Transforming AI Chatbots for a Brainstorming Teaching Technique of Process Writing

Chalermsup KARANJAKWUT [1], Kamonwan CHARUNSRI [2]

[1] chalermsup.ka@bsru.ac.th, orcid.org/0000-0003-3638-2533, Bansomdejchaopraya Rajabhat University, Thailand

[2] kamonwan.ch@bsru.ac.th, orcid.org/0009-0003-0913-4961, Bansomdejchaopraya Rajabhat University, Thailand

To Cite: Karanjakwut, C. & Charunsri, K. (2025). Transforming ai chatbots for a brainstorming teaching technique of process writing. *Malaysian Online Journal of Educational Technology, 13*(1), 1-18. http://dx.doi.org/10.52380/mojet.2025.13.1.559

ABSTRACT

This study investigated the impact of AI-driven brainstorming tools on process writing instruction and students' writing outcomes in the context of third-year Thai university students. A mixed-methods approach was employed to examine the effectiveness of AI-driven brainstorming tools, foreign English lecturers' preferences and comments towards AI-generated brainstorming results, students' preferences for specific AI chatbots, and the perceived challenges and facilitative factors experienced by students. The findings revealed that the intervention group using AI tools significantly outperformed the conventional group on two out of three assignments (People: $p = .002$; Things: $p < .001$), with ChatGPT emerging as the most popular AI chatbot (78.8%). Foreign English lecturers acknowledged the AI chatbots' strengths but preferred students' brainstorming results. Overreliance on AI for idea generation was identified as the most concerning challenge ($M = 4.62$), while enhanced creativity ($M = 4.53$) and increased idea generation ($M = 4.51$) were the most appreciated facilitative factors. The study demonstrates the potential of AI-driven brainstorming tools to revolutionize process writing instruction and highlights the importance of striking a balance between leveraging AI benefits and fostering students' independent thinking and creativity skills.

Keywords: AI chatbots, AI-driven brainstorming tools, process writing, ChatGPT, Gemini, Microsoft Bing

Article History:
Received: 2 June 2024
Received in revised form: 6 Nov. 2024
Accepted: 14 December 2024
Article type: Research Article

INTRODUCTION

Brainstorming is a crucial technique in the writing process, enabling students to generate, organize, and structure ideas for their writing assignments (Pratiwi & Julianti, 2022). Brainstorming activities guide students in overcoming writing obstacles and foster their critical thinking abilities (Karim et al, 2016; Khalilii, 2015). The implementation of brainstorming techniques has demonstrated significant improvements in students' narrative essay writing (Ramadhanti & Mana, 2018). Moreover, training in brainstorming strategies has been shown to have a positive impact on learners' writing performance (Rao, 2007).

Traditional brainstorming, a widely used technique in process writing, typically involves group discussions or individual exercises like freewriting, mind mapping, and listing ideas to generate diverse thoughts and solutions (Campbell & Ballenger, 2009; Rao, 2007). Despite its effectiveness, traditional brainstorming techniques face several challenges. One common issue in traditional brainstorming is that it often lacks idea diversity, as participants tend to focus on familiar or commonly repeated ideas. This tendency

to 'exploit' known concepts can limit creativity and lead to less innovative or suboptimal solutions (Oliva & Elaziz, 2020). Another challenge lies in the limited exploration of the search space, resulting in reduced idea diversity and an inability to escape suboptimal solutions (Phan et al, 2022). Additionally, traditional brainstorming techniques can be time-consuming and computationally demanding (Kochery, 1996). Furthermore, current Augmented Reality (AR) input methods used in brainstorming are not as efficient as non-digital tools, potentially hindering rapid idea generation (Kochery, 1996). Moreover, Osborn's traditional group brainstorming approach has been found to be ineffective in generating creative ideas, prompting the proposal of alternative methods like IGP (Individual Orientation-Group Interactions-Personal Reflection) to overcome this limitation (Rashid, 2022).

AI chatbots have emerged as powerful tools for brainstorming and idea generation, offering a personalized and engaging platform for students to explore their thoughts and develop their writing ideas. ChatGPT, Gemini, and Microsoft Bing Chat are AI chatbots that have been compared in various studies. ChatGPT has been found to outperform the other chatbots in terms of accuracy and relevance (Santos, 2023; Dao, 2023). Gemini, on the other hand, has the fastest response time (Bhardwaz & Kumar, 2023). Microsoft Bing demonstrates the highest user satisfaction and engagement (Bhardwaz & Kumar, 2023; Dao, 2023). In terms of performance on the VNHSGE English dataset, Bing Chat has been found to be better than ChatGPT and Bard (Dao, 2023).

AI-driven brainstorming tools offer a promising solution to these challenges, providing a platform for collective idea generation and innovation. These tools leverage artificial intelligence capabilities such as natural language processing, machine learning, and reasoning to automatically moderate brainstorming sessions (Strohmann et al, 2017). Additionally, AI-based systems can identify and interpret the activity status of multiple individuals during brainstorming meetings (Fujita et al, 2022). The integration of AI algorithms in brainstorming addresses the limitations of traditional techniques by enhancing idea diversity and encouraging exploration beyond familiar concepts. In fields like radiology and software development, AI has shown potential in optimizing data-driven processes and expanding solution possibilities by analyzing large, diverse datasets and identifying innovative approaches (Golding & Nicola, 2019; Bird et al., 2022). Similarly, in brainstorming, AI can mitigate the common problem of limited idea diversity by generating a wider range of creative prompts and insights, thus reducing the tendency to rely solely on well-known concepts. This can help overcome the "exploitation" issue and lead to more varied and innovative solutions in student writing. (Golding & Nicola, 2019; Bird et al, 2022).

