fulfil cultural, rhetorical, and contextual goals. Iterative design cycles such as combining AI-generated drafts with peer and instructor feedback can enable continuous improvement, reinforcing creativity as a dynamic process rather than a static outcome. Such practices not only empower learners to take ownership of their creative workflows but also cultivate creativity as a dynamic and lifelong skill.

5.2. Critical Thinking

The absence of meaningful difference in critical thinking between AI and non-AI frameworks underscores a systemic issue: criticality is scaffolded, not tool-dependent. Both frameworks emphasized structural coherence but rarely engaged learners in interrogating "how" modes and tools shape power dynamics. For example, while students critiqued AI biases in some studies such as Liu et al.'s (2024), few frameworks addressed broader questions like: "Whose cultural norms are embedded in AI algorithms?" or "How do platform templates privilege certain rhetorical styles?". This gap reflects what Cope and Kalantzis (2009) term "design without critique", a focus on multimodal production without examining the sociopolitical dimensions of design choices. To foster analytical rigor necessary for lifelong learning, DMC pedagogy must position AI outputs as cultural artifacts to deconstruct rather than neutral resources to consume.

Critical thinking in DMC remains superficial because traditional pedagogy often

conflates multimodal fluency (e.g., technical proficiency with tools) with critical literacy (e.g., questioning whose values tools encode). Without explicit scaffolding such as tasks asking students to audit AI outputs for cultural bias or deconstruct platform defaults, learners default to surface-level editing, mistaking technical compliance for intellectual rigor. Classroom activities might include identifying algorithmic stereotypes, where students identify and address racial or gender stereotypes in AI-generated images, or source verification protocols requiring them to cross-reference AI-generated claims with reputable academic databases. Reflective journaling can further deepen students' critical engagement and autonomy by prompting them to self-regulate their interactions with AI tools, and ethical dilemmas encountered beyond the classroom.

5.3. Ethical Literacy

The neglect of ethical literacy in both frameworks indicates a larger disciplinary divide. Language education has long prioritized authorship over digital citizenship such as combating algorithmic bias, reflecting what Buckingham (2007) calls a "protectionist" approach to technology. While AI frameworks required transparency in AI use by logging prompts, they rarely asked learners to act on ethical dilemmas, such as redesigning biased AI outputs or advocating for more inclusive datasets. This resonates Noble's (2018) critique of ethics as compliance in tech education, where rules replace transformative justice. DMC frameworks, therefore, must adopt critical AI literacy which frames ethics as collective responsibility, not just individual one.

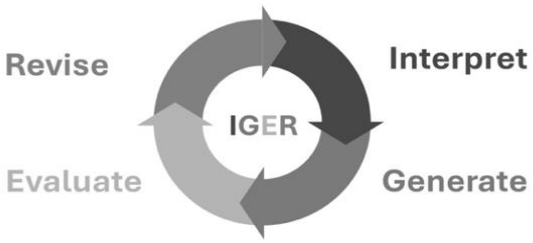
Thus, ethical literacy aims to formalize responsible AI use in multimodal projects, equips learners with decision-making frameworks that extend beyond academia. Students should be required to attribute AI-generated content clearly such as labelling images generated by AI or indicating when text has been revised from AI outputs. Besides, digital citizenship training should cover essential topics such as copyright laws and Creative Commons licensing to reinforce ethical awareness and accountability.

5.4. Implications

As a practical embodiment of the discussion, we propose the IGER Cycle, detailing how its stages operationalize the aforementioned dimensions. The IGER Cycle is not just a workflow but a scaffolded learning journey where AI literacy is cultivated iteratively.

Figure 2

IGER Cycle



The Interpret and Generate phases jointly embody the input - interaction - output logic of task-based language teaching (Long, 2015), while extending it to the visual and spatial affordances emphasised by multiliteracies scholarship (New London Group, 1996). Generate operationalises Vygotsky's concept of tool-mediated cognition, because GenAI acts as a dynamic other that stretches learners' zones of proximal development. Evaluate draws on

critical-AI-literacy frameworks (Ng et al., 2021) to embed bias detection, and it echoes Ushioda's (2020) person-in-context perspective by showing how motivational alignment shapes decisions to adopt or discard machine suggestions. Finally, Revise blends process-writing cycles with Kress's (2010) notion of remediation, shifting content across modes.

Table 2

IGER Cycle Description

Stage	Process	Activities
Interpret	Analyse task goals, audience, and multimodal resources	- Combine AI-generated with manual brainstorming (e.g., sketching ideas before using AI) - Conduct group discussions to adjust prompts to eliminate cultural biases (e.g., change "CEO" to "CEO from Africa")
Generate	Create initial drafts	- Facilitate peer review of AI outputs for stereotypes (e.g., "Does this image reinforce stereotypes?") - Engage in Hybrid drafting (AI + human inputs).
Evaluate	Critique outputs for coherence, bias, and effectiveness	- Host workshops to audit AI outputs - Compare AI claims with academic sources - Use reflective journals to document ethical concerns - Solicit instructor feedback
Revise	Refine content by merging AI outputs with human creativity	- Edit AI outputs for cultural nuances - Iterate based on feedback from previous stages - Discuss Creative Commons licensing - Add attribution labels

The IGER Cycle is a flexible and adaptable framework designed to cultivate AI literacy iteratively in a variety of educational contexts. Educators can tailor activities based on students' proficiency levels, institutional resources, and cultural considerations. For instance, in resource-rich environments, the Generate and Evaluate stages may incorporate AI tools, whereas in low-resource settings, brainstorming and peer feedback can still support critical thinking.

However, while the IGER Cycle offers versatility, several challenges may arise during its implementation. One of the primary concerns is over-reliance on AI tools. Educators should focus on the Revise stage, where students are required to refine AI outputs, and encourage activities that prioritize critical judgment. Another key challenge is ensuring educator and student readiness. Training programs should be integrated to equip educators with a fundamental understanding of AI tools and their ethical issues. Additionally, institutional constraints, such as variations in policies regarding AI use, technological infrastructure, and curriculum flexibility, can impact how the IGER Cycle is adopted. Flexibility within the cycle enables partial adoption or selective integration of stages to fit specific institutional needs.

6. Conclusion

The data reveal that AI vs. non-AI DMC frameworks diverge most starkly in creativity and ethical literacy, yet task design is the ultimate driver of whether learners reach higher-order competences. By embedding AI usage within carefully structured cycles of reflection and iteration, educators can harness AI's divergent potential without sacrificing learner agency, cultural sensitivity, or ethical responsibility. The proposed IGER Cycle offers a coherent framework for translating these principles into practice, underlining the importance of explicit scaffolding in fostering well-rounded AI literacy within DMC contexts. Such an approach not

only prepares students for lifelong learning in an AI-mediated world but also empowers them to navigate sociotechnical complexities with adaptability and self-direction. However, empirical research across diverse educational contexts is urgently needed to validate its efficacy. Large-scale quasi-experimental studies should track competence gains across proficiency levels and programme lengths, while longitudinal research is needed to capture how learners' ethical decision-making evolves as they progress from guided to autonomous collaboration with GenAI.

Although this review provides a systematic synthesis of AI-integrated and non-AI DMC frameworks, several factors limit the generalizability of its findings. First, the sample size for AI-oriented frameworks (n=7) is notably smaller than that of non-AI frameworks (n=41), reflecting the emerging state of AI use in DMC rather than a lack of pedagogical interest. This discrepancy may introduce bias by underrepresenting the full range of AI tools and applications available. Second, our selection criteria intentionally excluded K–12 and non-language contexts, thereby narrowing the scope to tertiary-level language education. Third, by omitting theoretical-only studies and retaining only the most recent iteration of identical frameworks, we may have inadvertently favoured certain forms of empirical research over others.

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