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Enhancing Scientific Communication and Character Values through AI-Assisted Folklore-Based Story Writing in Elementary STEM Learning

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Abstract: Scientific communication and character education are essential competencies in elementary STEM learning, yet classroom instruction often provides limited opportunities to integrate these competencies with local cultural resources and emerging technologies. This study investigated the effectiveness of AI-assisted folklore-based story writing in enhancing students' scientific communication and character values. A quasi-experimental pretest–posttest control-group design was used with 68 fifth-grade students from two elementary schools. The experimental group participated in STEM learning integrated with AI-assisted folklore-based story writing, while the control group received conventional STEM instruction. Data were collected using four instruments: (1) a Scientific Communication Assessment Rubric assessing scientific explanation, scientific vocabulary, evidence-based reasoning, organization of scientific ideas, and communication clarity; (2) a Character Observation Sheet; (3) a Folklore-Based Story Writing Rubric; and (4) a Student Perception Questionnaire. All instruments were validated by experts and demonstrated satisfactory reliability, with Cronbach's alpha coefficients ranging from 0.84 to 0.91. Data were analyzed using descriptive statistics, Shapiro–Wilk and Levene's tests, paired- and independent-samples t-tests, normalized gain (N-gain), Cohen's d, and Pearson's correlation. The experimental group achieved significantly higher scores in scientific communication and character development than the control group ($p < 0.001$), with high N-gain values (0.73 and 0.69, respectively) and large effect sizes (Cohen's $d = 1.48$ and 1.36). Scientific communication was positively correlated with character development ($r = 0.62$, $p < 0.001$). These findings indicate that AI-assisted folklore-based story writing is an effective, culturally responsive approach for strengthening scientific communication, character values, and scientific literacy in elementary STEM education.

Keywords: AI-assisted learning, folklore, scientific communication, character education, STEM learning.

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INTRODUCTION

One of the central aims of modern science instruction is to foster scientific literacy (preparation for the "science fair most people" rather than just "science for researchers"). From this lens, science learning should be seen not only as the acquisition of conceptual knowledge but also as the development of competencies to engage in discussions and make informed and responsible decisions about scientific and technological issues in society (Zapata et al., 2024). This framing asserts that scientific literacy includes those capacities to "think, reflect, communicate and take responsible decisions" in contexts involving science and technology or the participation of citizens in decision-making based on science This framing asserts that scientific literacy includes those capacities to "think, reflect, communicate and take responsible decisions" in contexts involving science and technology or the participation of citizens in decision-making based on science (Silva & Durán, 2024).

However, several studies document lasting tensions between desired competencies and classroom practice. In primary education, a realist constructivist epistemology of science remains a concept-centered, largely reductionistic discipline that permeates much traditional teaching, precluding students from engaging more deeply with authentic scientific practices, such as inquiry-oriented discourse (Bertea et al., 2023). Related scholarship underscores the importance of science literacy being conceptual, procedural, and contextualized (Mitjans, 2023), but also acknowledges that concept transmission can constrain the development of both communicative and epistemic dimensions for learning about science, e.g., how scientific knowledge is produced, justified, and socially situated (Más et al., 2021). This focuses on students' scientific communication, which reinforces contemporary discourses calling for the inclusion of meta-knowledge related to scientific practices, usually framed as Nature of Science (NdC), as a large component of literacy (Martorell et al., 2022), but also aids critical reflection about socioscientific and ethical dimensions of science (Zômpero et al., 2022).

Concurrently, science education is also expected to promote values and attitudes, as well as responsible citizenship, beyond academic accomplishment. Comparative and policy-oriented research emphasizes that science education should develop not only competences but also values and attitudes that enable learners to address real-life issues across the social, cultural, economic, and environmental dimensions (Zômpero et al., 2022). Likewise, STEM-informed proposals argue for education that engages students in participation in scientific-technological practices while foregrounding the values implicated in those practices (Tena, 2021) and for interdisciplinary STEAM project-based learning to develop skills in collaboration, communication, creativity, and critical thinking to solve everyday problems (Moral et al., 2022). While these references point to values in relation to literacy and STEM/STEAM aims, they also suggest a tension whereby values seem understood as rather broad goals of education, rather than systematically incorporated into learning activities in discipline-based content learning, even if it is well documented that science learning needs to connect to ethical, political, and societal issues (Portillo-Blanco et al., 2022).

A potential approach to bridging communication, values, and conceptual learning is interdisciplinary storytelling as a resource for science education. Chapters of the working "Counting the sciences" contend that stories can be paired with primary science teaching to humanize scientific knowledge, facilitate inquiry, and cultivate environmental literacy (Alcántara Manzanares et al., 2022). This aligns with wider arguments that scientific literacy is best promoted when science is understood in its contexts, as part of daily life and civic practices (Silva & Durán, 2024). However, contextualization also challenges ideas of who school science is relevant to and whose knowledge counts in schools. The literature on intercultural education critiques monocultural schooling that presents Western science as the "truth value", thereby excluding and marginalizing Indigenous identities and rationalities, rooted in longstanding patterns of devaluation (Quezada-Carrasco, 2022). Arguably, placing local cultural narratives (e.g., folklore) into context can be presented as a form of culturally responsive contextualization, one that legitimizes community knowledge or Identity in educational settings and resists monocultural trends, while still striving for literacy goals rooted in critical, evidence-based reasoning and rhetorical communication (Zapata et al., 2024).

At the same time, modes of science communication are shifting in a digitally mediated society. Studies on science communication in social media observe that more public engagement with and discussion of scientific topics are taking place online, leading to trends away from traditional media among younger populations (Velarde-Camaqui et al., 2024). This transition emphasizes the pedagogical significance of communication skills that can be applied across contexts, including formal education and mainstream public dialogue (Velarde-Camaqui et al., 2024). However, based on the conceptual consensus that science education should promote communication, critical thinking, and responsible decision-making as parts of scientific literacy (Silva & Durán, 2024), and the argument for storytelling to bolster science learning in primary settings (Alcántara Manzanares et al., 2022), this reference set does not directly test integrated models combining culturally grounded story-telling content with direct measurement of valued/character goals and effective communication processes with scientific outcomes in elementary STEM contexts.