Process writing instruction plays a vital role in developing students' writing skills by guiding them through structured stages, from brainstorming to drafting, revising, and editing. This approach enables students to engage deeply with each step of the writing process, enhancing their ability to organize ideas and express thoughts effectively. Despite its benefits, traditional brainstorming techniques within process writing often face challenges, such as limited idea diversity and creativity constraints. AI-driven brainstorming tools offer a promising alternative, providing a structured, personalized, and feedback-rich environment for idea generation. Conducting research on Transforming AI Chatbots for a Brainstorming Teaching Technique of Process Writing with third-year Thai university students presents an opportunity to evaluate the impact of this innovative approach on students' writing outcomes and to identify best practices for its implementation in the Thai educational context.

Research Questions

1.Does the implementation of AI-driven brainstorming tools in process writing instruction lead to significant improvements in students' writing outcomes compared to those who employ traditional brainstorming techniques?

2.What are the perceived preferences and comments by the foreign English lecturers towards the brainstorming results by AI chatbots compared with students?

3.What AI chatbots do the students use as the brainstorming tools in process writing?

4.What are the perceived challenges and facilitative factors experienced by third-year Thai university students when using AI chatbots as the brainstorming tools for process writing?

LITERATURE REVIEW

Use of AI in Thai Educational Context

Artificial intelligence (AI) has emerged as a transformative force in the Thai educational landscape, offering advantages such as personalized learning, real-world scenario testing, and a deeper understanding of AI concepts (Aung et al., 2022; Monserrat et al., 2022; Pongsermpol, 2009). AI technology is increasingly integrated into various educational settings across Thailand, with applications ranging from intelligent tutoring systems to adaptive learning platforms and AI-driven assessment tools, which are being adopted in schools and universities to support both teachers and students. However, the use of AI-assisted writing in teaching and practicing business communication has been met with mixed reactions, with some studies highlighting its ability to enhance efficiency and idea generation (Cardon et al., 2023), while others raise concerns about its potential to diminish critical thinking skills and authenticity (Utami et al., 2023; Burkhard, 2022; Xia et al., 2021; Nazari et al., 2021). Despite the potential benefits of AI in enhancing writing skills, Thai teachers face unique challenges in its implementation, such as the need for significant changes in instructional approaches (Ka-kan-dee & Kaur, 2015) and difficulties in assessing students' writing progression (Cardon et al., 2023), although AI also offers potential benefits for teaching writing, such as improved efficiency and idea generation (Aung et al., 2022) and the introduction of AI concepts to students through practical applications (Perrodin, 2021).

Process Writing and Traditional and AI-Driven Brainstorming Techniques

The cycle of process writing typically begins with brainstorming ideas. This initial step involves generating a wide range of ideas, without regard for their organization or structure. This process can be facilitated through various techniques, such as freewriting, mind mapping, and collaborative discussion (Campbell & Ballenger, 2009; Elbow, 1986). Once a sufficient number of ideas have been generated, the next stage involves organizing and structuring them into a coherent outline. This process helps to establish the overall framework of the writing piece and ensures that the ideas flow logically and cohesively (Flower & Hayes, 1980; Murray, 1977). After developing an outline, the writer then transitions to drafting the first iteration of the writing piece. This stage involves translating the organized ideas into a written form, focusing on conveying the main points and arguments (Atwell, 1987; Elbow, 1986). The subsequent stage is revising the drafted work. This involves refining the writing to enhance its clarity, coherence, and effectiveness. During revision, writers often make significant changes to the structure, content, and language of their writing pieces (Flower & Hayes, 1980; Murray, 1977). Following revision, writers engage in the editing stage. This stage involves proofreading the text to identify and correct grammatical errors, typos, and inconsistencies in formatting and style (Strunk & White, 2002; Zinsser, 2006). The final stage of the process writing cycle is publishing. This involves sharing the completed writing piece with the intended audience (Campbell & Ballenger, 2009).

Traditional brainstorming techniques in process writing, such as freewriting, mind mapping, and listing, have long been used to help students generate and organize ideas before drafting (Campbell & Ballenger, 2009; Rao, 2007). These methods encourage students to explore ideas individually or in groups, fostering creativity and critical thinking. However, traditional brainstorming can be limited by repetitive patterns of thought and time constraints, which sometimes restrict idea diversity and depth (Oliva & Elaziz, 2020). AI-driven brainstorming techniques, by contrast, utilize artificial intelligence to expand students' access to a broader array of ideas, potentially providing suggestions that might not emerge through conventional methods (Aung et al., 2022; Santos, 2023). Tools like ChatGPT, Gemini, and Microsoft Bing assist students by offering prompts, vocabulary options, and varied perspectives, helping to overcome common brainstorming limitations and stimulate creative thought. Integrating AI tools into brainstorming activities supports students in the initial stages of process writing, promoting diverse, structured ideas that can enhance the overall quality of their writing.

AI Chatbots: Generative AI Software to Enhance Writing Abilities

Recent studies have shown that AI chatbots, such as ChatGPT, Gemini, and Microsoft Bing, can significantly improve students' writing skills by providing feedback and assistance (Sumakul et al., 2022).

ChatGPT, developed by OpenAI, has revolutionized natural language processing with its ability to generate coherent and contextually relevant text across various domains (Brown et al., 2020; OpenAI, 2020). Gemini, from Google AI, utilizes Transformer architecture and self-attention to process and generate information with impressive fluency and coherence, offering functions like text generation, language translation, information retrieval, and question answering (Brundage et al., 2022; Vaswani et al., 2017; Brown et al., 2020; Wu et al., 2016; Radford et al., 2018; Liu et al., 2019). Microsoft Bing, a conversational AI chatbot, assists users with various tasks, such as answering questions, providing recommendations, generating creative content, and helping with writing assignments, including generating ideas for essay topics based on users' interests or assignment requirements (Microsoft, 2023).

