SURAT TANGGAPAN

1. Tambahkan co-author dari institusi luar negeri

Tanggapan:

Mahamadaree Waeno[7], [7]Fatoni University, Thailand

2. Abstrak wajib memuat deskripsi ringkas instrumen utama pengumpulan data. Lengkapi bagian metode di abstrak dengan menyebutkan jenis instrumen rubrik komunikasi dan rentang nilai Cronbach's alpha hasil uji reliabilitas yang diperoleh.

Tanggapan:

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, organisation 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 analysed using descriptive statistics, Shapiro–Wilk and Levene's tests, paired- and independent-samples t-tests, normalised gain (N-gain), Cohen's d, and Pearson's correlation analysis. 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 ($r = 0.62$, $p < 0.001$).

3. Bagian Pendahuluan belum diakhiri dengan rumusan masalah atau hipotesis penelitian. Tambahkan minimal tiga pertanyaan penelitian pada paragraf penutup yang mengarah pada pengujian literasi sains, pengembangan karakter, dan evaluasi persepsi siswa

Tanggapan:

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?

4. Pemilihan kelas terstruktur menuntut validasi kesetaraan dasar kognitif awal sebelum perlakuan diturunkan. Tambahkan tabulasi demografis berupa nilai rapor sains, pemerataan usia, atau gender untuk menihilkan ancaman bias pembentukan formasi sampel di metode penelitian

Tanggapan:

Participant Characteristics

To verify baseline equivalence and minimize sampling bias, demographic characteristics and prior academic performance were compared between the experimental and control groups before the intervention. The results are presented in Table 3.

Table 3. Demographic Characteristics and Baseline Equivalence of Participants

Characteristic	Experimental (n = 34)	Control (n = 34)	Statistical Test	*p*-value
Gender, n (%)			$\chi^2 = 0.06$	0.801
Male	17 (50.0)	18 (52.9)		
Female	17 (50.0)	16 (47.1)		
Age (years)			$t = 0.37$	0.715
Mean ± SD	10.78 ± 0.42	10.82 ± 0.39		
Range	10–11	10–11		
Previous Science Report Card Score			$t = 0.29$	0.772
Mean ± SD	78.56 ± 5.84	78.14 ± 5.63		
Baseline Scientific Communication (Pretest)	61.82 ± 8.24	62.17 ± 7.96	$t = 0.18$	0.857
Overall Participants	34	34		

Table 3 shows that the experimental and control groups were demographically comparable before the intervention. The gender distribution was balanced across both groups, with no significant difference ($\chi^2 = 0.06$, $p = 0.801$). Similarly, students' mean age did not differ significantly ($t = 0.37$, $p = 0.715$), indicating that participants were developmentally comparable. Previous science report card grades were also statistically equivalent ($t = 0.29$, $p = 0.772$), suggesting similar academic backgrounds in science. Furthermore, no significant difference was found in baseline scientific communication scores ($t = 0.18$, $p = 0.857$), confirming that cognitive ability was equivalent before treatment. These findings indicate that the two intact classes were comparable at baseline, thereby reducing the likelihood of sampling bias and supporting the internal validity of the quasi-experimental comparison.

5. Tabel 1 menampilkan nama instrumen tanpa melampirkan parameter pengujian validitas empiris tiap indikator. Tampilkan data koefisien reliabilitas seperti nilai r-hitung untuk instrumen rubrik analitik sebelum alat ukur ini dipakai menilai kinerja subjek observasi

Tanggapan:

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), with all indicators achieving 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.

6. Pembahasan belum memisahkan temuan sesuai kaidah uji efektivitas. Tata ulang temuan dengan alur wajib berikut: A. Characteristics of the Intervention yang menyertakan tangkapan layar fitur media interaktif, B. Findings on Variable 1 beserta uji hipotesis dan bukti dampaknya, serta C. Findings on Variable 2 dengan olahan data afektif. Bahas penyebab hasil statistik tersebut dengan mengaitkan fitur intervensi pada teori pemerolehan bahasa.

Tanggapan:

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, organise narrative structures, refine vocabulary, check sentence clarity, and revise scientific explanations. Teacher guidance was incorporated to ensure that students verified AI-generated information, maintained originality, and used AI responsibly.

The principal interactive features included a prompt-based idea generator, story-outline organiser, 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 Figures 5, 6, and 7).

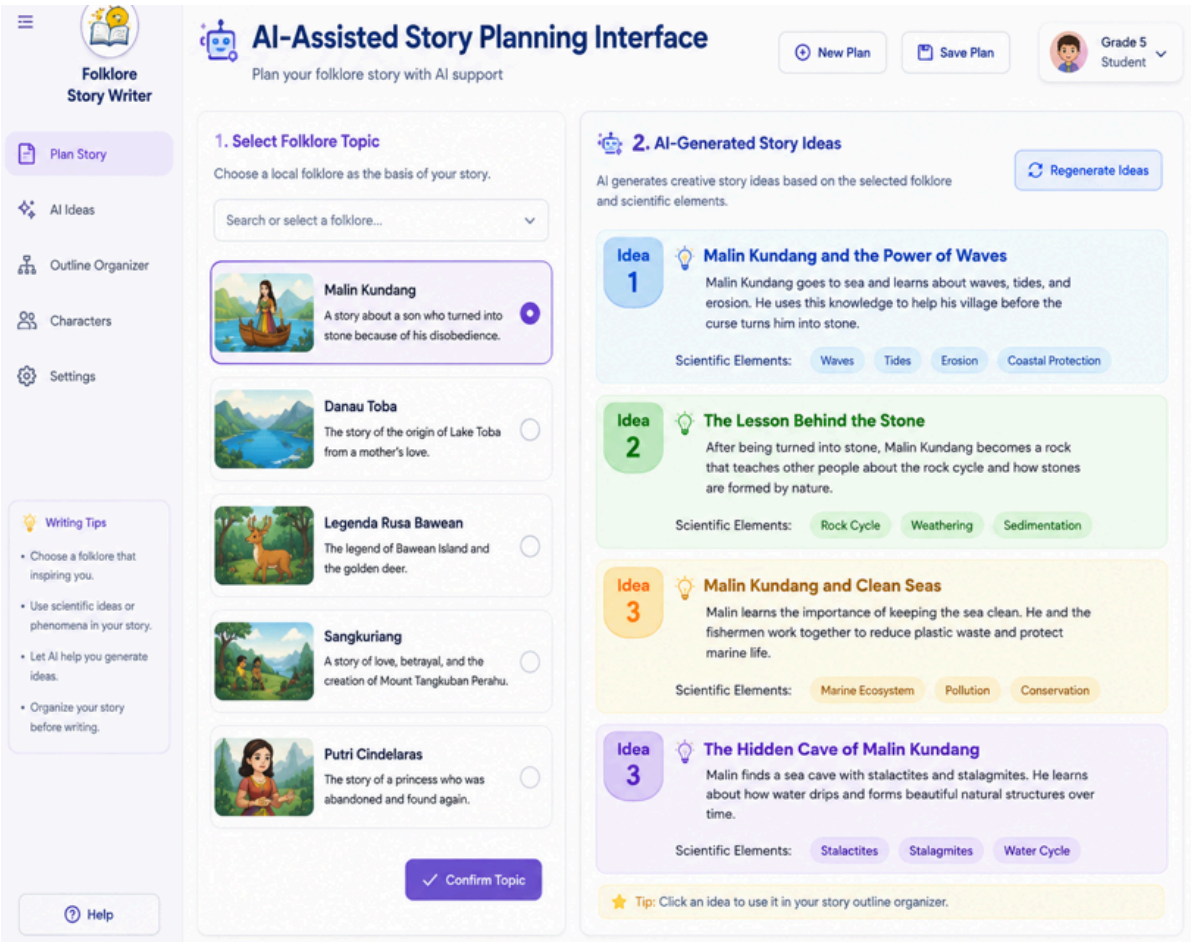

Figure 5. AI-Assisted Story Planning Interface

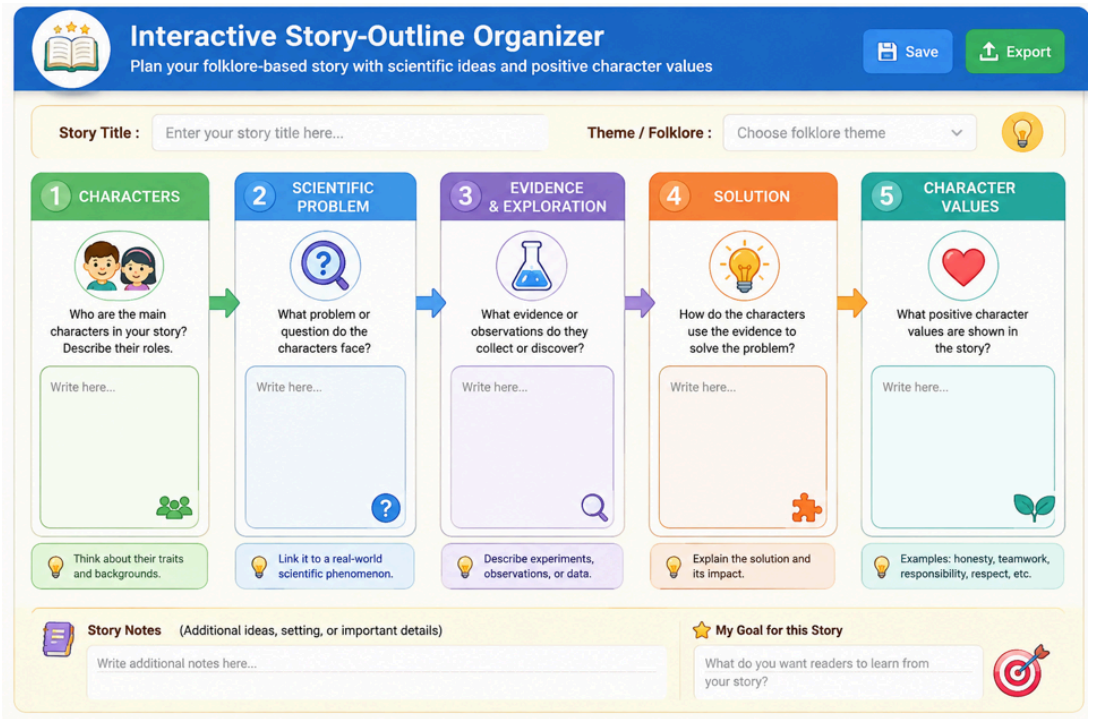

Figure 6. Interactive Story-Outline Organiser

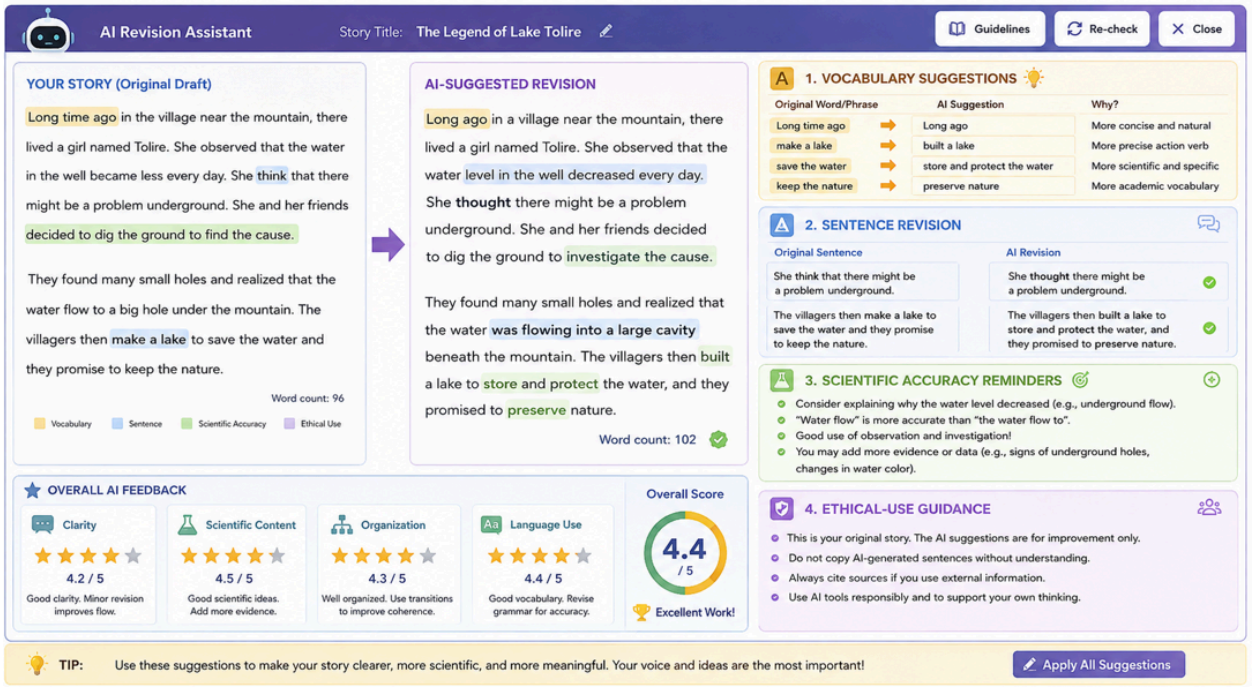

Figure 7. AI-Assisted Revision and Feedback Feature

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, organisation 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 6).

Table 6. 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 normalised gain for the experimental group was 0.73, categorised 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 organisation 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 8).

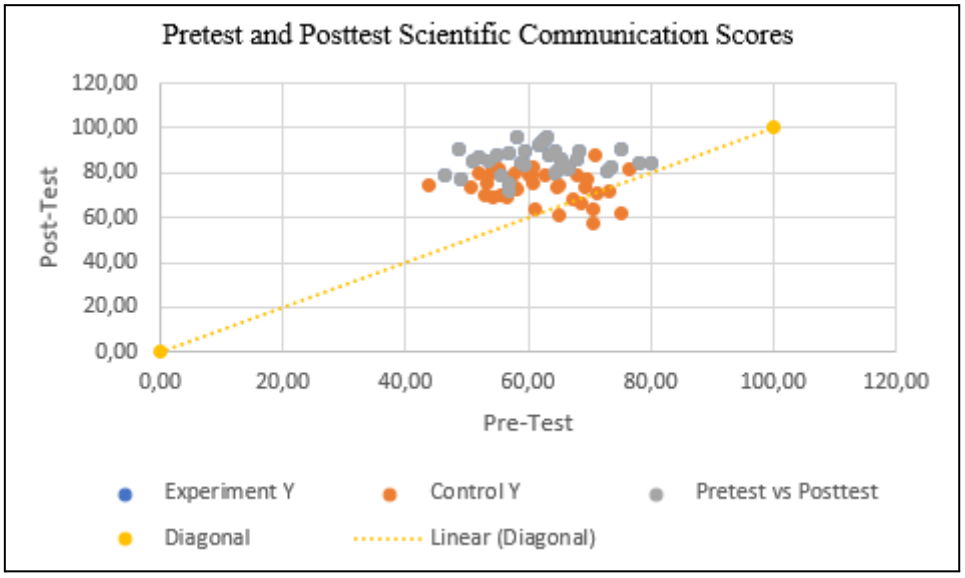

Figure 8. Comparison of Scientific Communication Scores

Figure 8 illustrates the distribution of individual pretest and posttest scientific communication scores for the experimental and control groups. The diagonal line ($y = x$) represents no improvement; therefore, points above the line indicate positive learning gains. Most experimental-group students achieved posttest scores between 80 and 95, despite pretest scores ranging from 50 to 75, demonstrating substantial and consistent improvement following the AI-assisted, folklore-based story-writing intervention. In contrast, the control group showed a wider distribution of posttest scores, with most scores between 60 and 80, indicating smaller and more variable gains after conventional STEM instruction. The absence of prominent outliers and the clear upward clustering of the experimental group support the statistical findings in Table 4, confirming that the intervention produced meaningful improvements in scientific communication across most participants rather than benefiting only a small number of high-performing students.

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 7).

Table 7. 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

The overall character score increased from 3.52 to 4.57, representing an improvement of 29.8%. The paired-samples analysis showed that 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 verifying AI-generated information and revising 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 emphasises meaningful interaction, scaffolded output, and culturally relevant input. Teacher guidance and AI-assisted feedback created opportunities for dialogue, reflection, and revision, enabling students to internalise 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 9).

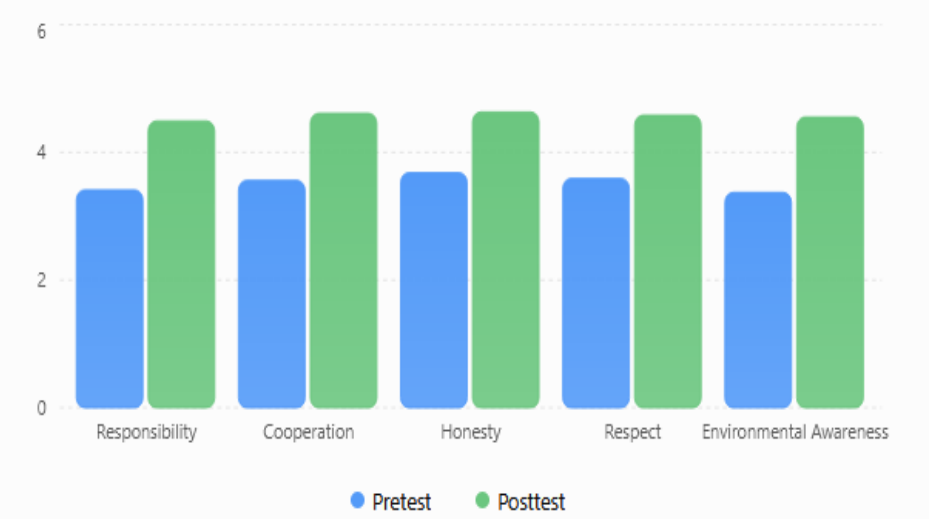

Figure 9. Character Development Profile

Figure 9**.** 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.

7. Visualisasi data eksperimen berupa diagram batang berkelompok mengaburkan posisi outlier dan peningkatan individu. Ubah grafik ini menjadi data distribusi skor pretest-posttest setiap siswa menggunakan SCATTER PLOT. Harap ikut instruksi berikut: pada ms. excel, buat 4 kolom yaitu untuk data pretest, data postest, diagonal x, diagonal y. Kolom data diisi dengan skor pretest dan posttest. Kolom diagonal x dan diagonal y diisi dengan 0 untuk baris pertama dan 100 untuk baris selanjutnya. Klik insert lalu chart lalu scatter. Klik select data lalu Add lalu isi series X value dengan data pretest dan isi series Y value dengan data posttest yang akan menghasilkan Series 1. Tambahkan X value untuk diagonal X dan Y value untuk diagonal Y sebagai series 2. Klik kanan pada titik data grafik Series 2 lalu Change Series Chart Type ubah chart type Series 2 menjadi Scatter with Straight Lines and Markers. Beri label titik-titik data Series 1 sesuai nomor partisipan

Tanggapan:

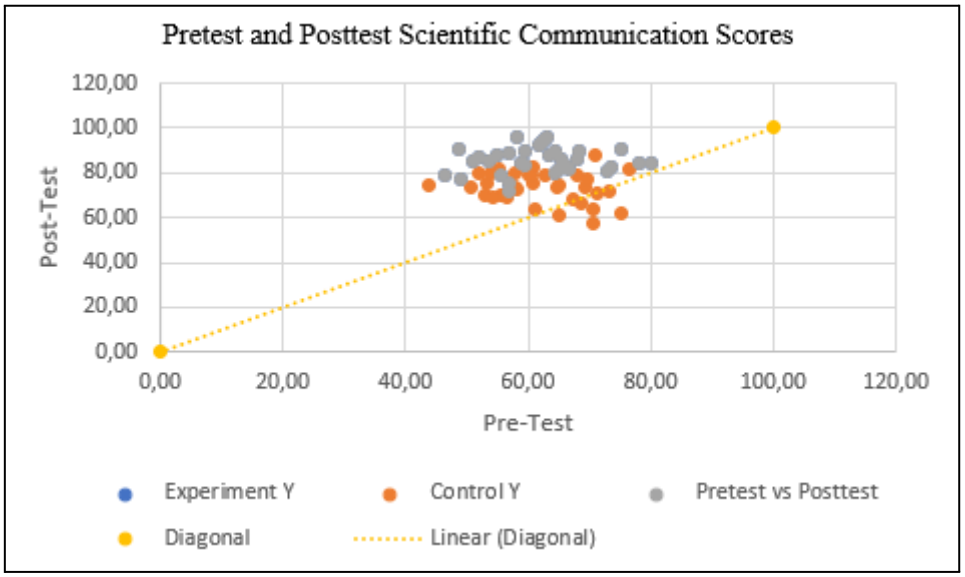

Figure 8. Comparison of Scientific Communication Scores

8. Klaim peningkatan kesadaran lingkungan bersumber pada konten kearifan lokal belum ditopang bukti tekstual di badan naskah. Sertakan cuplikan kalimat narasi cerita dari lembar kerja partisipan yang membuktikan stimulus kesadaran lingkungan tersebut terlahir dari adopsi kisah rakyat, bukan perubahan perilaku luar pengamatan harian.

Tanggapan:

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 the integration of local folklore into STEM story-writing activities rather than with behavioural changes occurring outside the classroom. During the intervention, students analysed traditional folktales containing 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 internalised environmental values by interpreting folklore through a scientific perspective and expressing those ideas in their written narratives. Rather than documenting behavioural changes beyond daily observation, the findings demonstrate that the stimulus for environmental awareness originated in the adoption of local folklore as a culturally meaningful learning resource, integrated with AI-assisted scientific story writing. This supports the role of contextual and culturally responsive STEM instruction in strengthening both scientific communication and environmental character.

9. Teks evaluasi kemampuan menulis cerita hanya mengulang angka skor matriks tanpa membedah interaksi proses berpikir siswa. Jelaskan tahapan pedagogis bagaimana bimbingan guru dan mesin merangsang siswa merangkai alur penceritaan yang selaras, lalu bandingkan pola respons teks dengan literatur metode mengarang terpadu.

Tanggapan:

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 emphasises 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, reorganise ideas, and improve linguistic clarity while preserving the cultural authenticity of the folklore. Consequently, the stories reflected not only accurate scientific content but also coherent narrative organisation, 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 for supporting scientific reasoning, maintaining narrative coherence, and ensuring responsible use of AI during the writing process.

10. Tabel 7 menampilkan data skala persepsi hanya lewat metrik rata-rata agregat. Ganti tabel tersebut dengan 100% STACKED BAR CHART. Harap ikuti panduan berikut: buat tabel kategorisasi skor terlebih dahulu pada sub-bab analisis data dengan pengelompokan Strongly Disagree hingga Strongly Agree. Buat visualisasi distribusi persentase jumlah siswa untuk setiap kategori dengan 100%. Pada ms. excel, klik insert lalu chart lalu bar lalu 100% stacked bar, dengan sumbu x adalah persentase 0-100% dan sumbu y berisi lima aspek pertanyaan persepsi

Tanggapan:

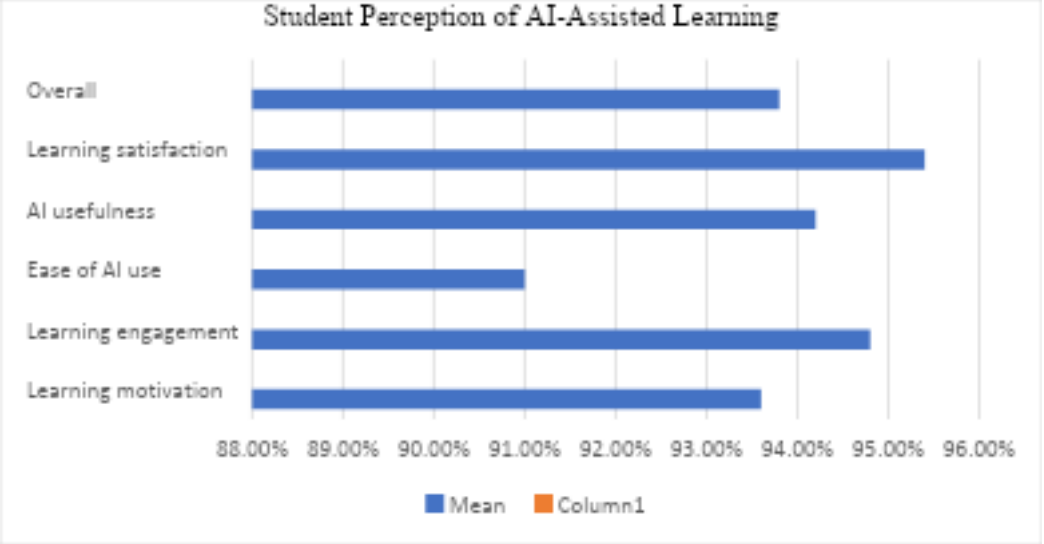

Figure 10. Student Perception of AI-Assisted Learning

11. Teks paragraf ini merepetisi mentah-mentah nilai rata-rata dari Tabel 7 tanpa nilai tambah analitis. Ubah gaya penulisan menjadi narasi yang membedah korelasi tren persepsi positif di mata siswa alih-alih mendikte susunan angka yang berlebihan.

Tanggapan:

Figure 10 reveals a consistent pattern of positive student perceptions across all evaluated dimensions, indicating that acceptance of the instructional model was driven by interconnected learning experiences rather than isolated factors. The highest rating for learning satisfaction (95.4%) was accompanied by similarly high levels of learning engagement (94.8%), AI usefulness (94.2%), and learning motivation (93.6%), suggesting that students who perceived AI as beneficial were also more engaged and motivated during STEM learning. Although ease of AI use (91.0%) received the lowest score, it remained highly positive, implying that minor technical challenges did not diminish overall acceptance. Collectively, these trends indicate that meaningful integration of AI with folklore-based STEM learning fostered an engaging, motivating, and satisfying educational experience

12. Simpulan memuat klaim keterampilan tingkat tinggi dan pemecahan masalah kolaboratif, dua atribut yang tidak memiliki landasan metrik pengujian di bagian instrumen. Hapus klaim overclaiming tersebut dan kembalikan rekomendasi simpulan berpijak pada variabel literasi komunikasi dan sikap budi pekerti.

Tanggapan:

The findings demonstrate that the AI-assisted folklore-based story writing model is effective in strengthening 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 that supported 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.

13. Penulis WAJIB menambahkan paragraf terkait deklarasi penggunaan AI tools dalam proses penulisan naskah SETELAH CONCLUSION DAN SEBELUM REFERENCES.

Tanggapan:

Declaration of Generative AI Usage in the Writing Process

During the preparation of this manuscript, the authors employed OpenAI ChatGPT (GPT-5.5) and Grammarly to assist with language refinement, improvement of academic writing style, grammatical editing, organization of manuscript sections, and enhancement of 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. All scientific content, study design, data collection, statistical analyses, results, interpretations, and conclusions were developed, verified, and critically reviewed by the authors. 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.

14. Jumlah daftar pustaka yang dicantumkan hanya berjumlah 23 sumber. Tambahkan literatur pendukung hingga mencapai minimal 30 referensi dengan proporsi mayoritas berupa jurnal internasional terbitan sepuluh tahun terakhir

Tanggapan:

[1] E. A. C. Zapata, S. Y. L. Ríos, and J. Osorio, “Naturaleza De La Ciencia Para La Enseñanza De La Relatividad General: Una Revisión Sistemática,” *Aula Abierta*, vol. 53, no. 2, pp. 149–158, 2024, doi: 10.17811/rifie.19960.

[2] T. A. M. Silva and E. Á. Durán, “Progreso Y Evaluación De Las Habilidades Científicas Mediante La Utilización De La Metodología De Indagación Científica en Educación Inicial,” *Revista Educación*, 2024, doi: 10.15517/revedu.v48i1.55824.

[3] M. R. A. Bertea, C. Pipitone, and A. M. Tallada, “Aprender a Formular Preguntas Investigables en La Formación Inicial Del Profesorado De Educación Primaria,” *Revista Eureka Sobre Enseñanza Y Divulgación De Las Ciencias*, vol. 20, no. 2, 2023, doi: 10.25267/rev_eureka_ensen_divulg_cienc.2023.v20.i2.2601.

[4] N. F. Mitjans, “Kahoot Y Quizizz: Cuando Jugar en Equipos Marca La Diferencia a La Hora De Motivar a Leer Noticias De Ciencias,” *Revista Electrónica Interuniversitaria De Formación Del Profesorado*, vol. 26, no. 2, pp. 129–142, 2023, doi: 10.6018/reifop.547421.

[5] M. A. M. Más, A. B. Roig, and Á. V Alonso, “Formar, Enseñar Y Aprender Sobre La Práctica Científica En Primaria Con Un Juego De Cajas Negras,” *Reire Revista D Innovació I Recerca en Educació*, vol. 14, no. 2, 2021, doi: 10.1344/reire2021.14.232607.

[6] J. J. V Martorell, N. Jiménez‐Tenorio, and J. M. O. Martínez, “La Naturaleza De La Ciencia Como Objeto De Aprendizaje en La Formación Inicial Del Profesorado De Ciencias De Secundaria.,” *Revista Interuniversitaria De Formación Del Profesorado Continuación De La Antigua Revista De Escuelas Normales*, vol. 97, no. 36.1, 2022, doi: 10.47553/rifop.v97i36.1.92424.

[7] A. d. F. Zômpero, D. L. P. Lozano, C. Werner, and X. V Tibaud, “Competencias Científicas en Los Currículos De Ciencias Naturales: Estudio Comparativo Entre Brasil, Chile Y Colombia,” *Praxis & Saber*, vol. 13, no. 34, p. e13401, 2022, doi: 10.19053/22160159.v13.n34.2022.13401.

[8] È. Tena, “Is our school air polluted? A model-based inquiry proposal for primary schools,” *Ápice Revista De Educación Científica*, vol. 5, no. 2, p. 87, 2021, doi: 10.17979/arec.2021.5.2.7613.

[9] F. J. R. Moral, M. del M. M. Martinez, and I. V Garcerán, “Steam en Educación Primara ¿Es Posible?,” *Góndola Enseñanza Y Aprendizaje De Las Ciencias*, vol. 17, no. 1, pp. 90–104, 2022, doi: 10.14483/23464712.17097.

[10] A. Portillo-Blanco, J. R. Díez, O. Barrutia, and J. Guisasola, “Diseño Y Evaluación De Una Intervención Educativa Sobre La Pandemia De La COVID-19 Y Las Medidas De Prevención,” *Revista Eureka Sobre Enseñanza Y Divulgación De Las Ciencias*, vol. 19, no. 1, pp. 1–19, 2022, doi: 10.25267/rev_eureka_ensen_divulg_cienc.2022.v19.i1.1302.

[11] J. Alcántara‐Manzanares, S. Aguilar-Cubillo, and A. Vara-López, “Contar Las Ciencias: Una Práctica Interdisciplinar en La Formación Inicial Del Profesorado De Educación Primaria Bilingüe,” *Profesorado Revista De Currículum Y Formación Del Profesorado*, vol. 26, no. 1, pp. 149–169, 2022, doi: 10.30827/profesorado.v26i1.15715.

[12] P. Quezada-Carrasco, “Educación Intercultural: Una Alternativa a La Educación Monocultural en Contexto Mapuche,” *Revista Cuhso*, vol. 32, no. 2, pp. 285–311, 2022, doi: 10.7770/cuhso-v32n2-art2502.

[13] D. Velarde-Camaqui, C. Viehmann, R. Díaz, and G. Valerio-Ureña, “Características De Los Videos Que Favorecen El Engagement De Los Divulgadores Científicos en TikTok,” *Revista Latina De Comunicación Social*, no. 82, pp. 1–18, 2024, doi: 10.4185/rlcs-2024-2232.

[14] E. Kara and Ç. Kılıç, “Düşünen Sınıf Materyalleri İle Desteklenmiş Cebir Öğretiminin Ortaokul Öğrencilerinin Problem Kurma Performanslarına Etkisi,” *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, vol. 20, no. 1, pp. 88–111, 2024, doi: 10.17860/mersinefd.1268381.

[15] N. C. Aksoy and O. Kelleci, “Enhancing Pre-Service Teacher’s TPACK Skills and Self Efficacy Beliefs Via Teaching Practice Assisted By AI-Based Simulation Environment,” *The Journal of International Educational Sciences*, vol. 10, no. 36, pp. 148–171, 2023, doi: 10.29228/inesjournal.71680.

[16] Y. Doğan, Z. KILIÇ, Y. Kalınkara, and T. Talan, “The Impact of Artificial Intelligence-Supported Instruction on Student Learning in STEM: A Systematic Review and Meta-Analysis,” *J. Intell.*, vol. 14, no. 6, p. 109, 2026, doi: 10.3390/jintelligence14060109.

[17] E. Mafrudin, “Contribution of Social Sciences in Strengthening the Character Education of Elementary School Students,” *Mandalika Journal of Social Science*, vol. 1, no. 2, pp. 29–33, 2023, doi: 10.56566/mandalika.v1i2.122.

[18] S. K. Vincent and B. Wasden, “A Quasi-Experimental Evaluation of Student Academic Performances in Single Sex Secondary Classrooms,” *J. Agric. Educ.*, vol. 64, no. 4, 2023, doi: 10.5032/jae.v64i4.122.

[19] W. Yang *et al.*, “Beyond Coding: Effects of a Computing Curriculum on Preschoolers’ Computational Thinking, Math, Language, and Social-Emotional Skills,” *Journal of Educational Computing Research*, vol. 64, no. 1, pp. 126–154, 2025, doi: 10.1177/07356331251384546.

[20] R. X. Suárez-García *et al.*, “DIALOGUE: A Generative AI-Based Pre–Post Simulation Study to Enhance Diagnostic Communication in Medical Students Through Virtual Type 2 Diabetes Scenarios,” *Eur. J. Investig. Health Psychol. Educ.*, vol. 15, no. 8, p. 152, 2025, doi: 10.3390/ejihpe15080152.

[21] S. Liu, X. Xia, Y. Liu, and H. Zhang, “Measurement Tools of Child Neglect From 2003 to 2023: A Systematic Review,” *Res. Soc. Work Pract.*, vol. 35, no. 5, pp. 543–575, 2024, doi: 10.1177/10497315241244826.

[22] D. Waeyeng, T. Khamphaya, P. Pouyfung, U. Vattanasit, and S. Yimthiang, “Blood Lead Levels Among Non-Occupationally Exposed Pregnant Women in Southern Thailand,” *Toxics*, vol. 10, no. 10, p. 599, 2022, doi: 10.3390/toxics10100599.

[23] J. Friska, I. Pramuaniati, and Mahriyuni, “Effectiveness of Using Canva Application to Improve Learning Outcomes of Tenth Grades Students,” *Jurnal Penelitian Dan Pengembangan Pendidikan*, vol. 7, no. 3, pp. 421–427, 2023, doi: 10.23887/jppp.v7i3.67879.

[24] M. A. Nygaard, H. E. Ormiston, and H. Enderle, “Examining the Classroom Impact of the Bounce Back Trauma Intervention: Implications for Selecting Progress Monitoring Tools,” *Assessment for Effective Intervention*, vol. 49, no. 3, pp. 126–137, 2024, doi: 10.1177/15345084231218614.

[25] E. Stiawan, B. Rahmat, L. Liliasari, and I. Rohman, “Enhancement of Indonesian High School Student Conceptual Mastery on VSEPR Topic Using Virtual Simulation of Molecule Shapes: A Case Study of Quasi-Experimental Evidence,” *Jurnal Pendidikan Ipa Indonesia*, vol. 11, no. 4, pp. 511–518, 2022, doi: 10.15294/jpii.v11i4.36385.

[26] M. D. BALÇIN, M. Yıldırım, and S. A. Oymak, “Ortaokul Öğrencilerine Yönelik Mühendisliğin Doğası Anlayışı Ölçeği: Geliştirme, Geçerlik Ve Güvenirlik Çalışması,” *Manisa Celal Bayar Üniversitesi Eğitim Fakültesi Dergisi*, vol. 12, no. 2, pp. 437–457, 2024, doi: 10.52826/mcbuefd.1517818.

[27] E. Öcal, A. Karademir, Ö. Saatçioğlu, and B. Demirel, “Preschool Teachers’ Preparation Programs: The Use of Puppetry for Early Childhood Science Education,” *Int. J. Educ. Method.*, vol. 7, no. 2, pp. 305–318, 2021, doi: 10.12973/ijem.7.2.305.

[28] L. Yang *et al.*, “Comprehensive Pan-cancer Analysis of MTDH for Human Tumor Prognosis and as an Immunological Biomarker Including Breast and Kidney Cancer,” *Oncol. Lett.*, vol. 28, no. 2, 2024, doi: 10.3892/ol.2024.14482.

[29] H. S. Nia *et al.*, “The Impact of Student Computer Competency On<scp>e‐learning</Scp>outcomes: A Path Analysis Model of Virtual Learning Infrastructure, Collaboration, and Access to Electronic Facilities,” *Nurs. Open*, vol. 11, no. 3, 2024, doi: 10.1002/nop2.2130.

[30] Q. Xie, X. Jia, X. Chen, and W. Dong, “Interdecadal Changes in the Interannual Variations in Spring Precipitation Over the Tarim Basin,” *International Journal of Climatology*, vol. 43, no. 14, pp. 6540–6559, 2023, doi: 10.1002/joc.8218.

[31] F. Yuhariah and I. Sujarwati, “The Correlation Between High School Students Vocabulary Mastery and Writing Ability,” *Pedagonal Jurnal Ilmiah Pendidikan*, vol. 7, no. 2, pp. 113–123, 2023, doi: 10.55215/pedagonal.v7i2.6649.

[32] G. Iandolo, M. Aroca-Salom, A. M. Esteban, G. González‐Cuevas, and C. Alonso‐Campuzano, “Storytelling, Verbal Fluency, and Teacher’s Perception of Primary School Spanish Students,” *Sage Open*, vol. 14, no. 4, 2024, doi: 10.1177/21582440241305599.

[33] D. I. Tsomokos and L. Raviv, “A Bidirectional Association Between Language Development and Prosocial Behavior in Childhood: Evidence From a Longitudinal Birth Cohort in the United Kingdom.,” *Dev. Psychol.*, vol. 61, no. 2, pp. 336–350, 2025, doi: 10.1037/dev0001875.

[34] A. Rahmayanti, A. R. Wijayaningputri, and I. Mukhlishina, “Problematics of Science Learning With Limited Educators at Sentul Community Learning Center Kuala Lumpur,” *Tunas Jurnal Pendidikan Guru Sekolah Dasar*, vol. 9, no. 1, pp. 34–39, 2023, doi: 10.33084/tunas.v9i1.6392.

[35] S. Tasnim, A. Hossain, and Д. Маринова, “How Can Stories in Primary Education Support Sustainable Development in Bangladesh?,” *Sustainability*, vol. 15, no. 16, p. 12620, 2023, doi: 10.3390/su151612620.

[36] H. Yaman and B. Anılan, “Values Education in Science Lessons With Activities: Responsibility Value,” *Science Education International*, vol. 32, no. 3, pp. 237–247, 2021, doi: 10.33828/sei.v32.i3.7.

[37] S. C. Relmasira, Y. C. Lai, and J. P. Donaldson, “Fostering AI Literacy in Elementary Science, Technology, Engineering, Art, and Mathematics (STEAM) Education in the Age of Generative AI,” *Sustainability*, vol. 15, no. 18, p. 13595, 2023, doi: 10.3390/su151813595.

[38] J. Han and D. Lee, “Research on the Development of Principles for Designing Elementary English Speaking Lessons Using Artificial Intelligence Chatbots,” *Humanit. Soc. Sci. Commun.*, vol. 11, no. 1, 2024, doi: 10.1057/s41599-024-02646-w.

[39] A. F. Sánchez, J. J. L. Castiñeiras, and A. Sánchez‐Bello, “Navigating the Future of Pedagogy: The Integration Of <scp>AI</Scp> Tools in Developing Educational Assessment Rubrics,” *Eur. J. Educ.*, vol. 60, no. 1, 2024, doi: 10.1111/ejed.12826.

[40] K. Sperling, L. Stenliden, J. Nissen, and F. Heintz, “Still W(<scp>AI</Scp>)ting for the Automation of Teaching: An Exploration of Machine Learning in Swedish Primary Education Using <scp>Actor‐Network</Scp> Theory,” *Eur. J. Educ.*, vol. 57, no. 4, pp. 584–600, 2022, doi: 10.1111/ejed.12526.

[41] P. Nedungadi, K. Tang, and R. Raman, “The Transformative Power of Generative Artificial Intelligence for Achieving the Sustainable Development Goal of Quality Education,” *Sustainability*, vol. 16, no. 22, p. 9779, 2024, doi: 10.3390/su16229779.

[42] L. Zhao, X. Wu, and H. Luo, “Developing AI Literacy for Primary and Middle School Teachers in China: Based on a Structural Equation Modeling Analysis,” *Sustainability*, vol. 14, no. 21, p. 14549, 2022, doi: 10.3390/su142114549.