Thus, this article describes a teaching strategy based on story writing with folklore as the cultural context of writing (written discourse) designed to enhance communicative and evidence-based reasoning skills aligned with scientific literacy goals, and compatible with STEM/STEAM rubrics for communication/collaboration/problem-solving skills (Moral et al., 2022), and civic/ethical ends of science education (Portillo-Blanco et al., 2022). Grounded in concerns about concept-dominant instruction in primary science and calls to ground science learning in practices, discourse, and culturally situated meaning-making (Quezada-Carrasco, 2022), the study provides empirical clarity on how narrative-centered, culturally responsive tasks can enhance young students' scientific communication in elementary STEM learning.

Despite the growing body of research on AI-supported learning, limited empirical evidence exists on integrating artificial intelligence, local folklore, and STEM learning to simultaneously enhance scientific communication, character values, and students' learning experiences at the elementary level. Previous studies have generally examined these aspects separately, leaving a gap in understanding how culturally responsive AI-assisted instruction can support multiple educational outcomes within a single instructional model. Therefore, this study investigates the effectiveness of an AI-assisted, folklore-based story-writing model in elementary STEM learning. Specifically, the study addresses the following research questions:

1. Does AI-assisted folklore-based story writing significantly improve elementary students' scientific communication skills compared with conventional STEM instruction?
2. Does AI-assisted folklore-based story writing significantly enhance students' character values, including responsibility, cooperation, honesty, respect, and environmental awareness?
3. How do students perceive the implementation of AI-assisted folklore-based story writing in terms of learning motivation, engagement, perceived usefulness of AI, ease of use, and overall learning satisfaction?

By addressing these research questions, the study contributes empirical evidence on integrating artificial intelligence, local wisdom, and STEM education to strengthen scientific communication, foster positive character development, and promote meaningful technology-enhanced learning in elementary classrooms. This study aims to: (1) identify whether AI-assisted folklore-based story writing would improve elementary students' scientific communication skills; (2) investigate its effect on students' character values; and (3) examine students' perceptions of learning with AI in STEM classrooms. The results will enrich further research on AI-augmented STEM education, resulting in an integrated, innovative instructional model of scientific literacy, character education, local wisdom, and the responsible use of artificial intelligence for elementary schools.

METHOD

Research Design

This research employed a quasi-experimental pretest–posttest control-group design, which is ideal when random assignment is not feasible in a real-life school environment, as intact classes must be retained (Kara & Kýlýç, 2024). In line with typical quasi-experimental designs in school-based studies, pre-existing monolingual Grade V classes were selected for the experimental and control groups (i.e., non-equivalent groups (Aksoy & Kelleci, 2023). The experimental group was provided with learning opportunities to engage in STEM through folklore-based story-writing activities combined with AI-assisted instruction, based on evidence indicating that AI-supported instruction is being examined as a means of enhancing STEM instruction (Doðan et al., 2026). The conventional group received teacher-centered printed text materials, serving as a comparison condition in the method used to isolate treatment effects in pretest–posttest control-group studies (Aksoy & Kelleci, 2023). The two groups took pretests and posttests that measured changes in scientific communication values and character, as is typical in the pretest–posttest control-group design for measuring outcomes before and after an experimental intervention (Mafrudin, 2023).

Participants

The sample included 68 Grade V students from two intact public elementary-school classes in Ternate, Indonesia, with a STEM curriculum; this is common in many studies utilizing field-based data collection methods where sampling and assignment are performed at the class (cluster) level, not the individual level (Vincent & Wasden, 2023). The study involved 68 fifth-grade students, equally divided between experimental and control groups. No significant differences were observed in gender ($p = 0.801$), age ($p = 0.715$), previous science achievement ($p = 0.772$), or baseline scientific communication ($p = 0.857$). These results confirmed demographic and academic equivalence between groups before the intervention, minimizing potential selection bias. Cluster random sampling was applied to select the classes, resulting in 34 students in the experimental group and 34 in the control group, which is consistent with previous research on STEM education that determined who the participants were by cluster random sampling and ended up making use of the cluster styles commonly used in curriculum analyses (W. Yang et al., 2025). We incorporated ethical safeguards for research with minors conducted in schools, since educational field research should protect and conform to practical and legal constraints associated with rights–based research projects involving children (Vincent & Wasden, 2023). For this reason, written informed consent was secured from key stakeholders (e.g., parent/guardian and student) before engaging in research, similar to studies that document parental consent for child participants' participation and written consent procedures under institutional ethics oversight (Suárez-García et al., 2025). The protocol received institutional ethics committee approval in accordance with customary practices for intervention studies.

Learning Procedures

The intervention was implemented over eight weeks through weekly STEM learning sessions following seven instructional phases. (1) STEM Orientation: Teachers introduced real-world scientific problems and learning objectives. (2) Folklore Exploration: Students read and discussed local folklore containing environmental, scientific, and moral values. (3) Scientific Investigation: Students conducted simple experiments, observations, and information searches related to the scientific concepts embedded in the folklore. (4) AI-Assisted Story Planning: Students used a generative AI writing assistant to brainstorm ideas, organize scientific information, improve vocabulary, and structure story outlines under teacher supervision. (5) Story Development and Revision: Students independently revised AI-generated suggestions, verified scientific accuracy, integrated character values, and completed their stories. (6) Presentation and Peer Discussion: Students presented their stories, explained the scientific concepts, and participated in peer feedback sessions. (7) Reflection: Students reflected on scientific learning, ethical AI use, local cultural values, and character development.

Throughout the intervention, teachers emphasized that AI functioned solely as a learning support tool, while students remained responsible for verifying scientific information, maintaining originality, and producing the final written work.

Research Instruments

To comprehensively evaluate the effectiveness of the AI-assisted, folklore-based story-writing intervention, four complementary research instruments were employed to assess cognitive, affective, and performance outcomes. The instruments measured students' scientific communication skills, character development, story-writing performance, and perceptions of the learning experience. All instruments were developed based on relevant theoretical frameworks and validated by experts before implementation. Table 1 summarizes the research instruments.

Table 1. Research instruments

Instrument	Purpose	Indicators / Components	Scale	Validity & Reliability
Scientific Communication Assessment Rubric	To assess students' ability to communicate scientific ideas during STEM learning and folklore-based story writing.	Scientific explanation; Scientific vocabulary; Evidence-based reasoning; Organization of scientific ideas; Communication clarity	Analytic rubric (1–5)	Content validity: I-CVI > 0.83; S-CVI = 0.94. Reliability: Cronbach's α = 0.91; inter-rater reliability > 0.85.
Character Observation Sheet	To evaluate students' character development throughout the learning activities.	Responsibility; Cooperation; Honesty; Respect; Environmental awareness	Five-point rating scale (1 = Very Poor to 5 = Excellent)	Content validity: I-CVI > 0.83; S-CVI = 0.94. Reliability: Cronbach's α = 0.88; inter-rater reliability > 0.85.
Folklore-Based Story Writing Rubric	To assess the quality of students' written stories integrating folklore and STEM concepts.	Scientific accuracy; Integration of folklore; Creativity; Narrative organization; Incorporation of character values	Analytic rubric (1–5)	Content validity: I-CVI > 0.83; S-CVI = 0.94. Reliability: Cronbach's α = 0.89; inter-rater reliability > 0.85.
Student Perception Questionnaire	To examine students' perceptions of the AI-assisted learning model.	Learning engagement; Perceived usefulness of AI; Ease of use; Learning motivation; Satisfaction with the instructional model (20 Likert-scale items)	Five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree)	Content validity: I-CVI > 0.83; S-CVI = 0.94. Reliability: Cronbach's α = 0.84.

Instrument Validation

All research instruments underwent expert validation and empirical reliability testing before implementation(Liu et al., 2024). Six experts in science education, elementary education, educational technology, language education, character education, and educational assessment reviewed the instruments for content relevance, construct clarity, language appropriateness, and measurement accuracy. Content validity was evaluated using the Content Validity Index (CVI)(Waeyeng et al., 2022). All indicators achieved I-CVI values above 0.83 and an overall S-CVI of 0.94, indicating excellent content validity. Instrument reliability was established through a pilot study involving 30 Grade V students from a school not included in the main study. Internal consistency analysis produced Cronbach's alpha coefficients ranging from 0.84 to 0.91, demonstrating good to excellent reliability. For the performance-based instruments, inter-rater reliability coefficients exceeded 0.85, indicating strong agreement between classroom teachers and researchers in assessing scientific communication and character development. These results confirmed that all instruments were valid, reliable, and appropriate for evaluating the effectiveness of the AI-assisted, folklore-based story-writing intervention.

Data Collection

Data were collected in five phases, following the traditional quasi-experimental pretest–posttest procedures, in which outcome measures are administered to both the experimental and control groups immediately before and after an intervention (Friska et al., 2023). Students took pretests on scientific communication, and baseline character-related behaviors were objectively recorded through structured classroom observation, consistent with observational progress monitoring of student behavior during implementation (Ygaard et al., 2024). Second, as in typical treatment vs. control data collection in a quasi-experiment, the experimental and control groups received their respective instructional treatments (Stiawan et al., 2022). Third, consistent with pre–post measurement and continuous behavioral observation, researchers conducted ongoing observations of classroom participation and character development in STEM activities. Fourth, students' written stories were rated in parallel using an established semi-structured rubric; this use of well-organized, standardized measurement tools aligns with extensive standards for test development and educational research (BALÇIN et al., 2024). Fifth, similar to pretest–posttest studies that administer post-intervention surveys and scales, posttests and student perception questionnaires were administered following the intervention (Öcal et al., 2021).

Data Analysis

Data were summarized using descriptive statistics (i.e., mean values and standard deviations) to describe student scores before and after the intervention. Student perceptions were analyzed descriptively by calculating the percentage of responses in each category based on mean values. Responses were classified into five categories: Strongly Disagree (SD) = 1, Disagree (D) = 2, Neutral (N) = 3, Agree (A) = 4, and Strongly Agree (SA) = 5.

Within-group pretest–posttest comparisons were conducted using paired-samples t-tests, and between-group comparisons used independent-samples t-tests, in line with established use of paired and unpaired Student's t-tests, respectively, in testing group differences (L. Yang et al., 2024). Statistical Analyses: Pearson's product–moment correlation, a commonly used method for evaluating linear associations between continuous variables, was employed to examine the relationships among scientific communication and character values (Nia et al., 2024). The significance of correlation coefficients was assessed using Student's t-test, as in previous applications of Pearson correlation inference (Xie et al., 2023). All the analyses were conducted in SPSS (previous studies stated that education-based correlation analysis is generally performed using SPSS (Yuhariah & Sujarwati, 2023).

RESULT AND DISCUSSION

Participant Characteristics

A total of 68 fifth-grade students participated in the study, with 34 students assigned to the experimental group and 34 to the control group. The experimental group comprised 17 males (50.0%) and 17 females (50.0%), whereas the control group included 18 males (52.9%) and 16 females (47.1%). Gender distribution did not differ significantly between groups ($\chi^2 = 0.06$, $p = 0.801$). The mean age was 10.78 ± 0.42 years in the experimental group and 10.82 ± 0.39 years in the control group, with both groups ranging from 10 to 11 years ($t = 0.37$, $p = 0.715$). Previous science report card scores were also comparable (78.56 ± 5.84 vs. 78.14 ± 5.63; $t = 0.29$, $p = 0.772$). Baseline scientific communication scores showed no significant difference (61.82 ± 8.24 vs. 62.17 ± 7.96; $t = 0.18$, $p = 0.857$). Thus, the groups were demographically and academically comparable before treatment, reducing potential selection bias in the quasi-experimental comparison.

Development of the AI-Assisted Folklore-Based Story Writing Model

After the needs analysis, the researchers designed an instructional model to integrate STEM learning, local folklore stories, character education, and artificial intelligence (AI) to enhance students' comprehension. This model aimed to support culturally relevant, meaningful scientific communication skills and foster character values through writing activities. While students retained responsibility for ensuring scientific accuracy and writing original stories, AI served as a learning scaffold, helping students brainstorm, organize ideas, edit language, and improve story coherence.

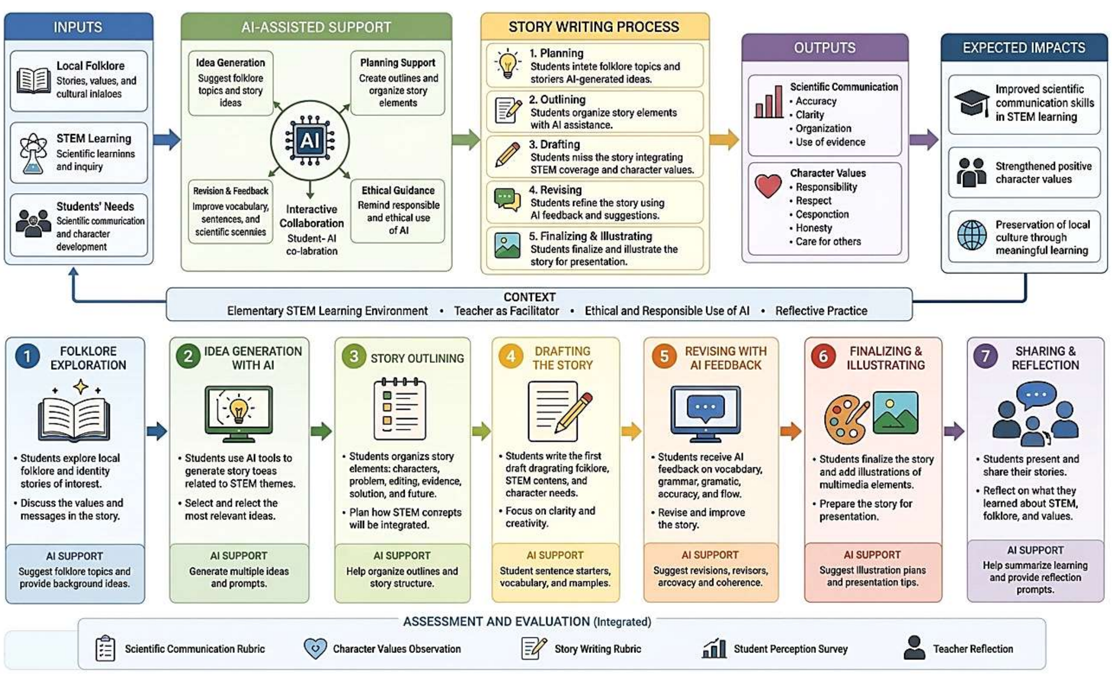

Figure 1. The conceptual framework of the ai-assisted folklore-based story writing model

The instructional model consists of seven sequential phases: (1) STEM Orientation, (2) Folklore Exploration, (3) Scientific Investigation, (4) AI-Assisted Story Planning, (5) Story Development and Revision, (6) Presentation and Peer Discussion, and (7) Reflection. Throughout these phases, scientific inquiry, literacy practices, ethical AI use, and character education were integrated into a single learning process. The resulting model emphasizes contextual STEM learning by embedding scientific concepts within local folklore narratives while encouraging students to communicate scientific ideas accurately through creative writing. Simultaneously, the model integrated moral values embedded in folklore into collaborative learning activities to foster responsibility, cooperation, honesty, respect, and environmental awareness.

Expert Validation Results

Before classroom implementation, six experts in science education, educational technology, elementary education, language education, character education, and educational assessment evaluated the instructional model and research instruments (see Table 2).

Table 2. Expert validation results

Component	Mean Score (1–5)	Validity (%)	Category
Learning objectives	4.82	96.4	Very Valid
STEM content	4.78	95.6	Very Valid
Folklore integration	4.87	97.4	Very Valid
AI-assisted learning activities	4.75	95.0	Very Valid
Character education integration	4.84	96.8	Very Valid
Scientific communication assessment	4.79	95.8	Very Valid
Language clarity	4.73	94.6	Very Valid
Overall	**4.80**	**96.0**	**Very Valid**

The overall expert validation score reached 96.0%, indicating that the instructional model possessed excellent content validity. Experts acknowledged the successful integration of STEM concepts, local folklore, AI-supported learning, and character education. Minor revisions focused on improving instructional wording, simplifying student worksheets, and strengthening ethi AI use guidelines before pilot implementation.

Practicality Evaluation

The revised instructional model was piloted in one elementary classroom to evaluate its practicality from both teacher and student perspectives. Practicality was assessed based on implementation feasibility, usability, learning engagement, and overall acceptance of the AI-assisted folklore-based STEM learning model. Demonstrates that the AI-assisted folklore-based story writing model achieved a Very Practical rating from both teachers and students. Teachers reported an overall practicality score of 4.73 ± 0.31, with student engagement receiving the highest rating (4.82 ± 0.28), followed by learning procedures (4.75 ± 0.36), ease of implementation (4.71 ± 0.39), and AI usability (4.63 ± 0.42). Similarly, students reported an overall score of 4.69 ± 0.35. Enjoyment obtained the highest student rating (4.81 ± 0.34), followed by learning motivation (4.72 ± 0.38), AI usefulness (4.66 ± 0.41), and ease of learning (4.59 ± 0.46). These consistently high scores indicate that the model was feasible, engaging, and easy to implement, while AI provided useful support for folklore-based story writing within elementary STEM learning.

The second practical evaluation indicates that the folklore-based story-writing model with AI assistance presented is highly practical in elementary STEM classrooms. Teachers assigned an overall mean score of 4.73 ± 0.31, indicating that the instructional procedures were clear, easy to implement, and well aligned with the elementary STEM curriculum. The model appeared to foster a high degree of student engagement (4.82 ± 0.28). Students also rated the model as highly practical overall (mean response: 4.69 ± 0.35). They indicated the highest efficacy in enjoyment (4.81 ± 0.34) and learning motivation (4.72 ± 0.15). It also illustrated that integrating local folklore with AI-assisted story writing provided students with an enjoyable, motivating learning environment. TAM analysis. The tools were overall useful (4.66 ± 0.41) and easy to use (4.59 ± 0.46), suggesting that the AI effectively contributed ideas and cohesive scientific storytelling while not imposing a significant technical burden on students during implementation.

The results suggest that the instructional model is achievable, accessible, and applicable to elementary STEM education. The consistently high teacher- and student-rated engagement levels in these studies show that local folklore, STEM learning, and smart AI augmentation can be executed effectively alongside high doses of live instruction.

Effectiveness of the Instructional Model

Characteristics of the intervention

The intervention combined elementary STEM learning, local folklore, character education, and AI-assisted story writing through seven sequential phases: STEM orientation, folklore exploration, scientific investigation, AI-assisted story planning, story development and revision, presentation and peer discussion, and reflection. The interactive media provided students with prompts to generate story ideas, organize narrative structures, refine vocabulary, check sentence clarity, and revise scientific explanations. Teacher guidance ensured that students verified AI-generated information, maintained originality, and used AI responsibly.