Challenges and Factors of Using AI Chatbots as Brainstorming Tools in Process Writing

The integration of AI chatbots as brainstorming tools in process writing has presented learners with various challenges, such as difficulty interpreting AI-generated ideas (Ray, 2023), potential for plagiarism and ethical implications (Guleria et al., 2023), lack of control over output (Chan & Hu, 2023), overreliance on AI for idea generation hindering critical thinking and creativity skills (Shanto et al., 2024), and difficulties in seamlessly integrating AI-generated ideas into writing (Dhillon et al., 2024). Despite these challenges, AI chatbots have been found to offer several facilitative factors that can enhance the writing process, including increased idea generation (Calvo & Ellis, 2010; Rao, 2007), exposure to diverse perspectives (Bibi & Atta, 2024), assistance in overcoming writer's block (Cotos et al., 2020), and opportunities for collaborative brainstorming (Gupta & Jain, 2017).

METHODS

Participants, Context, and Setting

Participants were purposively selected from third-year students enrolled in the Academic Writing for English Language Teaching course in the 2023 academic year. The 86 participants were divided into two groups: Section D1 (conventional group or traditional group) with 42 students and Section D2 (interventional group or AI group) with 44 students, totalling 86 participants. All participants were student teachers pursuing a Bachelor of Education majoring in English at an EFL public university in Bangkok, Thailand. Prior to enrolling in this course, they had completed four major English courses: Fundamental Grammar for English Language Teaching, Advanced Grammar for Teachers of English, Critical Reading for English Language Teaching, and English Materials and Learning Innovations Development. Consequently, the students possessed the requisite background in English grammar, reading skills, and technological skills for the writing course and this study.

Research Design and Instruments

This study employed a mixed-methods approach to investigate the research questions, dividing participants into two groups: the conventional group, which was taught using traditional brainstorming techniques (such as mind-mapping, listing, double list, and freewriting), and the interventional group, which utilized AI-driven brainstorming tools (ChatGPT, Gemini, and Microsoft Bing) to support their writing process. Both groups received identical topics for each assignment, focusing on descriptive, opinion-based, and comparative essays about people, places, and things.

In the interventional group, students began each assignment by using AI-driven tools to brainstorm ideas, generate keywords, and develop initial thoughts. They were instructed to interact with the AI to explore different perspectives and expand on initial ideas. This process included asking the AI for examples, receiving prompts, and refining their topic focus based on the AI's responses. After completing their AI-driven brainstorming sessions, students organized their ideas into structured outlines, focusing on logical flow and coherence.

Following the outline, students transitioned to the drafting stage, where they transformed their organized ideas into full-length essays. During drafting, students could revisit the AI tools if they needed additional prompts or ideas for specific sections, such as examples, transitions, or vocabulary. After completing the first draft, students moved on to revising and refining their work. This revision process

involved self-assessment and peer feedback (from classmates), with foreign English lecturers also providing feedback on language use, coherence, and idea development. Finally, students edited their work for grammar, style, and formatting issues before submitting their completed essays for grading. To minimize potential bias, graders were not informed whether brainstorming results were AI-generated or student-generated, ensuring that assessments focused solely on the quality of ideas and language use.

Over the six-week period, the foreign English lecturers provided feedback on each assignment, ensuring that the evaluation was unbiased and objective. At the end of the study, students in the interventional group completed a questionnaire (adapted from Sasikumar and Sunil, 2023, and Chan and Hu, 2023), which was validated by three experts in English language teaching and writing instruction. This questionnaire assessed students' preferences, challenges, and perceptions of using AI chatbots in brainstorming for writing assignments.

Data Collection and Analysis

The data were collected in the two periods of time which were during teaching (the three assignments) and after teaching (a questionnaire). For the three assignments, they are checked for its accuracy, appropriacy, and creativity, and graded by the foreign English lecturers. Then the data were analysed according to the research questions as follows:

Data Analysis for Research Question 1

Descriptive statistics (mean and standard deviation) were used to analyse quantitative data, while inferential statistics (*t*-test) were used to compare the two groups of students on the brainstorming assignments of research question 1, and the university criterion-referenced scales were used to analyse the mean scores of students' assignments graded by the English foreign lecturers consisting of the following interval scales:

Table 1. Meaning of scores based on the university criterion-referenced scales for grading the students' assignments by the English foreign lecturers

Scores (Marks)	Meaning
80 – 100	Excellent
75 – 79	Very good
70 – 74	Good
65 – 69	Average
60 – 64	Below average
55 – 59	Marginal
50 – 54	Poor
0 – 49	Very poor

Data Analysis for Research Question 2

Content analysis was employed to analyse qualitative data from the feedback notes of research question 2. To analyse the qualitative data from the lecturers' feedback notes regarding their perceived preferences and comments towards the brainstorming results by AI chatbots compared to students, a thematic content analysis approach was employed following the guidelines proposed by Braun and Clarke (2006), i.e. thorough reading the data, making notes and highlighting relevant excerpts. identifying key thoughts, generating coded segments, grouping potential themes based on similarity, patterns, and relationships between the coded excerpts. Through this iterative process of reviewing, comparing, and

refining themes, a practice recommended by Miles et al. (2014), four main overarching themes eventually emerged as predominant perspectives reflected in the lecturers' feedback: 1) Novelty and Creativity, 2) Depth and Development, 3) Language Use, and 4) Feedback Potential. In other words, the specific steps, from data immersion to coding, theme generation, reviewing, and finalization, enabled a rigorous qualitative analysis that captured the key themes present in the lecturers' feedback notes related to Research Question 2, adhering to the best practices recommended in the literature on thematic analysis (Braun & Clarke, 2006; Miles et al., 2014; Saldaña, 2021; Yin, 2015).

Data Analysis for Research Questions 3-4

The mixed-methods approach allowed for a comprehensive understanding of the impact of AI-driven brainstorming tools on process writing outcomes and students' perceptions of this innovative approach for research question 3, "What AI chatbots do the students use as the brainstorming tools in process writing?" The data was collected through a questionnaire that asked students to indicate which AI chatbots they used for brainstorming during the process writing assignments. For Part 1 (background of the respondents) and Part 2 (preference in AI chatbots as the brainstorming tools in process writing), the responses were tallied and percentages calculated to determine the proportion of students who used each AI chatbot (e.g., ChatGPT, Gemini, Microsoft Bing), following best practices for descriptive statistical analysis (Yin, 2015). For Part 5 of the questionnaire, open-ended responses were analyzed using thematic analysis (Braun & Clarke, 2006) to identify key reasons behind students' choices of AI chatbots. The responses were read thoroughly to become familiar with the data (Saldaña, 2021). Relevant excerpts and recurring ideas were coded and grouped into themes capturing the main factors influencing students' preferences (Nowell et al., 2017).

For Research Question 4, "What are the perceived challenges and facilitative factors experienced by third-year Thai university students when using AI chatbots as the brainstorming tools for process writing? The questionnaire, which was the same questionnaire as research question 3, but the statement items were in Part 3 and Part 4, included items rated on a Likert scale to assess students' perceptions of challenges and facilitative factors. Mean scores (*M*) and standard deviations (*SD*) were calculated for each item (Yin, 2015) to identify the most prominent challenges and facilitative factors. For the open-ended responses, they were again analyzed using thematic analysis (Braun & Clarke, 2006; Nowell et al., 2017) to gain deeper insights into the challenges and facilitative factors. Coding and theme generation followed the same process as described for Research Question 3, allowing researchers to identify and interpret patterns in students' experiences (Miles et al., 2014; Saldaña, 2021). The analysis of mean scores from the students' questionnaire was compared with the criteria of Likert (1932) as follows:

Table 2. Meaning of scores based on the university criterion-referenced scales for grading the students' assignments by the English foreign lecturers

Mean Scores	Levels of Challenge / Agreement
4.51 – 5.00	The most challenging / Highest
3.51 – 4.50	Very challenging / High
2.51 – 3.50	Moderately challenging / Average
1.51 – 2.50	Less challenging / Low
1.00 – 1.50	Least challenging / Lowest

Ethical Consideration

All participants were fully informed about the study's purpose, procedures, potential risks, and benefits, and were given the opportunity to ask questions and seek clarification. Informed consent was obtained voluntarily from all participants. Participant data was kept strictly confidential, with identities disclosed only with explicit authorization. The researcher implemented secure data storage methods and

restricted access to authorized personnel to safeguard participants' privacy. The researcher adhered to the highest standards of academic integrity, avoiding plagiarism, data fabrication, or result falsification. Participants were treated with respect and dignity, with sensitivity to cultural differences and without discrimination. The researcher carefully weighed the study's potential benefits, such as enhanced writing skills and creativity, against the risk of participants experiencing frustration or anxiety if they found the AI-driven brainstorming tools challenging to use.

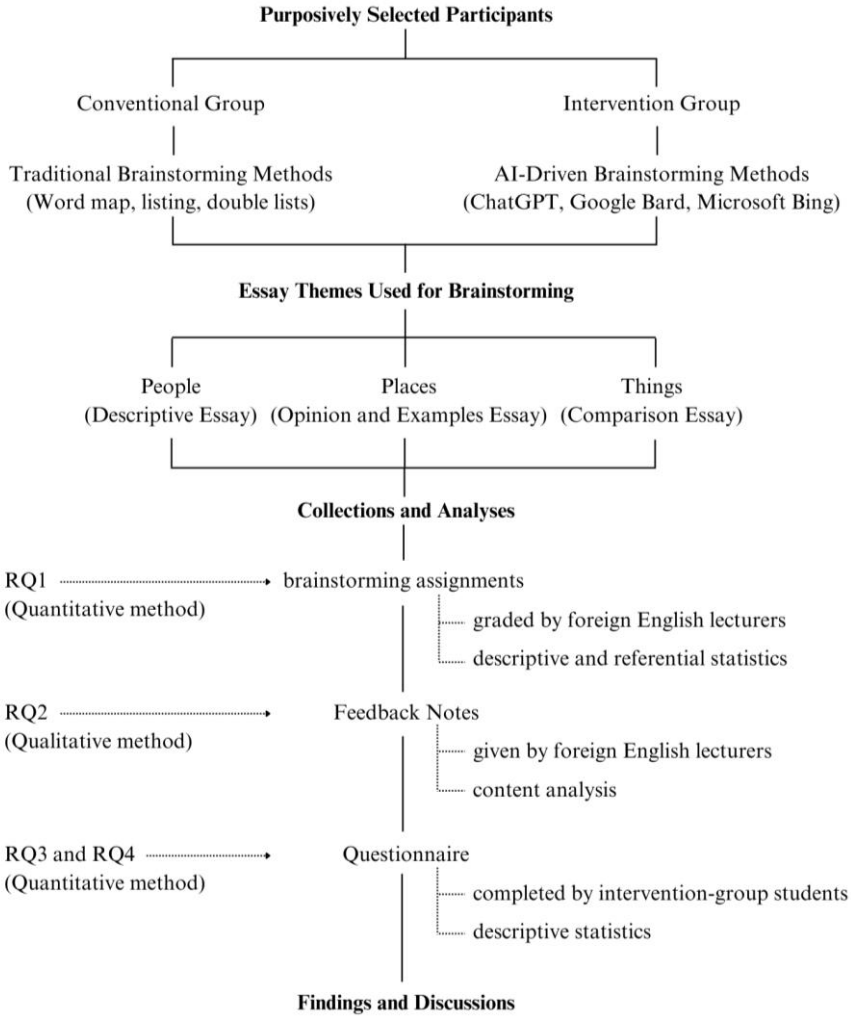

Figure 1. Research methodology of the study

FINDINGS

Research Question 1: Does the implementation of AI-driven brainstorming tools in process writing instruction lead to significant improvements in students' writing outcomes compared to those who employ traditional brainstorming techniques?

The brainstorming assignment scores were analysed using mean (*M*), standard deviation (*SD*), and an independent samples *t*-test to compare the mean scores between the AI-driven brainstorming group (Section D2) and the traditional brainstorming group (Section D1). For research question 1, there are four dimensions to report the findings consisting of 1) the overview of all the students' mean scores from the three assignments during the six weeks of brainstorming teaching techniques graded by foreign lecturers of English to investigate the overall level of achievement based on the university criterion-referenced scales, 2) the mean (*M*), standard deviation (*SD*), and an independent samples *t*-test of Assignment 1 (People), 3) the mean (*M*), standard deviation (*SD*), and an independent samples *t*-test of Assignment 2 (Places), and 4) the mean (*M*), standard deviation (*SD*), and an independent samples *t*-test of Assignment 3 (Things).

Table 3. The overview of all the students' mean scores from the three assignments during the six weeks of brainstorming teaching techniques graded by foreign lecturers of English (*N* = 86)

Assignments / Students' Groups	Assignments* 1 (People, Week 2)	2 (Places, Week 4)	3 (Things, Week 4)	M	Meaning
Intervention (*n* = 44)	82.5	79.8	85.3	82.5	Excellent
Convention (*n* = 42)	77.2	77.6	80.1	78.3	Very Good

*Each assignment values 100 marks

From Table 3, the average score of the three assignments of the intervention group (AI-driven brainstorming technique) was in the "Excellent" performance while the conventional group's performance was "Very Good" These findings suggest that the integration of AI-driven brainstorming tools in process writing instruction can potentially enhance students' writing outcomes, as evidenced by the higher mean scores achieved by the intervention group on the assignments.

Table 4. The mean (*M*), standard deviation (*SD*), and an independent samples t-test of Assignment 1 (People) (*N* = 86)

	M	*SD*	*t*	*df*	*p*
Intervention (*n* = 44)	82.5	6.7	3.21	84	.002
Convention (*n* = 42)	77.2	7.4			

From Table 4, the result from t-test indicated that there was a difference between the use of AI-driven brainstorming technique (*M* = 82.5, *SD* = 6.7) and traditional brainstorming technique (*M* = 77.2, *SD* = 7.4) in a significant level, *t*(84) = 3.21, *p* = .002. This means that those students from the intervention group who had been teaching with the AI-driven brainstorming technique had a significantly higher mean score than those in the convention group who had been teaching with traditional brainstorming technique on the 'People' brainstorming assignment.

Table 5. The mean (*M*), standard deviation (*SD*), and an independent samples *t*-test of Assignment 2 (Places) (*N* = 86)

	M	*SD*	*t*	*df*	*p*
Intervention (*n* = 44)	79.8	5.9	1.62	84	.11
Convention (*n* = 42)	77.6	6.2			

From Table 5, the result from t-test indicated that there was no statistically significant difference between the use of AI-driven brainstorming technique (*M* = 79.8, *SD* = 5.9) and traditional brainstorming technique (*M* = 77.6, *SD* = 6.2) in a significant level, *t*(84) = 1.62, *p* = .11. This means that those students from the intervention group who had been teaching with the AI-driven brainstorming technique and those in the convention group who had been teaching with traditional brainstorming technique can equally work on the 'Places' brainstorming assignment.

Table 6. The mean (*M*), standard deviation (*SD*), and an independent samples *t*-test of Assignment 3 (Things) (*N* = 86)

	M	*SD*	*t*	*df*	*p*
Intervention (*n* = 44)	85.3	5.1	3.78	84	.001
Convention (*n* = 42)	80.1	6.8			

From Table 6, the result from t-test indicated that there was a difference between the use of AI-driven brainstorming technique (*M* = 85.3, *SD* = 5.1) and traditional brainstorming technique (*M* = 80.1, *SD* = 6.8) in a significant level, $t(84) = 3.78$, $p < .001$. This means that those students from the intervention group who had been teaching with the AI-driven brainstorming technique had a significantly higher mean score than those in the convention group who had been teaching with traditional brainstorming technique on the 'Things' brainstorming assignment.

Research Question 2: What are the perceived preferences and comments by the foreign English lecturers towards the brainstorming results by AI chatbots compared with students?

The feedback notes provided by the lecturers were analysed using content analysis to identify key themes and patterns regarding their preferences and comments on the brainstorming results generated by AI chatbots versus students. The feedback notes of the foreign lecturers can be categorised into two types of comments: General comments and specific comments to each assignment (as shown in the Appendix). The perceived preferences and comments by the foreign English lecturers towards the brainstorming results by AI chatbots compared with students revealed the following main themes:

Firstly, Novelty and Creativity: By providing a range of lecturer comments ((1) – (5) and (A1-A3)) emphasizing the novelty, imagination, and unconventional nature of the AI ideas, as well as specific innovative examples from the assignments, this data helps reinforce the "Novelty and Creativity" theme. The lecturers consistently noted how the AI pushed boundaries and explored highly original concepts compared to more conventional student ideas. To support, the lecturers frequently commented on the novelty and creativity displayed in the AI-generated brainstorming ideas. For example, one lecturer noted, "The ideas from the AI were very unique and pushed the boundaries of conventional thinking." However, some lecturers felt that the AI results occasionally lacked coherence or relevance to the writing prompt.

Secondly, Depth and Development: By including lecturer comments ((6) – (10) and (B1-B3)) emphasizing the inherent depth, nuance, and development potential in student ideas compared to broader AI concepts, as well as specific examples where lecturers noted avenues for elaboration, this data reinforces the "Depth and Development" theme. The lecturers valued the layers and thoughtfulness present in student brainstorming that lent themselves to further idea exploration. In other words, while appreciating the AI's ability to generate a high volume of ideas quickly, several lecturers indicated a preference for the students' brainstorming results in terms of depth and development of ideas. A common observation was: "The student ideas, although fewer in number, demonstrated more nuanced thinking and development potential."

Thirdly, Language Use: By including lecturer comments ((11) – (15) and (C1-C3)) praising the AI's strong command of language mechanics, vocabulary, phrasing, and overall language sophistication, as well as pointing out errors in student work and providing contrasting high-quality AI examples, this data clearly supports the "Language Use" theme. The lecturers consistently noted the AI's polished, fluent, and advanced language skills compared to the students. To illustrate, the lecturers generally favoured the language use and grammatical accuracy in the AI brainstorming results compared to those of the students. One lecturer stated, "The AI output was incredibly polished and had very few language errors, unlike many student responses."

Lastly, Feedback Potential: By providing lecturer comments ((16) – (20) and (D1-D3)) emphasizing the value of using AI output for feedback purposes, including modelling, comparisons, facilitating dialogue, and idea exploration, this data supports the "Feedback Potential" theme. The lecturers saw AI brainstorming as a useful tool to provide constructive feedback and engage students in improving their skills. This means that many lecturers saw value in using the AI brainstorming as a starting point or supplementary resource to provide feedback to students. A lecturer mentioned, "Comparing the AI ideas to the students' work could

facilitate meaningful discussions and help identify areas for improvement."

Research Question 3: What AI chatbots do the students use as the brainstorming tools in process writing?

The questionnaire asked students to indicate which AI chatbots they used for brainstorming during the process writing assignments. The results are as follows:

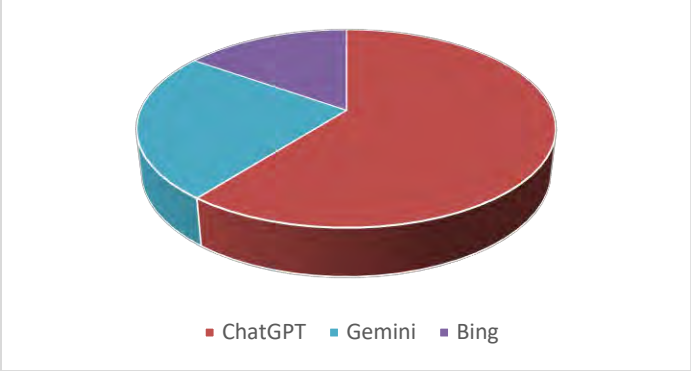

Figure 2. Percentage of the students' preference in using AI chatbots as the brainstorming tools in process writing

From Figure 2, it revealed that the most commonly used AI chatbot was ChatGPT, with over three-quarters of students (78.8% or 68 out of 86 students) reporting its use for brainstorming. Gemini (31.4% or 27 students), and Bing (19.8% or 17 students) were used by roughly a third and a fifth of students, respectively.

For the open-ended responses, the findings revealed some key reasons behind students' choices. For ChatGPT, students said, "ChatGPT was easy to access and provided very natural and fluent responses." Also, "I found ChatGPT to be the most creative and helpful for generating unique ideas." For Gemini, students said, "I used Bard because it integrated well with my existing Google accounts." And "Gemini seemed to have the most up-to-date information compared to the others." For Bing, most of the students said, "Bing gave me more control over the tone and style of the generated text." Also, "I preferred Bing's interface and found it more user-friendly."

Research Question 4: What are the perceived challenges and facilitative factors experienced by third-year Thai university students when using AI chatbots as the brainstorming tools for process writing?

The questionnaire included items rated on a 5-point Likert scale to assess students' perceptions of challenges and facilitative factors when using AI chatbots for brainstorming. The mean scores were calculated as follows:

Table 8. The mean scores, standard deviation and meaning of the perceived challenges experienced by third-year Thai university students when using AI chatbots as the brainstorming tools for process writing

Perceived Challenges	*M*	*SD*	Meaning
1. Difficulty interpreting AI-generated ideas	3.75	0.71	Very challenging
2. Concerns about plagiarism/ethical issue	3.28	1.14	Moderately challenging
3. Lack of control over output	3.15	0.92	Moderately challenging
4. Overreliance on AI for idea generation	4.62	0.44	The most challenging
5. Difficulty integrating AI ideas into writing	2.96	0.56	Moderately challenging

Table 8 shows the perceived challenges faced by the students. The most significant finding is that students considered *overreliance on AI for idea generation* as the most challenging aspect, with a mean score of 4.62 (*SD* = 0.44). This suggests that students were highly concerned about becoming too dependent on AI chatbots for generating ideas, which could potentially hinder the development of their own critical thinking and creativity skills. Other challenges, such as difficulty interpreting AI-generated ideas (M = 3.75, SD = 0.71), were perceived as very challenging, while concerns about plagiarism/ethical issues (M = 3.28, SD = 1.14), lack of control over output (M = 3.15, SD = 0.92), and difficulty integrating AI ideas into writing (M = 2.96, SD = 0.56) were considered moderately challenging. Interestingly, although overreliance on AI for idea generation is the students' most challenging, when analysing the open-ended opinions towards the challenges they perceived when using AI chatbots for brainstorming, a number of students reflected that irrelevant generated content and unrecognising plagiarism generated by chatbots were deeply described in the difficulty interpreting AI-generated ideas and the concerns about plagiarism/ethical issue challenges. For example, "Sometimes the AI gave me ideas that were completely off-topic or didn't make sense," "I was worried about accidentally plagiarizing from the AI's output without realizing it," etc.

Table 9. The mean scores, standard deviation and meaning of the facilitative factors experienced by third-year Thai university students when using AI chatbots as the brainstorming tools for process writing

Facilitative Factors	*M*	*SD*	Meaning
1. Increase idea generation	4.51	0.93	Highest
2. Overcoming writer's obstacles	4.09	0.85	High
3. Exposure to diverse perspectives	3.98	0.88	High
4. Collaborative brainstorming opportunities	3.95	0.91	High
5. Enhanced creativity	4.53	0.79	Highest

Table 9 presents the facilitative factors experienced by the students when using AI chatbots for brainstorming. The most significant findings reveal that *enhanced creativity* (*M* = 4.53, *SD* = 0.79) and *increased idea generation* (*M* = 4.51, *SD* = 0.93) were rated as the highest facilitative factors. This indicates that students found AI chatbots to be highly beneficial in stimulating their creativity and helping them generate more ideas for their writing. Other facilitative factors, such as overcoming writer's obstacles (*M* = 4.09, *SD* = 0.85), exposure to diverse perspectives (*M* = 3.98, *SD* = 0.88), and collaborative brainstorming opportunities (*M* = 3.95, *SD* = 0.91), were also rated highly by the students, suggesting that AI chatbots were effective in helping students overcome writing barriers, explore different viewpoints, and engage in collaborative brainstorming sessions. Moreover, the students' reflection in the open-ended session of the questionnaire put the emphasis that the enhanced creativity is the major factor of using the AI chatbots for brainstorming. For example, "The chatbot helped me think outside the box and consider angles I hadn't thought of before." Also, the students reflected in terms of AI assisting the increase of collaborative brainstorming opportunities that "Being able to bounce ideas back and forth with the AI made brainstorming feel like a real conversation."

DISCUSSION AND CONCLUSION

This study investigated the impact of AI-driven brainstorming tools on process writing instruction and students' writing outcomes, revealing that the intervention group using AI tools outperformed the conventional group, aligning with previous research on the benefits of AI-based tools in enhancing writing skills and engagement (Chen et al., 2022; Feng et al., 2023; Rao, 2007). The findings also highlighted foreign English lecturers' preferences for students' brainstorming results due to their depth, coherence, and potential for development, suggesting that AI chatbots should be used as supplementary tools rather than replacements for human creativity (Burkhard, 2022; Xia et al., 2021). Students' preferences for AI chatbots, such as ChatGPT, Gemini, and Microsoft Bing, were influenced by factors like accessibility, creativity, and user-friendliness (Nazari et al., 2021). However, the study identified challenges, such as overreliance on AI for idea generation,

emphasizing the need for teachers to strike a balance between leveraging AI benefits and fostering students' independent thinking and creativity skills (Suseno & Pinnington, 2018; Wang & Tian, 2021).

The key findings of this study have several implications for classroom practice. First, writing teachers should consider integrating AI-driven brainstorming tools into their process writing instruction to enhance students' writing outcomes and engagement. However, they should use these tools as supplementary resources rather than relying on them entirely. Second, teachers should facilitate discussions and provide feedback that compares AI-generated ideas with students' work to promote deeper understanding and idea development. Third, instructors should consider students' preferences and needs when selecting AI chatbots for brainstorming activities to ensure optimal learning experiences. Finally, teachers should provide guidance on the effective use of AI tools while emphasizing the importance of developing students' independent thinking and creativity skills.

Last but not least, although this study employed the mixed-methods approach which allowed for a comprehensive understanding of the impact of AI-driven brainstorming tools on process writing outcomes and the perceptions of both students and lecturers, plus, the use of multiple data sources, including brainstorming assignments, feedback notes, and questionnaires, enhanced the credibility and trustworthiness of the findings, the study was limited to a specific context (third-year Thai university students) and a relatively small sample size (N = 86). Future research should explore the effectiveness of AI-driven brainstorming tools in diverse educational settings and with larger sample sizes to enhance the generalizability of the findings.

CONCLUSION

This study aimed to investigate the impact of AI-driven brainstorming tools on process writing instruction and students' writing outcomes in the context of third-year Thai university students. The research was motivated by the need to explore innovative solutions to address the challenges associated with traditional brainstorming techniques, such as lack of idea diversity, limited exploration, inefficiency, and ineffectiveness. A mixed-methods approach was employed to examine the research questions, which focused on the effectiveness of AI-driven brainstorming tools in improving students' writing outcomes, foreign English lecturers' preferences and comments towards AI-generated brainstorming results, students' preferences for specific AI chatbots, and the perceived challenges and facilitative factors experienced by students when using these tools.

The findings revealed that the implementation of AI-driven brainstorming tools led to improved writing outcomes compared to traditional brainstorming techniques. The intervention group using AI tools significantly outperformed the conventional group on two out of three assignments, with an overall "Excellent" performance rating. Foreign English lecturers acknowledged the AI chatbots' strengths in generating novel ideas and producing polished language output, but exhibited a preference for students' brainstorming results due to their greater depth, coherence, and potential for development. ChatGPT emerged as the most popular AI chatbot among students, followed by Gemini and Microsoft Bing. Students' preferences were influenced by factors such as accessibility, creativity, and user-friendliness. However, overreliance on AI for idea generation was identified as the most concerning challenge, while enhanced creativity and increased idea generation were the most appreciated facilitative factors. To prevent plagiarism, teachers should encourage students to use AI suggestions as inspiration rather than final content. Discussing the ethical implications of AI-generated ideas and emphasizing the importance of originality can help students develop a responsible approach to using these tools.

The study's findings contribute to the growing body of research on the integration of AI-driven tools in educational settings, particularly in the context of writing instruction. The results suggest that AI-driven brainstorming tools can be effective in enhancing students' writing outcomes and creativity when used as supplementary resources. However, teachers must strike a balance between leveraging the benefits of AI technology and fostering students' independent thinking and creativity skills. The study underscores the importance of considering students' preferences and needs when selecting AI tools and providing guidance on their effective use. While AI brainstorming tools like ChatGPT generated a large volume of ideas, some outputs lacked relevance to the writing prompt, as noted by a student: ‘Sometimes the AI suggested ideas that didn’t make sense in the context of my topic.’ Teachers should guide students on how to assess AI-generated ideas critically. As AI technology continues to advance, it is crucial for researchers and practitioners

to collaborate in exploring innovative ways to harness its potential while ensuring that students develop the essential skills needed for success in the 21st century.

REFERENCES

Atwell, M. (1987). *Beyond the basics: Teaching writing in the middle and secondary school years*. Heinemann.

Aung, Z. H., Sanium, S., Songsaksuppachok, C., Kusakunniran, W., Precharattana, M., Chuechote, S., Pongsanin, K., & Ritthipravat, P. (2022). Designing a novel teaching platform for AI: A case study in Thai school context. *Journal of Computer Assisted Learning, 38*(6), 1714-1729. https://doi.org/10.1111/jcal.12706

Bhardwaz, S., & Kumar, J. (2023, May 4-6). An Extensive comparative analysis of chatbot technologies - ChatGPT, Gemini and Microsoft Bing [Paper presentation]. *2023 2nd International Conference on Applied Artificial Intelligence and Computing (ICAAIC)*. Salem, India. https://ieeexplore.ieee.org/document/10140214

Bird, C., Ford, D., Zimmermann, T., Forsgren, N., Kalliamvakou, E., Lowdermilk, T., & Gazit, I. (2022). Taking flight with copilot. ACM Queue, 20(6), 35-57. https://doi.org/10.1145/3582083

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101.

Brown, T.B., Mann, B., Ryder, N., Subbiah, M., Kaplan, J., Dhariwal, P., Neelakantan, A., Shyam, P., Sastry, G., Askell, A., Agarwal, S., Herbert-Voss, A., Krueger, G., Henighan, T., Child, R., Ramesh, A., Ziegler, D.M., Wu, J., Winter, C., Hesse, C., Chen, M., Sigler, E., Litwin, M., Gray, S., Chess, B., Clark, J., Berner, C., McCandlish, S., Radford, A., Sutskever, I., & Amodei, D. (2020). language models are few-shot learners. *ArXiv (Cornell University). https://arxiv.org/abs/2005.14165*

Brundage, M., Avin, S., Clark, J., Toner, H., Eckersley, P., Garfinkel, B., Dafoe, A., Scharre, P., Zeitzoff, T., Filar, B., Anderson, H., Roff, H., Allen, G. C., Steinhardt, J., Flynn, C., HÉigeartaigh, S. Ó., Beard, S., Belfield, H., Farquhar, S., et al. (2018). The malicious use of artificial intelligence: forecasting, prevention, and mitigation. *Apollo - University of Cambridge Repository*. https://doi.org/10.17863/CAM.22520

Burkhard, M. (2022, November 8). Student perceptions of ai-powered writing tools: towards individualized teaching strategies [Paper presentation]. *19th International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2022)*. https://www.iadisportal.org/digital-library/student-perceptions-of-ai-powered-writing-tools-towards-individualized-teaching-strategies

Calvo, R. A., & Ellis, R. A. (2010). Students' conceptions of tutor and automated feedback in professional writing. *Journal of Engineering Education, 99*(4), 427-438. https://doi.org/10.1002/j.2168-9830.2010.tb01072.x

Campbell, G., & Ballenger, C. (2009). ***The process writing approach: A practical guide for teachers*****.** Continuum.

Cardon, P. W., Fleischmann, C., Aritz, J., & Logemann, M. K. (2023). The challenges and opportunities of AI-assisted writing: Developing AI literacy for the AI age. *Business and Professional Communication Quarterly, 86*(3), 257-295. https://doi.org/10.1177/23294906231176517

Chan, C. K. Y., & Hu, W. (2023). Students' voices on generative AI: Perceptions, benefits, and challenges in higher education. *International Journal of Educational Technology in Higher Education, 20:43*, 1-18. https://doi.org/10.1186/s41239-023-00411-8

Chen, B., Zhang, F., Nguyen, A., Zan, D., Lin, Z., Lou, J-G., & Chen, W. (2022). Codet: Code generation with generated tests. *ArXiv (Cornell University). https://arxiv.org/abs/2207.10397.*

Cotos, E., Huffman, S., & Link, S. (2020). Understanding graduate writers' interaction with and impact of the Research Writing Tutor during revision. *Journal of Writing Research, 12*(1), 187-232.

https://doi.org/10.17239/jowr-2020.12.01.07

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). Sage.

Dao, X-Q. (2023). Performance comparison of large language models on VNHSGE English dataset: OpenAI ChatGPT, Microsoft Bing Chat, and Gemini. *ArXiv (Cornell University)*. https://arxiv.org/abs/2307.02288

Dhillon, P. S., Molaei, S., Li, J. Q., Golub, M., Zheng, S., & Robert, L. (2024). Shaping human-AI collaboration: Varied scaffolding levels in co-writing with language models. *ArXiv (Cornell University)*. https://arxiv.org/abs/2402.11723

Elbow, P. (1986). *Embracing uncertainty: Global strategies for writing and teaching writing*. Oxford University Press.

Feng, Y., Vanam, S., Cherukupally, M., Zheng, W., Qiu, M., & Chen, H. Investigating code generation performance of chat-gpt with crowdsourcing social data. *Proceedings of the 47th IEEE Computer Software and Applications Conference*, pp. 1–10, 2023.

Flower, L., & Hayes, J. R. (1980). The perception of structure in writing. *Cognitive Psychology, 12*(2), 171-210.

Fujita, S., Gidel, T., Kaeri, Y., Tucker, A., Sugawara, K., & Moulin, C. (2020, October 11-14). AI-based automatic activity recognition of single persons and groups during brainstorming [Paper presentation]. *2020 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*. Toronto, Canada. https://ieeexplore.ieee.org/document/9282981

Golding, L. P., & Nicola, G. N. (2019). A business case for artificial intelligence tools: The currency of improved quality and reduced cost. Journal of the American College of Radiology, 16(9), 1357-1361. https://doi.org/10.1016/j.jacr.2019.05.004

Guleria, A., Krishan, K., Sharma, V., & Kanchan, T. (2023). ChatGPT: ethical concerns and challenges in academics and research. *Journal of Infection in Developing Countries*, *17*(09), 1292–1299. https://doi.org/10.3855/jidc.18738

Gupta, V., & Jain, N. (2017). Harnessing information and communication technologies for effective knowledge creation. *Journal of Enterprise Information Management*, *30*(5), 831–855. https://doi.org/10.1108/jeim-10-2016-0173

Ka-kan-dee, M., & