Enhancing Elementary Students' Writing Habits with Generative AI: A Study of Handwritten Diary and AI Companions

Chang-Yen Liao

Graduate Institute of Network Learning Technology, National Central University | Taiwan

Abstract: This empirical exploration investigates how integrating a handwritten diary with a generative AI writing companion can strengthen elementary school students' writing habits and interests in a naturalistic classroom setting. The AI companion serves as a personalized assistant, offering real-time ideas, suggestions, and feedback. By encouraging students to handwrite daily experiences and emotions, then digitize their entries, the approach fosters both reflection and skill development. Over 18 weeks, 32 students from grades three to five (average age 10.5 years old) recorded their diary in Chinese and interacted with the AI companion. This exploratory study employed a pre-post, single-group design, analyzing diary entries, interaction logs, and questionnaire data to assess changes in writing participation and interest. The findings indicate three major outcomes: a notable increase in writing participation, reflected by a rise in the number of ideas and entry length; an enhanced level of writing interest, demonstrating the effectiveness of merging traditional handwriting with AI tools; and improved writing behavior through more frequent and diverse writing activities. When students encountered challenges—such as topic selection or content organization—the AI companion supplied up to three suggestions, preventing information overload and preserving independent thinking. Overall, this interactive, AI-supported environment transformed writing from a solitary task into a dynamic, collaborative process, boosting motivation and quality. The study thus illustrates how strategically blending handwritten diary with innovative AI systems can enrich writing education and sustain students' long-term engagement, while acknowledging its exploratory nature and the need for further research to establish causal links.

Keywords: generative AI, writing companion, handwritten diary, writing habits, writing interest

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Contact: Chang-Yen Liao, Graduate Institute of Network Learning Technology,

National Central University, Taoyuan | Taiwan - CalvinCYLiao@gmail.com

1. Introduction

In today's educational landscape, writing is recognized not only as a fundamental language skill but also as a critical vehicle for fostering creativity and higher-order thinking (Graham, Harris, Kiuhara, & Fishman, 2017). Beyond its academic utility, writing serves as a powerful tool for children's holistic development, enabling them to articulate their inner worlds, navigate complex emotions, construct their identities, and connect meaningfully with others in an increasingly diverse society (Wells, 1986; Dyson, 2013). At the elementary level, writing plays a pivotal role in students' overall learning and cognitive development; yet many young learners experience considerable uncertainty when tasked with writing assignments. They frequently struggle to identify suitable topics or effectively articulate their ideas, which can lead to negative attitudes toward writing (Nolen, 2007). If such challenges are not addressed, they may adversely affect students' future motivation, their capacity for self-expression, and their ability to communicate complex thoughts effectively (Daly, 1978; Duhigg, 2012; Bruning & Horn, 2000; Graham et al., 2017).

Current writing instruction in many elementary classrooms tends to emphasize assessment and the correction of linguistic elements—such as word usage, punctuation, and grammar—while paying relatively little attention to nurturing writing interest or developing consistent writing habits (Liao et al., 2018). With limited class time available for writing practice, teachers are often unable to provide the individualized support that many students need. As a result, students spend excessive time deliberating on what to write, how to structure their compositions, or how to express their ideas clearly, which further diminishes their overall engagement with the writing process (Nolen, 2007).

In response to these instructional challenges and the need for more engaging writing practices, a growing body of research advocates for the implementation of diary writing as a daily practice strategy. Diary writing leverages short, accessible formats derived from everyday experiences to reduce writing pressure while gradually building vocabulary and writing skills (Cohen, White, & Cohen, 2011; Sá, 2002; Martinviita, 2016). This approach not only offers manageable writing tasks with flexible structures but also encourages students to draw on their personal experiences, thereby enhancing engagement and promoting consistency (Nückles, Hübner, & Renkl, 2020; Regan, Mastropieri, & Scruggs, 2005); Looi et al., 2023). Kelso-Marsh et al. (2025) further showed that when parents are autonomously motivated and actively engage in home writing activities, their second-grade children develop stronger attitudes and produce higher-quality writing, whereas parent involvement driven by external pressures had no such effect. This highlights the importance of cultivating a supportive home writing culture.

For the purposes of this study, "diary writing" is operationally defined as a low-stakes, self-directed practice where students regularly handwrite about their personal experiences, thoughts, and emotions, often without strict formal or academic constraints (Nückles, Hübner, & Renkl, 2020). In this, it shares characteristics with personal **journaling** and **daybooks**, which prioritize authentic self-expression. It is distinct, however, from more structured **"reflective**

(learning-based) logs," which are typically tied to specific curriculum content and evaluative criteria. By framing diary writing in this manner, the current study focuses on a practice intended to foster personal reflection and writing habits rather than formal academic composition.

Indeed, empirical evidence suggests that regular diary writing can foster a more positive outlook on writing and contribute to measurable improvements in overall writing performance (Dincel & Savur, 2019; Suryaman, 2019). Moreover, during the COVID-19 pandemic, diary writing was effectively utilized to help students document their learning and daily experiences, strengthening self-reflection and increasing writing interest (Khoridatul, 2022). However, despite these benefits, students, particularly younger or less confident writers, may still face significant hurdles even with diary writing. These can include motivational challenges, such as a lack of perceived purpose or sustained interest, and cognitive difficulties related to idea generation ('writer's block'), content organization, vocabulary retrieval, or structuring coherent narratives (Bereiter & Scardamalia, 1987; Pajares, 2003). Such obstacles can limit the consistency and depth of their diary entries, thereby hindering the full realization of this practice's potential.

Given these persistent challenges in fostering consistent and meaningful writing engagement, there is a critical need to explore innovative instructional strategies that can simultaneously address both the technical and motivational aspects of writing. It is in this context, particularly in addressing the cognitive and motivational hurdles inherent in personal writing tasks like diaries, that emerging AI-based support systems present a promising avenue. This exploratory study is therefore positioned to investigate how integrating handwritten diary writing with a generative AI writing companion might inform efforts to enhance elementary students' writing skills, foster sustained writing habits, and ultimately transform their attitudes toward writing. Specifically, we aim to explore the potential of this blended approach to increase writing participation, cultivate various dimensions of writing interest, and support students' cognitive strategies during the writing process, particularly when they encounter common writing difficulties.

2. Relevant studies

2.1 The Role of Handwriting in Writing Development and Cognitive Processing

Handwriting proficiency is widely recognized as a cornerstone of early writing development, profoundly influencing children's journey into literacy (Graham et al., 2000). A significant body of research indicates that as children achieve fluency in handwriting, essential cognitive resources are liberated, allowing them to engage more deeply with higher-level writing processes such as idea generation, planning, and revision (Beers et al., 2017; Graham et al., 1997). For instance, experimental work by Graham et al. (2000) with beginning writers demonstrated that targeted handwriting instruction not only enhanced transcription abilities but also led to notable improvements in overall compositional fluency. This connection between rapid, accurate letter production and improved text quality is further supported by

findings from Connelly et al. (2007), who highlighted how the automatization of handwriting enables children to shift their focus towards textual content and structure. By alleviating the burden on working memory, handwriting fluency empowers young learners to more consistently navigate the conceptual and linguistic complexities of writing (Graham & Harris, 2000).

While handwriting forms a critical base, the educational landscape also encompasses digital transcription modes. Studies on keyboard-based composition suggest that typing can facilitate swift text editing, which may particularly benefit older or more proficient writers already possessing high typing fluency (Berninger et al., 2009). However, it is important to note that the cognitive advantages of typing appear contingent on the learner's existing keyboarding speed and familiarity with digital text production (Connelly et al., 2007). Conversely, compelling empirical work suggests that the physical act of handwriting can reinforce the brain's action-perception coupling; the precisely coordinated hand movements and proprioceptive feedback involved in forming letters have been linked to deeper encoding of letters and words (Kiefer & Trumpp, 2012; Mangen et al., 2015). This embodied engagement is believed to foster stronger neural activation relevant to language processing and long-term memory (van der Weel & Van der Meer, 2024). Thus, while keyboarding offers distinct advantages for text revision and reorganization, a consensus remains regarding the crucial role of dedicated handwriting instruction, especially in the early grades (Feng et al., 2019; Graham et al., 1997).

Recent investigations have further broadened our understanding by examining other embodied transcription techniques, such as drawing. Illustrating this, Richardson and Lacroix (2024) found that the sensorimotor integration inherent in both drawing and handwriting yielded superior recall compared to purely digital text production. In a similar vein, Beers et al. (2017) demonstrated that both handwriting skill and writing modality significantly predicted the fluency and linguistic complexity of student compositions across grades 4 to 9, with and without specific writing disabilities. This confluence of findings underscores a consistent theme: although technology-rich environments can greatly augment the composing process, handwriting remains a key element in supporting deeper conceptual engagement. Consequently, educators are frequently encouraged to integrate both handwriting and typing in authentic writing tasks like journals or daily logs (Graham, 2018), enabling students to reap the unique cognitive and kinesthetic benefits of handwriting while concurrently acquiring essential digital transcription skills (Skar et al., 2022). A balanced pedagogy embracing multiple modalities ensures learners develop a versatile repertoire of strategies for diverse writing goals (Feng et al., 2019; Richardson & Lacroix, 2024). Given this established importance of handwriting for cognitive engagement and skill development, educators continually seek effective practices to leverage these benefits. One such practice, diary writing, not only promotes regular writing habits but also offers a rich context for self-expression and language exploration.

2.2 The influence of diary on writing skills development

Research on diary writing consistently highlights its multifaceted value in nurturing young learners' writing skills, confidence, and motivation (Jones & East, 2010; Ningrum, Rita, & Hastini, 2013). A key finding from studies like Jones and East (2010) is that daily diary writing routines in early primary classrooms can foster learner autonomy, allowing students to experiment with ideas and language free from the pressures of high-stakes evaluation. Such continuous engagement in reflective writing has been shown to enhance both the fluency and accuracy of children's writing as they become more comfortable expressing themselves. Similarly, for diverse learner populations, Luu (2010) found that journal writing provided EFL learners with frequent, meaningful writing practice outside formal classroom settings, leading to noticeable improvements in fluency and overall motivation. Further underscoring its reflective power, Haghnavaz Bazir (2016) emphasized that diary writing promotes deeper self-reflection and critical thinking, as learners document personal experiences and gradually build connections between prior knowledge and new concepts. Thus, a recurring theme in this body of literature is the potential of diary writing to serve as a low-anxiety platform that encourages children to develop and refine essential literacy practices (Farrah, 2012).

When compared with more traditional writing pedagogies, diary writing reveals clear distinctions in both process and outcomes. For example, Ningrum et al. (2013) observed that teacher-centered, formal writing exercises often led to heightened anxiety and limited enjoyment among children. In stark contrast, diary writing, as an open-ended and self-directed activity, enables learners to focus on brainstorming and organization without the pervasive fear of errors (Barjesteh, Vaseghi, & Gholami, 2011). This process-centered orientation helps reduce performance pressure and fosters iterative learning (Engin, 2011). Moreover, diary writing can be seamlessly embedded into daily classroom routines, such as morning meetings, thereby reinforcing fine motor coordination, letter knowledge, and oral language skills (Zhang & Bingham, 2019). Fadaei et al. (2024) further showed that electrodermal activity increased at the beginning and end of expressive writing sessions, and that adopting a third-person perspective amplified these responses, suggesting that diary-like writing provokes measurable arousal and that self-distancing shapes how writers experience the task. Overall, research suggests that the consistent use of diary writing effectively addresses many shortcomings of formal instruction, including time pressure, formulaic prompts, and limited student choice (Jones & East, 2010; Gerde, Bingham, & Pendergast, 2015).

The literature collectively underscores diary writing as a method that situates literacy growth within a child's authentic experiences and personal reflections (Jones & East, 2010; Haghnavaz Bazir, 2016; Sá, 2002). Students who regularly maintain writing diaries often demonstrate higher engagement levels and strengthened literacy-related self-efficacy (Jones & East, 2010). Furthermore, the introspective or reflective nature of diary practice encourages a beneficial interplay between emotions, cognition, and language use (Engin, 2011; Sá, 2002). When combined with principles of scaffolding and meaningful, context-based tasks, diary

writing can lead to improvements in letter formation, spelling, and overall clarity (Zhang & Bingham, 2019). Taken together, these studies confirm that diary writing not only enhances mechanical accuracy but also nurtures creativity and fosters purposeful literacy skills (Luu, 2010), offering a motivating, learner-centered environment for sustained writing growth while mitigating the anxiety often associated with traditional writing exercises (Farrah, 2012; Ningrum et al., 2013). However, despite these recognized benefits, students may still face challenges in consistently engaging with diary writing, such as maintaining motivation, generating fresh ideas, or structuring their thoughts effectively. It is here that emerging technologies, particularly Generative Artificial Intelligence (GenAI), offer new avenues of support.

2.3 Generative artificial intelligence in writing research

Generative artificial intelligence (GenAI) has rapidly expanded its applications across diverse creative and professional domains and is now increasingly explored as a supportive tool in educational settings. Particularly relevant to this study, elementary school diary writing—a reflective and personal medium fostering expressive skills and self-reflection—stands to benefit significantly from GenAI's capabilities. Young writers often grapple with challenges such as writer's block, limited idea generation, and difficulties in organizing their thoughts. By providing real-time, adaptive support, GenAI holds the potential to alleviate these obstacles and enhance overall writing development.

Recent advancements in large language models (LLMs) have spurred the creation of tools capable of sophisticated text rewriting, continuation, and style transformation (Yuan et al., 2022). A notable example is Wordcraft, a creative writing tool developed by Yuan et al. (2022), which demonstrates how AI can generate multiple narrative directions, helping students break free from rigid thought patterns and explore a broader range of creative options. In the specific context of diary writing, such systems can offer tailored suggestions for topic development, stylistic adjustments, and vocabulary enhancement. This scaffolding not only aids students in expressing their ideas more coherently but also encourages them to experiment with different narrative forms, thereby promoting both creativity and fluency.

Moreover, GenAI has been successfully integrated into situational writing tasks within educational environments. Bai et al. (2024) illustrated that a three-step prompt engineering approach (writing, editing, verification) enables teachers to rapidly generate high-quality learning scenarios using ChatGPT. This method creates engaging prompts that resonate with students' daily experiences, providing a contextual framework that can inspire more thoughtful diary entries. Consequently, when elementary students face challenges in selecting topics or articulating their thoughts, real-time AI feedback can offer alternative ideas and prompt further reflection, potentially reducing writing anxiety and transforming the task into a more interactive and enjoyable process.

Beyond its creative benefits, GenAI has also demonstrated a capacity to enhance productivity and content quality in professional writing contexts (Noy & Zhang, 2023). While these findings are primarily based on adult populations, the underlying principles can be

adapted to support younger learners. For elementary students, AI writing companions may serve as an effective bridge between limited writing experience and the need for expressive autonomy. Despite valid concerns regarding the authenticity and emotional depth of AI-generated content (Messer, 2024; Osone et al., 2021), when GenAI is employed as a supportive tool rather than a replacement for human creativity, it can effectively complement traditional instruction by providing inspiration and facilitating iterative revision. This collaborative approach encourages students to engage more deeply with the writing process while preserving their unique voices. Moreover, Boillos and Idoiaga (2025) surveyed 314 university students and found that AI-based writing tools were valued for assisting with planning, drafting, and revision; however, students also expressed concerns about academic integrity and the erosion of their own skills. The authors emphasize that educators must address these ethical issues as AI becomes increasingly integrated into writing instruction.

In summary, the incorporation of generative AI into elementary school diary writing holds considerable promise. By offering adaptive, real-time feedback and creative guidance, GenAI can assist young writers in overcoming common challenges, fostering greater creativity, and improving overall writing fluency. As technological advancements continue and educators become more adept at integrating these tools, GenAI is poised to become an integral component of modern writing instruction, effectively bridging the gap between traditional pedagogy and digital innovation.

2.4 The present study

This study examines the combined impact of traditional handwritten diary writing and a generative AI writing companion on elementary school students' writing habits, cognitive engagement, and overall motivation. Recognizing that diary writing provides a low-pressure, expressive medium for self-reflection and personal expression, the research investigates whether the integration of AI-driven, real-time support can further enhance writing performance and foster enduring writing practices. Specifically, the study aims to determine if the AI writing companion can improve both the quantity and quality of diary entries by increasing the frequency, length, and diversity of ideas—a trend evidenced by the increased numbers and richer content observed during the intervention phase compared to the baseline. Moreover, by offering immediate, context-sensitive suggestions and guiding questions during key writing stages (i.e., planning, drafting, and revising), the AI system is expected to alleviate cognitive barriers (such as difficulties in topic selection and content development) and promote a more reflective, iterative approach to writing. In addition, the study explores whether the personalized feedback from the AI writing companion can enhance students' writing interest—particularly in dimensions such as curiosity, immersion, and meaningfulness—as indicated by significant improvements in posttest measures, even as certain long-term aspects (like overall interest development) may require further support. To directly address these observations and align with the current data, the research is guided by the following central questions:

1. How does the integration of the AI writing companion influence students' writing participation, specifically in terms of the frequency, number, length, and idea diversity of diary entries?
2. To what extent does the AI writing companion affect various dimensions of writing interest—such as curiosity, immersion, and meaningfulness—when comparing pre- and post-intervention measurements?
3. How does real-time AI feedback impact students' cognitive strategies during the writing process, particularly regarding topic selection, planning, and revision, as evidenced by both quantitative measures and qualitative observations?

By merging the reflective practice of handwriting diaries with the dynamic, interactive support of AI technology, this study seeks to provide empirical insights into innovative strategies for enhancing writing instruction in elementary education—contributing both to a deeper theoretical understanding and to the practical refinement of writing pedagogy.

3. Method

3.1 Participants

The participants in this exploratory study consisted of 32 students (62.50% boys; 37.50% girls; average age 10.5 years, SD = 0.95 years, with ages ranging from approximately 9 to 12 years reflecting their grade levels) from three intact classes (one class each from third, fourth, and fifth grade) in an elementary school located in a suburban district of Taoyuan, northern Taiwan. The school serves a community with a general socio-economic background, representative of typical suburban areas in Taiwan. Within these existing classes, all students were invited to participate in the study on a voluntary basis. Data were collected from those 32 students who provided both student assent and written parental consent. Among the participants, there were 7 fifth-grade students (6 boys and 1 girl), 12 fourth-grade students (5 boys and 7 girls), and 13 third-grade students (9 boys and 4 girls).

The "write-habitually" activity, which formed the context of this investigation, spanned one semester (approximately 22 weeks). Each participating student personally owned an iPad, which they were permitted to use daily for learning purposes both at school and at home. This ensured consistent access and a high degree of familiarity with the device's operation. However, it is noted that before the commencement of this study's observation period, the participants had almost no prior experience using similar AI-powered learning companions or chatbots designed to support writing. All diary entries and interactions with the AI companion were conducted in Mandarin Chinese.

While formal standardized pre-assessments of writing ability were not administered as part of this exploratory study, participants, spanning grades three to five, were considered to exhibit writing development stages generally consistent with their respective grade-level expectations for Taiwanese elementary students. Teachers anecdotally described a typical

range of writing proficiencies within each participating class. This study did not systematically categorize or control for these individual differences in baseline writing ability, as its focus was on exploring the intervention's reception and initial outcomes within a naturalistically diverse student group. Ethical approval for this research was obtained from the Research Ethics Committee for Human Subject Protection (NTHU REC No. 11108ES080). Written informed consent was secured from parents/guardians, and student assent was obtained prior to participation. All participant data were anonymized to ensure confidentiality.

3.2 Research design and procedure

This study employed an exploratory, descriptive research design with pre- and post-intervention measurements. It is important to reiterate that this investigation was not a formal experiment or quasi-experiment. Consequently, the findings are intended to provide initial insights and identify potential trends rather than establish definitive causal relationships. The primary aim was to observe and describe student engagement and experiences when this novel, AI-supported diary writing approach was introduced.

The investigation was conducted over a total period of approximately 16 weeks within one academic semester, structured into two main phases following an initial introductory session on diary writing:

Phase 1: Baseline Data Collection (Weeks 1-4). In this initial 4-week phase, pre-intervention data were collected using the Writing Interest Questionnaire (WIQ) to establish a baseline measure of students' writing interest. Prior to this phase, the classroom teacher conducted a 50-minute introductory session explaining the concept and purpose of keeping a handwritten diary. During these four weeks, students were encouraged by their teachers to freely choose their diary topics and engage in freewriting (Elbow, 1975) based on whatever thoughts came to mind, without any AI support. The teacher's role was to encourage participation and create a supportive environment for diary writing. This phase served to gather baseline writing samples, frequency of writing, and initial interest levels.

Phase 2: AI-Supported Diary Writing Activity (Weeks 5-16). Following the baseline phase, the "write-habitually" diary activity continued for the subsequent 12 weeks, but with the introduction of the AI writing companion. At the beginning of this phase (Week 5), the AI writing companion system was introduced to all participating students during another dedicated 50-minute class session. During this session, the teacher, with support from the research team, demonstrated how to interact with the AI writing companion, showed examples of how it could provide suggestions, and gave students the opportunity to test and use the system under guidance.

Throughout this 12-week phase, students continued their regular handwritten diary practice, still freely choosing their topics. The teacher continued to provide overall encouragement for diary writing and offered general feedback on completed entries as per their usual classroom practice, focusing on content and expression rather than directly on AI usage. The AI companion was positioned as an optional, supplementary support tool. Students were instructed that when they encountered writing difficulties (e.g., topic selection,

idea generation, or structuring thoughts), they could consult the AI writing companion for possible ideas and support. Teachers encouraged students to first attempt to brainstorm independently or discuss with peers, and then to use the AI as an additional resource if they still felt stuck. The AI's role was thus to scaffold the initial stages of composing or overcome specific hurdles, not to replace student effort, teacher guidance on the overall writing process, or evaluation of the final written product. Upon completion of this 12-week phase (at the end of Week 16), the WIQ was administered again as a posttest, and a "write-habitually" questionnaire was used to gather students' perceptions regarding their use of the AI system and the overall activity.

Overall, the "write-habitually" activity, both before and during the AI integration, encouraged students to engage in handwritten diary activities during their free time or on holidays, aiming to integrate this writing practice into their daily lives. This approach was intended to help students develop an initial understanding of various writing topics, connect these topics to their personal experiences, and generate initial writing ideas, thereby fostering their creativity and expressive abilities. It should be clarified that the diary writing activity was primarily designed as an out-of-school task. Students were encouraged to write during their free time at home or on holidays, integrating the practice into their personal routines. While the writing itself occurred outside the classroom, teachers supported the activity by providing encouragement and general feedback on completed entries during regular class time. This approach aimed to foster writing habits in a naturalistic, low-pressure setting. The research team observed student engagement and collected data (diary entries, questionnaire responses, and AI interaction logs where available) throughout both phases to understand the unfolding process and student responses. To understand the unfolding process, the research team employed an unobtrusive observational approach. "Observation of student engagement" was not conducted through direct, real-time surveillance of students' writing behaviors, especially when they wrote outside of school. Instead, it was inferred from the analysis of multiple data sources collected over the semester, including: (1) the handwritten diary entries themselves, which revealed frequency and content; (2) questionnaire responses detailing students' perceptions and habits; and (3) AI interaction logs (where available). This indirect method of observation was designed to minimize any potential influence on students' natural writing behaviors.

3.3 Diary writing activity design

This study integrates a systematic diary writing activity design, the Write-habitually activity, and the GenAI Writing Companion to enhance students' writing motivation, habits, and skills. By encouraging students to consistently handwrite their diary and then digitize their entries for reflection and growth, the Write-habitually activity establishes a regular, structured practice that supports the development of writing routines. Meanwhile, the GenAI Writing Companion acts as an intelligent assistant, offering limited yet focused suggestions, immediate feedback, and interactive guidance to help students overcome writing challenges. Through this combination of regular writing and AI support, the process evolves from a solitary

task into a dynamic, engaging, and collaborative experience, ultimately fostering increased motivation and improved writing quality.

3.3.1 Write-habitually activity

The Write-habitually activity, grounded in the Interest-Driven Creator Theory (IDC) (Chan et al., 2018), seeks to cultivate consistent writing habits by integrating teacher-curated themes with student-selected topics. At the outset of the semester, the instructor provides ten thematically related reading materials anchored in students' daily experiences, thereby establishing a scaffold for exploration. In addition, students are required to identify at least two self-chosen topics that resonate with their personal interests, ensuring that both structured guidance and genuine engagement are achieved. By striking a balance between teacher-prescribed and individually pursued themes, this approach promotes motivation, autonomy, and a sense of ownership over the writing process (Draper, Barksdale-Ladd, & Radencich, 2000).

Following their engagement with both assigned and self-selected readings, students first undertake an objective writing phase, wherein they synthesize the primary ideas using their own words—thereby bolstering comprehension of the core material. Subsequently, they proceed to a subjective writing phase, where they articulate personal reactions, pose questions, and formulate ideas based on their individual backgrounds. This dual-phase strategy not only encourages analytical thinking but also fosters creative insight and personal connection to the text (Bean, 2019; Truax, 2018). Each week, students develop one of these reflections into a short essay which they share on an online platform to invite peer feedback and dialogue. By offering and receiving constructive critiques, students come to view writing as a communal endeavor, reinforcing both the social and cognitive dimensions of literacy development.

In tandem with the weekly essay process, students maintain a reflective journal to document their evolving insights, encountered obstacles, and notable progress in writing. Research has shown that reflective journaling heightens metacognitive awareness and supports self-regulated learning (Kasprabowo, Rahayu, & Widyaningrusm, 2021). Moreover, diary keeping as a regular writing practice has been linked to enhanced writing ability and personal growth (Dincel & Savur, 2019). With consistent teacher guidance, this ongoing reflection also fosters a growth mindset (Dweck, 2006)—the belief that one's abilities can be developed over time through dedication and persistence (Dweck, 2006; Grecco, 2020). By iterating through reading, objective and subjective writing, reflective journaling, and peer feedback, the Write-habitually activity systematically encourages students to internalize writing as a habitual practice. Over time, they develop enhanced writing proficiency, sustained motivation, and a deeper appreciation for written expression, thereby embodying the core principles of IDC by aligning intrinsic student interests with rigorous, meaningful learning experiences (Compton-Lilly, 2014; Bean, 2019).

3.3.2 GenAI writing companion

To provide immediate, structured support and address common writing challenges, this study utilized a GenAI writing companion specifically developed for elementary students' diary writing in Mandarin Chinese.

Technical Aspects and Development

The GenAI writing companion was developed by the research team. Its core natural language understanding and generation capabilities were powered by OpenAI's GPT-3.5 large language model, accessed via its API. To enhance the relevance and specificity of the suggestions provided to students, the system integrated a Retrieval-Augmented Generation (RAG) technique. This RAG component allowed the LLM to draw upon a curated knowledge base of age-appropriate writing prompts, thematic ideas suitable for diary entries, and exemplary phrases relevant to elementary student expression in Mandarin Chinese, thereby grounding the AI's responses in contextually appropriate information.

When a student photographed their handwritten diary entry, an integrated Optical Character Recognition (OCR) engine, specifically Microsoft Azure Cognitive Services for Vision (OCR service), was employed to convert the image to text. The recognized text from Azure OCR was then further processed in conjunction with the LLM to enhance contextual accuracy before being used as input for the AI companion's suggestion generation. This two-step process aimed to improve the AI's understanding of the student's handwritten content. While this approach generally yielded high accuracy, the system also allowed students to manually review and correct the digitized text within the interface if OCR errors occurred, ensuring the AI received the most accurate input possible.

Training and Implementation

As detailed in Section 3.2, a dedicated 50-minute training session was conducted for all participating students at the beginning of Phase 2. This session, facilitated by the classroom teacher and members of the research team, included: (1) an overview of the AI companion's purpose as a supportive tool; (2) a live demonstration of how to upload diary entries and interact with the AI (e.g., requesting ideas, asking for elaboration prompts); (3) examples of effective ways to phrase requests to the AI; and (4) a hands-on practice period where students could try the system with guidance. Teachers also received a brief orientation on the system's functionalities and pedagogical integration, emphasizing its role in fostering student autonomy rather than providing direct answers. Ongoing, informal support was available from teachers throughout the 12-week period.

Mitigating Bias and Ensuring Appropriate Suggestions

Several measures were implemented to guide the AI towards providing constructive and unbiased suggestions: 1) Prompt Design and RAG Curation: The underlying prompts used to query GPT-3.5 were carefully crafted. Furthermore, the knowledge base for the RAG system was curated by the research team to contain educationally sound, neutral, and positive

content, thereby steering the AI's suggestions. 2) Limited and Diverse Suggestions: As described below, the system was programmed to offer a maximum of three distinct suggestions at a time, providing variety while preventing cognitive overload and encouraging student choice. 3) Teacher Guidance: Teachers played a crucial role in mediating the students' interaction with AI. They were encouraged to discuss with students the nature of AI-generated content, emphasizing that AI is a tool whose suggestions should be critically evaluated, adapted, or even rejected if not suitable. 4) Monitoring and Review (Exploratory Phase): Given the exploratory nature of this study, continuous automated bias detection was not a built-in feature of this initial system. However, the research team periodically reviewed a random sample of anonymized AI-student interaction logs to anecdotally assess the appropriateness, relevance, and neutrality of the AI's suggestions and to identify any potential recurring issues or areas for system refinement. Students were also encouraged to report any confusing, unhelpful, or inappropriate suggestions to their teacher.

Real-time Idea Support and Focused Suggestions

The GenAI writing companion is designed to offer immediate assistance when students encounter writer's block or lack clarity in choosing a journal topic. By supplying exactly three carefully selected ideas or suggestions at a time, the system aims to strike a balance between providing creative guidance and preserving student agency. This constrained approach prevents cognitive overload and encourages learners to engage in independent thinking. When students request assistance, the GenAI writing companion analyzes the context of their journal entry—such as the student's previous writing history, interests, or relevant keywords—before generating possible directions to explore. These directions may involve specific themes, angles for discussion, or potential narrative structures. In this way, the system supports students in quickly overcoming initial writing barriers while fostering sustained motivation and confidence.

In Figure 1, on the left side, the calendar highlights the days on which the student engaged in diary writing, with red markings denoting completed entries. This system enables students to monitor and reflect on their writing habits by referencing specific dates. On the right side, a photograph displays the student's handwritten diary, illustrating both the reflective nature of the writing process and the student's collaborative interactions with an GenAI writing companion.

Figure 1: Visualizing Writing Practices: Calendar Tracking and AI-Enhanced Diary Interactions

Continuous Feedback and Personalized Guidance

Beyond the initial brainstorming stage, the GenAI writing companion provides continuous, context-specific support throughout the writing process. This functionality delivers timely, iterative feedback on content development and structural coherence. Once a student submits an inquiry, the companion offers targeted responses on diary entries, thereby facilitating reflective learning and the refinement of writing skills.

After the student photographs their handwritten diary entry, the system employs AI-driven OCR technology to recognize and extract the textual content. As illustrated in Figure 2, the recognized content is displayed on the left side of the interface. Subsequently, the student may interact with the GenAI writing companion to pose further inquiries and receive additional guidance. By leveraging natural language processing techniques, the companion detects potential logical gaps, highlights areas requiring further elaboration, and prompts the student with guiding questions that encourage deeper reflection. Moreover, tailored suggestions are offered based on the student's unique writing profile, thereby accommodating individual learning preferences and varying levels of proficiency.

Figure 2: Display of Recognized Content and Subsequent Interaction with the GenAI Writing Companion

In addition to providing textual advice, the AI companion also delivers encouraging messages (e.g., "That's an interesting start!", "Keep up the great work!") to nurture a growth mindset (Dweck, 2006), effectively transforming writing from a potentially solitary task into a more interactive and engaging learning experience. By seamlessly integrating real-time idea support with student-initiated continuous feedback loops, the GenAI writing companion aims not only to improve the quality of student writing but also to promote the development of enduring writing habits. It is important to note that while the AI facilitated re-examination of text and could indirectly lead to noticing basic errors, its primary focus during this study was on higher order thinking skills like idea generation and content organization, rather than explicit correction of foundational skills (e.g., grammar).

3.4 Data collection and analysis

3.4.1 Writing participation

This study aimed to explore how the integration of an AI writing companion might be associated with changes in elementary students' handwritten diary activities. The exploration focused on four key dimensions of writing participation: the Number of Handwritten Diary Entries, the Frequency of Handwritten Diary Entries (interval between entries), the Diversity of Ideas in Handwritten Diary Entries, and the Length of Handwritten Diary Entries. To identify potential changes over time, the research was structured with a baseline phase (without AI intervention) and an AI-supported intervention phase. By comparing data across these two phases, the study sought to describe and understand how the additional AI support was

related to students' writing behaviors and the characteristics of their diary entries in each of the four dimensions.

Over one semester, the research team gathered 156 handwritten diary entries from participating students in Grades 3, 4, and 5. During the four-week baseline phase (Phase 1), 46 diary entries were collected. This included two entries each from participating third- and fourth-graders, and the initial diary entry from participating fifth-graders for this phase. The subsequent 12-week AI-supported intervention phase (Phase 2) yielded an additional 110 diary entries. To ensure fidelity of the data, all handwritten documents were first digitized using the AI-driven OCR technology (Microsoft Azure Cognitive Services for Vision, as described in Section 3.3.2). This was followed by two rounds of manual verification by separate research assistants who compared the OCR output with the original handwritten content. This meticulous process ensured that the transcribed data closely matched the original handwritten entries, thus maximizing the reliability of subsequent analyses.

To assess students' writing participation, the study examined both the total Number of Handwritten Diary Entries submitted by each student in each phase and the average interval (in days) between their entries (i.e., Frequency of Handwritten Diary Entries). Descriptive statistics, including mean values and standard deviations, were computed for these metrics for each grade level and for the overall sample, comparing Phase 1 and Phase 2. These comparisons aimed to describe any observed shifts in writing engagement patterns.

In addition to these participation metrics, each handwritten diary entry was analyzed for the Diversity of Ideas and its Length. The "Diversity of Ideas" metric aimed to capture the richness of content, reflecting both objective writing (e.g., summaries or key points of an event) and subjective writing (e.g., personal reflections, critiques, emotional responses), thereby providing an indication of students' critical thinking and creativity. Trained raters identified distinct "idea units" within each entry to gauge this diversity and depth. The "Length of Handwritten Diary Entries" was measured by word count (after digitization and verification) to capture the level of detail and effort invested.

Comparative analysis of the Diversity of Ideas and Length of Diary Entries between the baseline and intervention phases was conducted using descriptive statistics (e.g., means, standard deviations). To explore the statistical significance of any observed changes within this single-group, pre-post design, paired-samples t-tests were employed for these continuous variables (Ideas and Length). This test was chosen as it is suitable for comparing the means of two related sets of scores from the same participants at two different time points. Effect sizes (e.g., Cohen's d) were also calculated to provide context for the magnitude of any observed differences.

To ensure consistency in evaluating the "Diversity of Ideas," two independent raters, blind to the study phase, coded a randomly selected subset (e.g., 25%) of the diary entries. Inter-rater reliability was calculated using Cohen's Kappa. ($\kappa = 0.85$) Any disagreements on the remaining entries were then resolved through discussion between the raters, or by a third adjudicating rater, to finalize the coding for all entries. The finalized data for all four dimensions were then used in the subsequent analyses.

3.4.2 Writing interest questionnaire

To investigate students' interest in the "habitual writing" learning activity, this study is grounded in the "Interest-Driven Creator Theory" and the concept of "interest loops" (Hidi, 1990; Hidi & Renninger, 2006). The study also utilizes dimensions of "personal interest" as referenced in prior research and adapts a writing interest questionnaire originally developed by Liao (2019). The questionnaire categorizes questions into four dimensions. Each dimension contains six items, resulting in a total of 24 items, rated on a five-point Likert scale. The questionnaire includes four dimensions: Curiosity (assessing stimulation of curiosity), Immersion (evaluating engagement and "flow" state), Meaningfulness (exploring transformation of writing into a personal interest), and Stages of Interest Development (examining future writing plans and long-term interest). The reliability values for the questionnaire are as follows: Curiosity (0.778), Immersion (0.805), Meaningfulness (0.852), Stages of Interest Development (0.719), and Overall Interest Dimension (0.918). These values indicate that the questionnaire is a reliable tool for assessing students' interest in the habitual writing activity across different dimensions.

3.4.3 Write-habitually questionnaire

To understand students' experiences in the "write-habitually" activity, this study conducted the "Write-habitually questionnaire" with students from various grades. All students participated, and the questionnaire took approximately 15 minutes to complete. The questionnaire covered the following four main aspects: (1) students discussed which aspects of the activity interested them the most and why, revealing their points of interest and motivations. (2) students were asked when they usually engaged in the "write-habitually" activity and why they chose that time, aiming to understand their time management. (3) the interviews explored which parts of the activity were most helpful for their writing learning and why, highlighting the most effective components. (4) students described the challenges or difficulties they encountered during the activity and their causes, identifying primary obstacles.

4. Results

4.1 Writing participation and Diary Characteristics

This section details student participation in diary writing throughout the study and examines characteristics of the diary entries, specifically focusing on the number of entries, writing frequency, diversity of ideas, and length. This exploration aims to address our first research question concerning how the integration of the AI writing companion might influence these aspects of student writing.

4.1.1 Baseline Writing Habits: Number and Frequency of Diary Entries by Grade Level

To understand students' initial writing engagement before the introduction of the AI companion, we first examined the number of diary entries and the writing frequency during the overall semester-long activity period, which included both baseline and intervention phases but for this initial descriptive analysis, reflects overall engagement patterns that can inform baseline understanding. Table 1 presents these data across Grades 3, 4, and 5.

The data in Table 1 reveal distinct patterns in students' writing behavior by grade level over the semester. Third-grade students demonstrated the highest participation, producing an average of approximately six diary entries (M = 6.09, SD = 1.04), with an average interval of about two weeks between entries (M = 14.92 days, SD = 3.40). In contrast, fourth-graders generated slightly fewer entries (M = 5.08, SD = 0.90) at a somewhat longer interval of roughly three weeks (M = 18.53 days, SD = 1.77). Fifth-grade students exhibited the lowest number of entries (M = 4.00, SD = 0.00), with an extended average writing interval of approximately four weeks (M = 28.57 days, SD = 5.59).

Table 1. Number and Frequency of Students' Handwritten Diary Entries (Overall Semester)

	Number of Writings	Writing Frequency (days)
Grade	M (SD)	M (SD)
3rd (n = 13)	6.09 (1.04)	14.92 (3.40)
4th (n = 12)	5.08 (0.90)	18.53 (1.77)
5th (n = 7)	4.00 (0.00)	28.57 (5.59)

These findings indicate a clear trend: as grade level increased, both the total number of diary entries produced and the frequency of writing tended to decline during the observation period. This pattern might suggest that older elementary students face increasing academic pressures or shifting priorities that impact their engagement with non-mandated writing tasks like personal diaries. The complete lack of variance (SD = 0.00) in the number of entries for fifth-graders further points towards a highly uniform writing pattern within this older cohort, possibly reflecting consistent teacher expectations or a shared student perception of the task's requirements at this level. These baseline insights are crucial for contextualizing any subsequent changes observed after the AI intervention and highlight potential grade-specific needs for support.

Student Perspectives on Diary Writing Schedules (Baseline Context): To further understand these baseline writing habits, interviews explored when students typically engaged in diary writing and their rationale. These qualitative insights offer a richer understanding of their time-management and motivational approaches before extensive AI interaction. Participant responses primarily fell into three categories: weekend-focused writing, split-session writing (school and home), and teacher-directed scheduling.

Weekend-Focused Writing: Eight students (50%) preferred to concentrate their diary writing on weekends. This approach, as exemplified by S302 who "completed all entries on Saturdays and Sundays at home," allowed for dedicated blocks of time. S303 similarly reported writing strictly on weekends, often completing all entries in one sitting, suggesting a batching strategy. S309 noted that writing once a week, typically on a holiday, felt sufficient, stating, "I just write when I have a longer free time," illustrating a focus on efficiency and consistency within a chosen timeframe. These accounts suggest that for half the participants, weekends provided the perceived optimal conditions for focused diary writing.

Split-Session Writing: Six students (37.50%) adopted a more flexible, split-session approach. For instance, S310 described working on entries "mostly at home in segments," sometimes prompted by teacher requests but also occasionally keeping a smaller personal journal daily. S505 exemplified a staggered habit: "I often start at school if there's a little time, then finish the rest at home." This pattern, including S507's use of brief intervals like "five minutes after class," highlights how some students integrated diary writing incrementally into diverse daily schedules.

Teacher-Directed Scheduling: Finally, three students (18.75%) indicated that their diary writing was primarily driven by teacher instructions. S303 mentioned writing on weekends "only when the teacher told us to," and S310 similarly produced entries mainly "when prompted by the teacher." This reliance on external cues, as S505 echoed by stating they would write "based on the teacher's guidance," underscores that for a subset of students, teacher requirements were a critical motivator for engaging in diary writing practices.

4.1.2 Changes in Diary Idea Diversity and Length: Pre- and Post-AI Companion Integration

To explore how the AI writing companion might have influenced the content of students' diaries, we compared the average diversity of ideas and the length of entries between the 4-week baseline phase (no AI) and the subsequent 12-week AI-supported intervention phase. During the baseline phase, 46 diary entries were collected (two each from third- and fourth-graders, and one from fifth-graders for this specific phase comparison). During the 12-week intervention phase, an additional 110 entries were collected from the same students. All entries were digitized and manually verified, then assessed for idea diversity (number of distinct "idea units") and length (total word count).

Table 2. Comparison of Average Idea Diversity and Length of Students' Handwritten Diary Entries Between Baseline (No AI) and Intervention (AI-Supported) Phases

	First phase (n = 46)		Second phase (with AI writing companions) (n = 110)	
Grade	Ideas M (SD)	Length M (SD)	Ideas M (SD)	Length M (SD)
3rd	3.50 (0.96)	238.68 (106.71)	4.07 (0.78)	303.29 (91.13)
4th	3.38 (1.06)	378.79 (148.05)	3.89 (0.70)	413.59 (115.48)
5th	4.14 (1.07)	418.57 (114.79)	4.33 (0.66)	491.95 (81.58)
total	3.53 (1.03)	325.89 (146.56)	4.06 (0.74)	381.38 (123.20)

The data presented in Table 2 suggest a positive trend across all three grades, with students' diary entries in the AI-supported phase generally exhibiting both a higher average number of ideas and longer word counts compared to the baseline phase. For example, third-grade students' average idea score increased from 3.50 (SD = 0.96) to 4.07 (SD = 0.78), and their average entry length grew from 238.68 words (SD = 106.71) to 303.29 words (SD = 91.13). Similar positive shifts were observed for fourth and fifth graders.

This pattern suggests that the integration of the AI Writing Companion may be associated with students producing richer and more detailed diary content. This finding partially addresses our first research question by indicating a potential positive influence of AI on the qualitative aspects (idea diversity) and quantitative output (length) of student writing. It is important to acknowledge, however, that these observed changes occurred in the context of an ongoing writing activity, and factors such as increased familiarity with diary writing over time or the novelty of the AI tool could also have contributed to these improvements. Future research with a control group would be necessary to more definitively isolate the AI companion's specific impact. For instance, one student (S405, Grade 4) from the post-intervention questionnaire noted, "Sometimes I didn't know what to write, but the AI gave me some cool ideas, so I could write more," which qualitatively supports the observed increase in length and idea diversity.

4.2 Writing interest

This section examines changes in students' writing interest across four dimensions—Curiosity, Immersion, Meaningfulness, and Interest Development—before and after their engagement in the "write-habitually" diary activity, which included the AI writing companion in its latter phase. These analyses aim to address our second research question regarding the extent to which the AI-supported diary writing activity affected these various dimensions of writing interest.

4.2.1 Descriptive Overview of Writing Interest by Grade Level (Pre- and Post-Activity)

Table 3 provides a descriptive overview of the mean (M) and standard deviation (SD) values for each of the four interest dimensions, comparing pretest and posttest measurements for students in Grades 3, 4, and 5.

Table 3. Pretest and Posttest Means (SD) for Four Dimensions of Interest (Curiosity, Immersion, Meaningfulness, and Interest Development) Across Grades 3, 4, and 5

Grade	Curiosity		Immersion		Meaningfulness		Interest Development	
	Pretest M (SD)	Posttest M (SD)	Pretest M (SD)	Posttest M (SD)	Pretest M (SD)	Posttest M (SD)	Pretest M (SD)	Posttest M (SD)
3rd	2.77 (0.64)	3.28 (0.84)	2.69 (0.51)	3.44 (1.00)	2.78 (0.62)	3.24 (0.91)	2.64 (0.62)	2.87 (0.83)
4th	3.01 (0.77)	3.25 (0.78)	3.35 (1.04)	3.55 (1.13)	3.28 (0.84)	3.34 (1.14)	3.47 (0.72)	3.15 (0.87)
5th	3.31 (1.12)	3.28 (1.08)	3.23 (0.60)	2.94 (1.01)	3.21 (1.05)	3.73 (0.60)	3.37 (0.35)	2.91 (0.94)

A visual inspection of Table 3 suggests varying patterns of change across grade levels and interest dimensions. For instance, third-grade students appeared to show increases across all four dimensions, particularly in Immersion (from M=2.69 to M=3.44). Fourth-graders showed modest increases in Curiosity, Immersion, and Meaningfulness, but a slight decrease in Interest Development. Fifth-graders, interestingly, showed an increase in Meaningfulness (from M=3.21 to M=3.73) but decreases in Immersion and Interest Development, with Curiosity remaining relatively stable. These descriptive grade-level variations highlight the complexity of interest development and suggest that the "write-habitually" activity, including the AI integration, might have been experienced or responded to differently by students at different developmental stages. However, due to the small sample sizes within each grade, these grade-specific trends should be interpreted with caution and primarily serve as exploratory observations.

4.2.2 Overall Changes in Writing Interest Dimensions (Pre- vs. Post-Activity)

To assess the overall changes in writing interest for the entire participant group (N=32) following the "write-habitually" activity (which incorporated the AI companion), paired-samples t-tests were conducted. Table 4 presents these results, including mean scores, standard deviations, t-values.

Table 4. Paired t-Test Results for the Impact of "Habitual Writing" on Four Dimensions of Interest

Interest Dimension	Pretest M(SD)	Posttest M(SD)	t
Curiosity	2.98 (0.81)	3.26 (0.85)	-2.463**
Immersion	3.06 (0.81)	3.38 (1.05)	-2.092**
Meaningfulness	3.06 (0.82)	3.39 (0.94)	-2.455**
Interest Development	3.11 (0.72)	2.99 (0.85)	0.835

*p***< .001*

As shown in Table 4, the "write-habitually" activity, incorporating the AI writing companion, was associated with statistically significant increases in students' **Curiosity**, **Immersion**, and **Meaningfulness**. Specifically, curiosity rose from a pretest mean of 2.98 to a posttest mean of 3.26 (p = .020), suggesting that engaging in AI-supported diary writing stimulated students' inquisitiveness. Immersion also improved significantly (from M=3.06 to M=3.38, p = .045), indicating that students became more absorbed in their writing tasks over time. The sense of meaningfulness exhibited a similar positive pattern (from M=3.06 to M=3.39, p = .020), pointing to an enhanced perception of relevance or personal value in the writing activity.

In contrast, **Interest Development** (reflecting longer-term writing plans and interest) did not show a statistically significant difference between the pretest (M = 3.11) and posttest (M = 2.99), t(31) = 0.835, p = .409. This finding, which directly addresses a component of our second research question, implies that while the AI-supported diary activity effectively bolstered immediate engagement factors like curiosity and immersion, it might not, within the timeframe of this study, have been sufficient on its own to foster deeper, longer-term interest growth or commitment to writing.

Overall, these results suggest that the AI-supported "write-habitually" activity can be an effective tool for enhancing aspects of situational writing interest (curiosity, immersion, meaningfulness). However, fostering more enduring interest development may require additional strategies, longer intervention periods, or different types of support. It is also plausible that the novelty of the AI tool contributed to the initial increases in engagement, an aspect that would require further investigation with control conditions.

4.2.3 Student Perspectives on Writing Engagement and Motivation

Interview data provided richer insights into what aspects of the AI-supported diary writing activity most engaged students and fueled their motivation, helping to contextualize the quantitative findings on writing interest.

The Role of the AI Writing Companion: A significant majority of interviewed participants (13 out of 16, or 81.25%) emphasized that discussing and collaborating with the GenAI writing companion was a critical and engaging component of their diary writing. For instance, S302

explained, "Sometimes I didn't know what to write about, but talking to the AI helped me decide on a topic. It was like having a helper." This sentiment underscores the AI's role in overcoming initial writing inertia. Similarly, S311 described a boost in confidence and efficiency: "I liked that I could talk to the AI first on my iPad to get some ideas, then write them down. It made me feel like I could do it better and faster." These student voices directly illustrate how interaction with the AI companion could provide the inspiration and scaffolding that fostered increased curiosity and immersion, as reflected in the quantitative data.

Autonomy in Topic Selection: The freedom to choose their own diary topics was a significant motivator for nine students (56.25%). S404 expressed, "I liked that I could pick my own theme, so I could write about what I really wanted to write about," suggesting that self-directed topics enhance creative energy and perceived meaningfulness. S505 echoed this, stating, "I could do what I want in my diary, not what someone else told me to write." This autonomy in topic choice, facilitated by the diary format and sometimes supported by AI suggestions for *their* chosen themes, likely contributed to the increased sense of meaningfulness. S413 further remarked, "Writing about my life makes me happy," connecting personal experience with positive affect and deeper interest, aligning with the observed increase in the Meaningfulness dimension.

The Value of Handwriting and Reflection: Five students (31.25%) specifically commented on how the act of handwriting their compositions positively influenced their memory and emotional expression, contributing to a sense of immersion and value. S401, while acknowledging occasional frustration with the physical act of writing, noted, "Writing it by hand helps me remember things better and think more about what I'm saying." S407 described handwriting a diary as "a good habit" that builds perseverance. These reflections highlight how the tangible, manual aspect of diary writing, even within an AI-supported environment, remained a valued component for some students, potentially contributing to their sense of immersion and the personal relevance of the activity.

4.3 Observation of students' writing behavior and AI Interaction

This section presents qualitative observations of students' writing behaviors during the diary writing activity, focusing on how they approached writing in Chinese, the challenges they encountered, and how interactions with the GenAI writing companion appeared to influence their process. These observations provide contextual understanding for our third research question, which explores how real-time AI feedback impacts students' cognitive strategies during writing, particularly regarding topic selection, planning, and revision.

Observed Benefits of Diary Writing in Chinese: Direct observations and informal interactions revealed several perceived benefits of regular diary writing for the participating students' Chinese literacy development. **Enhanced Expressive Fluency:** Approximately half of the learners (eight out of 16 systematically observed for these behaviors) demonstrated or articulated an enhanced capacity to articulate ideas through consistent diary keeping. For example, Student 303 remarked during an informal check-in, "I'm more aware of how to convey what I mean now," suggesting that frequent diary-keeping fostered more deliberate

use of Chinese characters and a clearer sense of narrative coherence. Likewise, Student 310's diary entries showed an improved ability to record personal experiences more cohesively over time, capturing everyday details with greater clarity in written Chinese. Student 401 noted that diary entries served as "a good way to share my day," implying that this reflective practice strengthened both descriptive and emotional expression. **Vocabulary Development:** Another eight students were observed actively engaging in vocabulary expansion through their diary writing. They reported that the act of trying to express specific thoughts or experiences often led them to consult dictionaries or verify character forms. For instance, Students 404 and 412 mentioned gains not only in overall character knowledge but also in the accuracy of their written expressions as a result of these efforts. In such instances, when students chose to use the GenAI writing companion for vocabulary support (e.g., "How do I write [concept]?"), it often provided real-time prompts for correct or alternative characters, thereby potentially easing the burden of manual dictionary lookups and facilitating smoother writing flow. As S404 put it, "Sometimes the AI knows the word I want faster than the dictionary."

Persistent Writing Challenges: Despite these positive observations, students also continued to face common writing challenges, particularly in the initial stages of composing. **Topic Selection and Idea Generation:** Approximately nine students were observed struggling with topic selection, often spending extended intervals deliberating before settling on an idea. Students 302 and 303, for example, frequently expressed uncertainty about what to write. This observation underscores the cognitive load involved in idea generation for young writers. Similarly, Students 309 and 401 described instances of fragmented brainstorming, highlighting their difficulty in converting preliminary thoughts into coherent diary entries. **Lexical Difficulties:** Four participants were noted to encounter recurring issues with unfamiliar Chinese characters or expressions. They sometimes resorted to using placeholders (e.g., drawing a picture or leaving a blank), writing partial pinyin transcriptions, or making frequent dictionary checks. While Student 404 acknowledged that "looking up words in the dictionary is slow, but it helps me learn them," Student 507 found this process "a bit annoying sometimes," suggesting a desire for more immediately accessible lexical support.

Role of the GenAI Writing Companion in Addressing Challenges: Observations indicated that interactions with the GenAI writing companion often played a role in mitigating some of these frustrations, particularly those linked to slow topic selection or vocabulary gaps. **Mitigating Writer's Block and Supporting Vocabulary Needs:** Students who chose to utilize the GenAI tool when facing these challenges tended to exhibit heightened self-assurance. Receiving immediate suggestions for thematic directions (e.g., "What was the most interesting thing that happened today?") or specific characters appeared to reduce periods of unproductive searching. For example, after S302 expressed difficulty finding a topic, they interacted with the AI and then began writing, later stating, "The AI gave me three ideas, and I picked one." Similarly, when S507 was unsure how to write a specific character, the AI provided the correct form, allowing them to continue writing without a lengthy dictionary search. **Fostering Momentum and Confidence:** This timely assistance seemed to promote a sense of success and helped maintain students' momentum in completing their diary

entries. While it is difficult to disentangle the AI's direct effect from the overall focus on writing or potential novelty effects without a control group, these observations suggest that the AI companion, when used, served as a valuable scaffold for many students, particularly in the planning and drafting stages.

Ultimately, these qualitative observations underscore that diary writing in Chinese can be a potent catalyst for literacy growth among young learners. However, its effectiveness is often mediated by students' ability to navigate initial hurdles in idea generation and lexical access. The GenAI writing companion, in this exploratory context, appeared to offer a promising means of support by providing timely, targeted assistance for these specific challenges. This, in turn, seemed to foster more engaged and confident writing practices, illuminating the potential of an essential interplay among student agency, accessible support tools (like AI), and the reflective nature of diary writing. These observations provide rich, contextual insights relevant to our third research question, suggesting that AI feedback can indeed impact students' cognitive strategies by offering alternative pathways for topic selection and vocabulary retrieval, thereby influencing their planning and drafting processes.

5. Discussion

This exploratory study investigated the integration of a generative AI writing companion with traditional handwritten diary practices among elementary students. The findings offer initial insights into how this blended approach may influence students' writing participation, interest, and writing behaviors. This discussion will interpret these findings in relation to relevant theoretical frameworks, explore nuanced observations, and consider the practical implications for writing education.

5.1 Student Writing Participation: Navigating Engagement and AI Scaffolding

The data on student participation (Section 4.1) painted a nuanced picture, revealing both developmental trends in diary engagement and the potential role of AI as a supportive scaffold. The observed decline in the number and frequency of diary entries with increasing grade level (from Grade 3 to Grade 5) aligns with existing literature suggesting that older elementary students often face heightened academic demands and shifting priorities, which can impact their engagement with discretionary writing tasks (Nolen, 2007). This underscores the need for tailored support; as Dincel and Savur (2019) suggest, while younger students might benefit from structured prompts to maintain routine, older students may require more sophisticated motivational strategies, such as increased autonomy or collaborative opportunities, to sustain interest. Our finding that nearly half the students preferred weekend-focused writing, while others adopted flexible, incremental approaches, further emphasizes the importance of offering diverse pathways for task completion, accommodating varying student preferences for autonomy and structure (Rasouli & Shoari, 2015).

A key finding related to our first research question was the noteworthy increase in both the length and idea diversity of students' diary entries during the AI-supported phase. This observation can be interpreted through the lens of scaffolding theory (Wood, Bruner, & Ross,

1976; Vygotsky, 1978). The AI writing companion, by offering real-time suggestions for topics or content elaboration (as described in Section 3.3.2 and observed in Section 4.3), likely functioned as an effective scaffold. It appeared to reduce the cognitive load associated with idea generation and organization, enabling students to produce more elaborate and thematically richer texts. As one student (S405) noted, "Sometimes I didn't know what to write, but the AI gave me some cool ideas, so I could write more," directly illustrating this scaffolding effect. This aligns with research showing that appropriate support can help learners operate within their Zone of Proximal Development, achieving more than they could independently (Vygotsky, 1978). The AI, similar to effective teacher feedback (Truax, 2018), seemed to transform the diary-writing process into a more dynamic and interactive experience, potentially leading to deeper engagement with the task, as reflected in the increased output. However, it is crucial to acknowledge, as discussed further in limitations, that the novelty of the AI or the general emphasis on the writing activity itself could also have contributed to this increased output.

Therefore, while the AI companion shows promise in enhancing participation through scaffolding, thoughtful activity design remains paramount. Educators should consider how to combine structured guidance (e.g., thematic prompts, clear expectations) with flexible completion options and intelligent AI support to foster consistent writing habits and richer written expression, particularly for older elementary students who may exhibit declining intrinsic motivation for such tasks.

5.2 Writing Interest: Situational Sparks and the Quest for Enduring Engagement

The introduction of the GenAI writing companion appeared to positively influence several dimensions of students' situational writing interest, aligning with our second research question. The statistically significant increases in Curiosity, Immersion, and Meaningfulness (Section 4.2.2) resonate with research suggesting that interactive and supportive learning tools can enhance motivation and engagement (Chou et al., 2025; Baylor & Kim, 2005). Students' qualitative feedback (Section 4.2.3) provided rich insights into these changes. For instance, S302's comment about the AI helping decide on content ("talking to the AI helped me decide on a topic") directly links to increased Curiosity and reduced uncertainty. S311's feeling of being "able to do it better and faster" with AI support likely contributed to enhanced Immersion and task value.

The strong appeal of autonomy in topic selection, reported by over half the interviewed students, further explains the rise in Meaningfulness. When students like S404 could "write about what I really wanted to write about," the task became more personally relevant. This finding strongly supports principles from Self-Determination Theory (Deci & Ryan, 2000), which posits that autonomy is a fundamental psychological need crucial for intrinsic motivation and well-being. The AI companion, in this context, did not dictate topics but rather offered support *within* student-chosen themes, creating a synergistic effect where learner agency was preserved and even enhanced by targeted AI scaffolding (Dinçer & Doğanay, 2017).

However, a particularly nuanced finding was the lack of significant improvement in the 'Interest Development' dimension, which assesses longer-term writing commitment. This suggests that while the AI-supported diary activity effectively triggered and maintained *situational interest* (Hidi & Renninger, 2006), fostering the development of more enduring *individual interest* may require a more multifaceted and prolonged approach. The 12-week AI-supported phase, though substantial, might have been insufficient for such deeper attitudinal shifts. As Hidi and Renninger's (2006) four-phase model of interest development suggests, students may have primarily experienced the "triggered" and "maintained" situational interest phases. Progressing to "emerging" and "well-developed" individual interest often necessitates not only continued engagement but also the internalisation of value and the development of self-generated goals over a much longer period, potentially supported by varied tasks, deeper reflection, and opportunities for competence demonstration (Hietala & Niemirepo, 1998). The novelty of the AI tool itself might also have inflated initial engagement (curiosity, immersion) without necessarily translating into a deeper, long-term commitment to writing as a personally valued activity.

The enduring appreciation for handwriting expressed by some students, despite its occasional frustrations, also warrants discussion. Their perception that "writing it by hand helps me remember things better" (S401) aligns with theories of embodied cognition (Van der Weel & Van der Meer, 2024) and research on the cognitive benefits of handwriting for memory and conceptual understanding (Mangen et al., 2015). This suggests that even in an AI-enhanced environment, the physical act of writing can contribute to a sense of Meaningfulness and Immersion for some learners, reinforcing the value of a balanced approach that incorporates both traditional and digital modalities.

In sum, while the GenAI companion significantly boosted aspects of immediate writing engagement, cultivating lasting writing interest is a more complex endeavor. Educators should consider leveraging AI to spark initial curiosity and provide meaningful support, but this should be coupled with strategies that foster personal value, competence, and autonomy over extended periods, potentially through diverse writing projects, opportunities for sharing, and structured reflection on the writing process and its personal significance.

5.3 Writing Behaviors: Fluency, Vocabulary, and Navigating Challenges with AI Support

Observations of students' writing behaviors (Section 4.3) indicated that AI-supported diary writing in Chinese could serve as a valuable tool for enhancing expressive fluency and vocabulary acquisition, while also highlighting persistent challenges that AI might help mitigate. This aligns with our third research question exploring AI's impact on students' cognitive strategies.

The reported increase in students' ability to articulate ideas and capture everyday experiences cohesively ("I'm more aware of how to convey what I mean," S303) suggests that the regular, reflective practice of diary writing, supported by the AI when needed, contributed to improved narrative coherence and descriptive expression. This echoes research linking

consistent writing practice with enhanced writing quality and fluency (Graham et al., 2000). The AI's role here might be indirect, by reducing the cognitive load of other aspects (like idea generation), it may free up resources for students to focus on clarity and expression.

Students' engagement in broadening their Chinese vocabulary, sometimes facilitated by the AI ("Sometimes the AI knows the word I want faster than the dictionary," S404), is also noteworthy. While consulting traditional dictionaries reinforces learning, the AI companion offered a more immediate lexical scaffold. This instant support can be particularly beneficial in maintaining writing momentum, preventing the frustration that can arise from laborious dictionary searches, especially for complex character-based languages. This aligns with Cognitive Load Theory (Sweller, 1988), suggesting that by reducing extraneous load (like difficult dictionary lookups), the AI allows students to allocate more cognitive resources to the primary task of writing and vocabulary integration. The tactile experience of handwriting coupled with occasional AI support for vocabulary appears to reinforce lexical access and retention, consistent with findings on embodied cognition and multimodal learning (Mangen et al., 2015; Van der Weel & Van der Meer, 2024).

Despite these benefits, challenges in topic selection and managing unfamiliar characters persisted for some students. The observation that students spent considerable time brainstorming or resorted to placeholders underscores the cognitive demands of these tasks (Graham, Harris, & Fink, 2000). It is in these specific instances that the GenAI writing companion frequently proved advantageous. Students' reports of receiving immediate suggestions for themes ("The AI gave me three ideas, and I picked one," S302) or characters demonstrate the AI's potential as a just-in-time cognitive tool. This aligns with the principles of situated learning (Lave & Wenger, 1991), where support is most effective when provided authentically within the context of the task. By offering on-the-spot advice, the AI appeared to reduce unproductive search time and foster a sense of self-efficacy and accomplishment (Richardson & Lacroix, 2024).

In essence, the AI writing companion, within this exploratory study, demonstrated potential as a dynamic scaffolding tool that could help students navigate common cognitive hurdles in the writing process. While the diary writing activity itself fostered literacy development, the AI's contribution lay in making that process smoother and less frustrating at critical junctures. However, the effectiveness of such an AI hinges on its ability to provide genuinely helpful, non-intrusive support and on pedagogical strategies that encourage students to use it as a tool for thought, rather than a crutch. Ensuring students still engage in active problem-solving (e.g., trying to recall a character before asking the AI) remains crucial.

6. Conclusions and Implications

This exploratory study investigated the integration of a generative AI writing companion with traditional handwritten diary practices among elementary students in Taiwan. The findings provide initial, encouraging evidence that such a blended approach can be associated with positive shifts in students' writing habits, engagement, and situational writing interest. Specifically, the incorporation of the AI companion was linked to an increase in the length and

idea diversity of diary entries. Quantitative analyses indicated statistically significant improvements in curiosity, immersion, and meaningfulness related to writing, while qualitative data from student interviews highlighted the AI's role in alleviating common writing challenges like idea generation and topic selection through real-time, adaptive support.

These results suggest that strategically merging the reflective, embodied practice of handwriting with the dynamic, interactive support of AI can transform diary writing from a potentially isolated task into a more engaging, iterative, and scaffolded learning experience. The AI appeared to function as a cognitive tool, helping students navigate initial writing hurdles and fostering a sense of confidence and momentum. However, the study also underscored that while AI can spark situational interest, the development of enduring, individual writing interest is a more complex process likely requiring longer-term, multifaceted pedagogical strategies beyond the scope of the current intervention.

Overall, this study contributes to the nascent body of research on the pedagogical applications of generative AI in elementary writing education. It offers a preliminary model for how traditional literacy practices can be thoughtfully augmented by emerging digital technologies. While the exploratory nature of this research means that causal claims cannot be definitively established, the observed trends and student experiences provide a valuable foundation for future, more rigorous investigations and highlight the potential of AI to enrich writing instruction when implemented with clear pedagogical goals and an understanding of its role as a supportive, rather than substitutive, tool.

6.1 Implications for practice

The findings of this exploratory study, while preliminary, offer several practical considerations for educators and curriculum designers interested in leveraging generative AI to support elementary students' writing. Primarily, AI writing companions should be positioned as scaffolding tools to help students overcome specific hurdles like writer's block or initial idea generation, rather than as replacements for direct instruction or student effort; the overarching goal must remain the enhancement of student agency and critical thinking. Consequently, it is crucial to explicitly teach students how to engage with AI critically—understanding its suggestions as starting points, evaluating their relevance, and learning to adapt or reject them as needed. Classroom discussions about AI's capabilities, limitations, and potential biases are essential for fostering responsible use. Furthermore, a balanced approach is recommended, where AI support complements, rather than supplants, opportunities for independent brainstorming, peer collaboration, and the continued practice of traditional skills like handwriting, which holds cognitive benefits. To facilitate effective integration, teacher training and professional development are vital, focusing on AI literacy and pedagogical strategies for using AI to support differentiated writing instruction. Educators can also explore using AI tools not just for drafting, but also to support metacognitive reflection, for instance, by prompting students to discuss why certain AI suggestions were useful or not. Finally, introducing AI in low-stakes, expressive writing contexts, such as the

diary writing explored in this study, can provide a safe and engaging environment for students to experiment with and learn to navigate AI writing support.

6.2 Research Limitations and Future Directions

The findings of this exploratory study, while encouraging in highlighting potential benefits, should be interpreted considering several limitations, which in turn suggest avenues for future, more rigorous research. Firstly, as an exploratory study conducted in a naturalistic classroom setting, this investigation did not include a control group. Consequently, we cannot definitively attribute the observed changes in writing participation or interest solely to the integration of the AI writing companion. Alternative explanations, such as the intensified focus on diary writing itself, maturational effects over the semester, the novelty of using a new AI tool, or variations in teacher guidance and student interaction not systematically controlled for, may have contributed to the outcomes. While this design allowed for rich, contextualized observations, it limits our ability to make strong causal inferences. Secondly, the participant sample was relatively small (N=32) and drawn from three classes within a single elementary school in Taoyuan, Taiwan. This localized context and specific demographic may limit the generalizability of the findings to broader student populations with different cultural and educational backgrounds. Thirdly, the 12-week duration of the AI-supported phase may not have been sufficient to capture the full long-term effects on sustained writing interest and habit formation, particularly concerning the deeper phases of individual interest development. Additionally, the AI companion's design to offer three suggestions at a time, while aiming to balance guidance with independence, requires further investigation to determine its optimal impact on creative exploration and student autonomy. Finally, pre-existing individual differences in writing proficiency, student familiarity with digital tools, and the specific dynamics of teacher-student interactions were not systematically controlled, potentially influencing how students engaged with the intervention.

Building on the insights from this exploratory work, future research should aim to address these limitations and further explore the potential of AI in writing education. To establish clearer causal links, future studies could incorporate experimental or quasi-experimental designs with control groups. Expanding research to include larger and more diverse samples from multiple educational contexts is also crucial. Longitudinal studies are needed to assess the long-term impact on writing habits and sustained interest. Further research could also optimize AI functionalities by exploring different types and numbers of AI-generated suggestions, explicitly integrating and evaluating AI feedback on foundational writing skills (e.g., Chinese character accuracy, grammar, punctuation), developing differentiated AI support, and examining hybrid models combining AI with peer and teacher feedback. Investigating how such AI-supported interventions affect various demographic groups or students writing in different languages, alongside a deeper exploration of the teacher's role and pedagogical strategies in integrating these tools, would also be highly valuable. Addressing these areas will not only refine models of AI-supported diary writing but also contribute to a broader understanding of how technology can be leveraged to foster effective,

inclusive, and enduring writing practices in elementary education. This study provides a preliminary foundation, suggesting that while AI integration shows promise, continued thoughtful design, rigorous empirical validation, and a focus on pedagogical alignment are essential for realizing its full potential.

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