The principal interactive features included a prompt-based idea generator, story-outline organizer, vocabulary and sentence suggestions, revision feedback, and a presentation interface. These features allowed students to move from scientific investigation to narrative production in a structured manner. Local folklore provided the cultural context, while STEM activities supplied scientific evidence and concepts that students incorporated into their stories (see Figure 2).

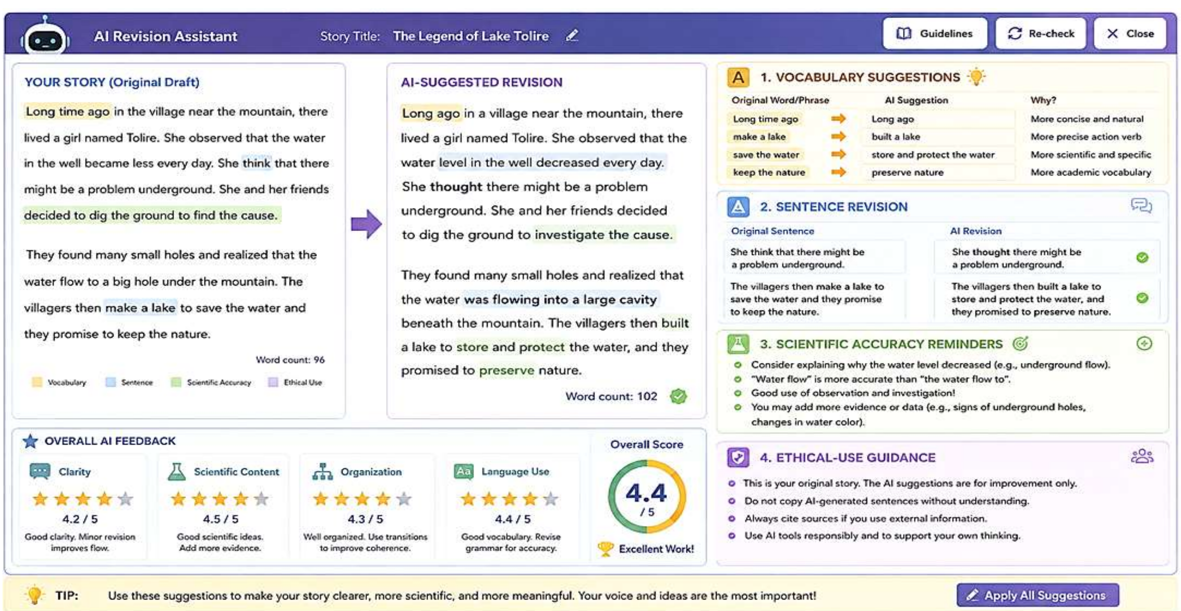

Figure 2. AI-Assisted revision and feedback feature

These features supported language development through repeated exposure to scientific vocabulary, guided sentence construction, collaborative discussion, and opportunities to revise written output. From a language acquisition perspective, the intervention provided comprehensible input, scaffolded production, interaction, and corrective feedback. Students first encountered scientific concepts through folklore and investigation, then transformed them into written and oral explanations. This process reflects the principle that language develops more effectively when learners receive meaningful input and are required to produce language for authentic communicative purposes.

Findings on Variable 1: Scientific Communication

Variable 1 was students' scientific communication, measured through scientific explanation, scientific vocabulary, evidence-based reasoning, organization of scientific ideas, and communication clarity. The effectiveness of the intervention was examined by comparing the pretest and posttest scores of the experimental and control groups (see Table 3).

Table 3. Scientific communication scores

Assessment	Experimental, Mean ± SD	Control, Mean ± SD	*t*	*p*
Pretest	61.82 ± 8.24	62.17 ± 7.96	0.18	0.857
Posttest	85.76 ± 5.93	73.41 ± 6.84	7.98	<0.001

The pretest results showed no statistically significant difference between the experimental and control groups (t = 0.18, p = 0.857). Therefore, the two groups had comparable scientific communication abilities before the intervention. After treatment, the experimental group obtained a substantially higher posttest score than the control group (t = 7.98, p < 0.001). The experimental group's normalized gain was 0.73, categorized as high, while Cohen's d was 1.48, indicating a large intervention effect. The hypothesis for Variable 1 was formulated as follows:

H_{01}: There is no significant difference in scientific communication between students receiving AI-assisted folklore-based story writing and students receiving conventional STEM instruction.

H_{11} : Students receiving AI-assisted folklore-based story writing demonstrate significantly higher scientific communication than students receiving conventional STEM instruction.

Because p < 0.001, H_{01} was rejected, confirming that the intervention significantly improved students' scientific communication. The improvement resulted from integrating folklore exploration, scientific investigation, AI-assisted planning, teacher feedback, and collaborative revision. Folklore provided meaningful contexts for scientific learning, while AI supported idea organization and vocabulary development without replacing students' critical thinking. Guided story writing required students to construct evidence-based explanations, revise inaccurate terminology, and refine logical coherence. Consistent with language acquisition theory, the combination of meaningful input, scaffolded output, interaction, and feedback enhanced students' ability to communicate scientific concepts accurately, coherently, and confidently. Comparison of Scientific Communication Scores (Figure 3).

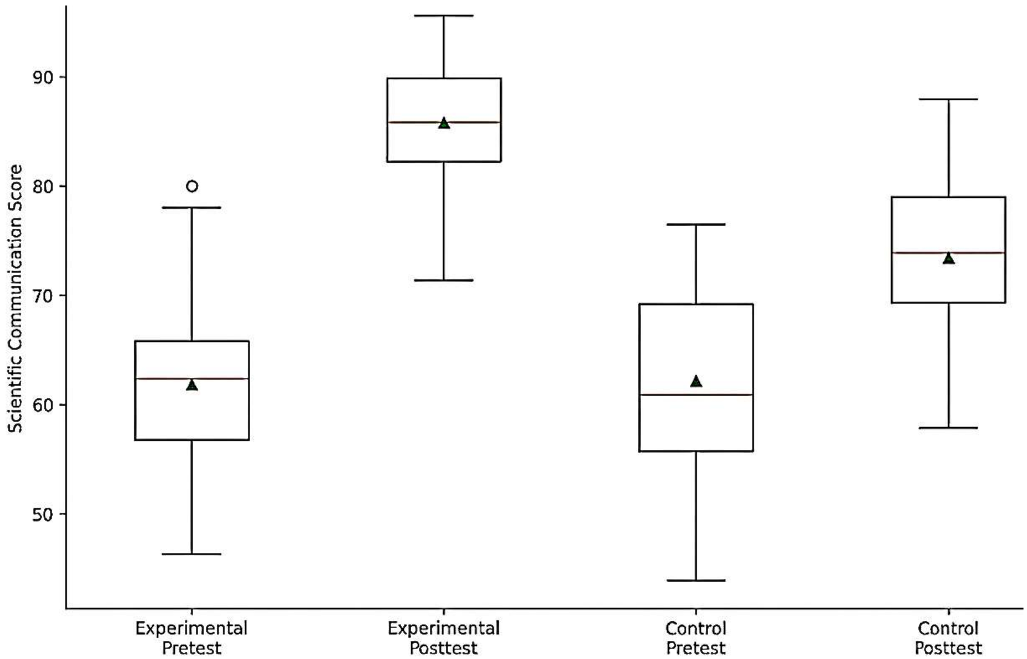

Figure 3. Comparison of scientific communication scores

Figure 3 shows comparable pretest distributions between the experimental and control groups, supporting baseline equivalence. Following the intervention, the experimental group demonstrates a pronounced upward shift, with a median posttest score of 85.80, compared with 73.88 in the control group. The experimental posttest distribution is also relatively compact (IQR = 7.62), indicating consistently high performance. Only one potential outlier appears in the experimental pretest distribution, while no posttest outliers are observed. Overall, the boxplots visually reinforce the greater improvement in scientific communication among students receiving AI-assisted folklore-based story-writing instruction.

Findings on Variable 2: Character Development

Variable 2 was character development, measured through responsibility, cooperation, honesty, respect, and environmental awareness. These affective outcomes were assessed using a five-point observation scale completed during the learning activities (see Table 4).

The overall character score increased from 3.52 to 4.57, representing an improvement of 29.8%. The paired-samples analysis showed that

Table 4. Character development scores

Character Dimension	Pretest	Posttest	Improvement (%)
Responsibility	3.41	4.49	31.7
Cooperation	3.56	4.61	29.5
Honesty	3.68	4.63	25.8
Respect	3.59	4.58	27.6
Environmental awareness	3.37	4.55	35.0
Overall	3.52	4.57	29.8

this increase was statistically significant ($t = 8.92$, $p < 0.001$). Cohen's *d* was 1.36, indicating a large effect. The hypothesis for Variable 2 was formulated as follows:

H_{02} : AI-assisted folklore-based story writing does not significantly improve students' character values.

H_{12} : AI-assisted folklore-based story writing significantly improves students' character values.

Because $p < 0.001$, H_{02}, was rejected and H_{12}, was accepted. The intervention produced a significant positive effect on students' character development, with environmental awareness showing the greatest improvement (35.0%). This gain was primarily stimulated by environmental messages embedded in local folklore, which students integrated into scientifically grounded stories rather than merely recalling moral lessons. Responsibility increased as students took on roles that verified AI-generated information and revised their work, while cooperation developed through collaborative investigations, peer feedback, and joint story planning. Honesty was reinforced by requiring students to evaluate and rewrite AI suggestions in their own words. These findings are consistent with language acquisition theory, which emphasizes meaningful interaction, scaffolded output, and culturally relevant input. Teacher guidance and AI-assisted feedback created opportunities for dialogue, reflection, and revision, enabling students to internalize both scientific concepts and character values. Consequently, the intervention simultaneously strengthened scientific communication and affective development within an authentic, culturally responsive STEM learning environment. Pretest and posttest average scores (see Figure 4).

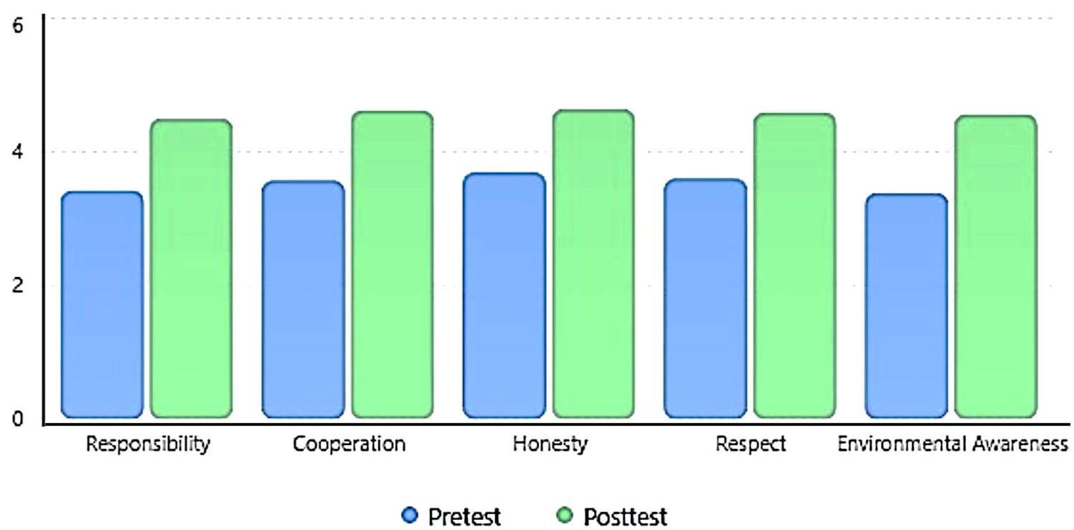

Figure 4. Character development profile

Figure 4. The character development profile shows consistent improvement across all five dimensions. Environmental awareness recorded the largest increase, from 3.37 to 4.55, followed by responsibility, cooperation, respect, and honesty. The posttest scores, ranging from 4.49 to 4.63, indicate that the instructional model effectively strengthened students' moral, social, and environmental character values.

Correlation Between Scientific Communication and Character Development

Pearson correlation analysis examined the relationship between students' post-intervention scientific communication and character development scores. The analysis revealed a statistically significant, moderately strong positive correlation (r = 0.62, p < 0.001), indicating that students with higher scientific communication scores also tended to demonstrate stronger character outcomes(see Table 5).

Table 5. Correlation matrix of scientific communication and character development

Variable	1	2
1. Scientific Communication	1.00	
2. Character Development	**0.62***	1.00

Note: Pearson's *r*; ***p* < 0.001; *N* = 68.

The positive correlation indicates an association rather than causation. Approximately 38.4% shared variance ($r^2 = 0.384$) suggests meaningful overlap between the two outcomes, consistent with an instructional environment integrating scientific expression, collaborative story construction, local cultural values, and reflective learning.

Environmental Awareness Through Local Folklore

Among the five character dimensions, environmental awareness showed the greatest improvement, increasing by 35.0% (Table 5). This improvement was primarily associated with integrating local folklore into STEM story-writing activities rather than with behavioral changes outside the classroom. During the intervention, students analyzed traditional folktales that convey messages about environmental conservation, discussed the scientific concepts embedded in the stories, and incorporated these values into their own narratives. Consequently, the observed improvement reflects students' understanding and expression of environmental values in the context of learning activities.

Evidence from students' worksheets demonstrates that environmental awareness emerged directly from interpreting the environmental messages contained in the folktales. For example, one Student wrote:

> Participant P07: "*The villagers protected the forest because trees keep the river clean and provide habitats for animals. If people cut down all the trees, floods and landslides may occur*."

Another student connected the cultural narrative with scientific reasoning:

> Participant P15: "*The story teaches us not to throw rubbish into the river. Clean rivers help fish survive and provide clean water for people*."

Similarly, another participant explained:

> Participant P22: "*After reading the folklore, I learned that caring for nature is everyone's responsibility because humans and the environment depend on each other.*"

These excerpts indicate that students internalized environmental values by interpreting folklore through a scientific perspective and expressing those ideas in their written narratives. Rather than documenting behavioral changes beyond daily observation, the findings show that the stimulus for environmental awareness came from adopting local folklore as a culturally meaningful learning resource, integrated with AI-assisted scientific storytelling. This supports the role of contextual and culturally responsive STEM instruction in strengthening both scientific communication and environmental character.

Story Writing Performance

Students' folklore-based stories were evaluated to determine the quality of scientific content, narrative construction, creativity, and integration of local cultural values following the AI-assisted STEM learning intervention. Indicates that students achieved excellent performance across all dimensions of folklore-based story writing, with an overall score of 89.16 ± 4.96.

Folklore integration obtained the highest mean (91.06 ± 5.13), demonstrating students' strong ability to incorporate local cultural elements into their narratives. Creativity followed with 90.21 ± 5.48, while character integration reached 89.47 ± 5.72, reflecting effective incorporation of moral values. Scientific accuracy also achieved a high score (88.15 ± 5.84), indicating that students communicated scientific concepts appropriately within their stories. Although narrative organization recorded the lowest mean (86.92 ± 6.11), it remained within the Excellent category. Overall, these findings demonstrate that AI-assisted writing supported students in integrating scientific knowledge, cultural authenticity, creativity, and character values into coherent folklore-based narratives.

The complementary pedagogical roles of teacher guidance and AI assistance throughout the writing process can explain the quality of students' stories. Teachers first established conceptual understanding by facilitating STEM investigations, discussing the scientific principles underlying the selected folklore, and encouraging students to identify environmental and moral messages. During the planning stage, the AI system served as a cognitive scaffold, generating alternative ideas, suggesting narrative structures, and recommending appropriate vocabulary. Rather than accepting AI-generated text at face value, students were required to evaluate the scientific validity of the suggestions, revise the content using evidence gathered during classroom investigations, and adapt the narrative to reflect the original folklore. Teachers continuously monitored this process, providing corrective feedback on scientific accuracy, logical coherence, and ethical AI use while encouraging collaborative discussion among peers. This combination of human pedagogical guidance and machine-assisted scaffolding enabled students to construct narratives with clear introductions, logically connected scientific events, coherent resolutions, and consistent integration of character values.

The resulting response patterns are consistent with the literature on integrated composition methods, which emphasizes that effective writing develops through recursive cycles of planning, drafting, revising, and reflecting rather than through a single drafting activity. In the present study, students repeatedly moved between scientific inquiry, folklore interpretation, AI-supported drafting, teacher feedback, and peer review before producing the final story. This iterative process encouraged students to refine scientific explanations, reorganize ideas, and improve linguistic clarity while preserving the folklore's cultural authenticity. Consequently, the stories reflected not only accurate scientific content but also coherent narrative organization, creative expression, and meaningful integration of local wisdom. These findings suggest that AI functions most effectively as a pedagogical scaffold within a structured composition framework, where teacher guidance remains essential to support scientific reasoning, maintain narrative coherence, and ensure responsible AI use during the writing process.

Student Perceptions of AI-Assisted Learning

Students' perceptions were evaluated to determine the acceptability and usability of AI-assisted folklore-based story writing in STEM learning. The questionnaire assessed motivation, engagement, ease of use, perceived usefulness, and overall learning satisfaction (see Figure 5).

The 100% stacked bar chart presents the proportion of students classified from Strongly Disagree to Strongly Agree across five perception dimensions. Responses were overwhelmingly concentrated in the Strongly Agree category, ranging from 91.2% to 100%, indicating consistently positive perceptions of AI-assisted folklore-based STEM learning.

Because narrating and inquiring stories using visual material aim to build children's language-related competencies directly relevant to scientific communication, incorporating storytelling into primary education can enhance

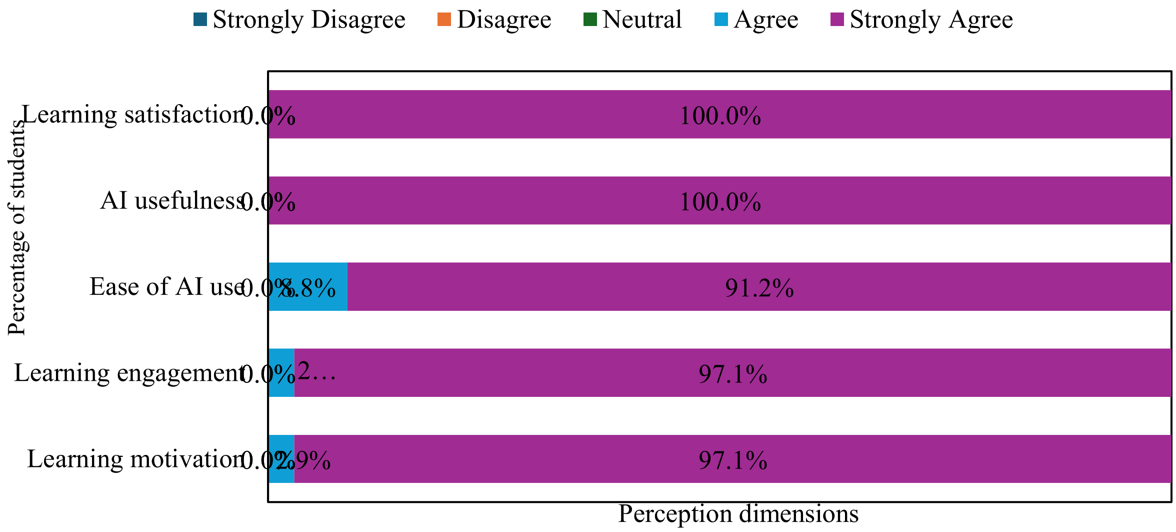

Figure 5. Student perception of ai-assisted learning

pupils' literacy skills (Iandolo et al., 2024). The curriculum also highlights storytelling as a way for schools to promote language development and foster prosocial dispositions, drawing attention to its value as a communicative practice rather than solely a literary activity (Tsomokos & Raviv, 2025). Additionally, designing science learning tasks that require students to represent ideas narratively aligns with the overarching goal of elementary science education: not only to support knowledge but also attitudes and skills (Rahmayanti et al., 2023). We interpret narrative structures as a pedagogical mechanism that encourages students to tell stories more purposefully, consistent with work emphasizing the educational potential of story-structure skills and teachers' awareness among younger learners.

Grounding local folklore as a narrative foundation will further support learning by introducing culturally relevant contexts and explicitly stating the moral dimensions of student learning. Oral storytelling is referred to as needing more usage in primary school, even though it has "great benefits", and folk values delivered through stories are heterogeneously argued to help build moral values that support sustainability (Tasnim et al., 2023). Evidence and research in science education indicate that values-oriented practices/ programs are effective for values education and can positively influence student interaction, supporting this rationale (Yaman & Anýlan, 2021). Accordingly, combining science learning and story-based narratives grounded in folklore represents a potential avenue for simultaneously targeting both narrative-related research outcomes associated with understanding of phenomena and character/value-related outcomes (e.g., desired social responsibility themes such as cooperation and, to some extent, responsibility) normally targeted by character education initiatives, maybe especially if the content of the stories foregrounds these kinds of themes since sustainability-oriented moral values tend to have strong links to how a story is told when it comes to its role within storytelling more broadly speaking (W. Yang et al., 2025)

Conceptualizing generative AI as a scaffold for students' writing and explanation work is more meaningful than seeing it as automation of thinking within structured instruction. Current work on design-oriented approaches to elementary STEAM in the age of generative AI emphasizes scaffolding as an important approach, arguing that early AI literacy development prepares children for responsible and ethical use (Relmasira et al., 2023). Alongside this, AI research on elementary lesson design highlights the importance of general instructional design principles and guidelines to help teachers plan and orchestrate AI-supported activities (Han & Lee, 2024). The iterative nature of the method, which relies on identifying mistakes and correcting outputs to achieve the intended outcome, indicates that learning to work with AI is a disciplined practice requiring reflection rather than simply accepting whatever ChatGPT produces (Sánchez et al., 2024). At the same time, critical research on AI-based teaching tools in primary-level classrooms reveals ongoing debates over transparency, algorithmic biases, and governance, highlighting the need for teachers to ensure human validation when deploying AI in tasks requiring precision and accountability (Sperling et al., 2022).

Overall, these perspectives lend themselves to an interdisciplinary pedagogical framework where (i) storytelling scaffolds communicative competence and knowledge co-construction (Iandolo et al., 2024), (ii) folklore contributes moral/ sustainability-related values and culturally meaningful content (Tasnim et al., 2023), and (iii) AI in itself may not necessarily facilitate learning but helps/process when provided with explicit scaffolding mechanisms alongside teacher-designed systems that monitor student node collections (Relmasira et al., 2023). Such an integration is also consistent with broader claims that generative AI can support the achievement of goals for "quality education" (e.g., through more effective teaching, enhanced engagement, and greater incorporation of sustainable development and global citizenship themes into curricula) (Nedungadi et al., 2024). However, these benefits will only be realized if teachers have the capacity to integrate AI into their practice, where clear directives as well as supportive policy will be vital ingredients for successful integration of AI in inclusive educational contexts (and structured pedagogical frameworks surrounding the use of AI services facilitate structured practice) (Zhao et al., 2022).

CONCLUSION

The findings show that the AI-assisted, folklore-based story-writing model effectively strengthens both scientific communication literacy and moral attitudes in elementary STEM learning. Students who participated in the intervention achieved significantly higher scientific communication performance than those receiving conventional instruction, indicating improved ability to explain scientific concepts, use appropriate scientific vocabulary, organize evidence-based arguments, and communicate ideas coherently. These improvements were supported by teacher-guided scientific inquiry, AI-assisted planning and revision, and the integration of local folklore into meaningful writing activities.

The intervention also produced significant gains in moral attitudes, particularly in responsibility, cooperation, honesty, respect, and environmental awareness. The greatest improvement in environmental awareness reflects the successful integration of ecological messages embedded in local folklore with scientific investigation and reflective story writing. Rather than functioning as a content generator, AI served as a pedagogical scaffold, supporting idea development, language refinement, and critical evaluation under continuous teacher supervision.

Overall, the combination of culturally responsive pedagogy, responsible AI use, and structured writing activities created a learning environment that simultaneously fostered communication literacy and moral development. These findings suggest that AI-assisted folklore-based story writing provides a practical and innovative instructional approach for integrating scientific literacy, character education, and local cultural wisdom in elementary STEM classrooms.

DECLARATION OF GENERATIVE AI USAGE IN THE WRITING PROCESS

During the preparation of this manuscript, the authors used OpenAI ChatGPT (GPT-5.5) and Grammarly to assist with language refinement, improving academic writing style, grammatical editing, organizing manuscript sections, and enhancing clarity and readability. The tool was also used to support the drafting of non-empirical text, including descriptions of the research methodology and interpretation of findings based on the authors' analyses. The authors developed, verified, and critically reviewed all scientific content, study design, data collection, statistical analyses, results, interpretations, and conclusions. The authors carefully evaluated and revised all AI-assisted outputs to ensure their accuracy, originality, and compliance with the journal's ethical and authorship requirements. The authors accept full responsibility for the content of the published article.

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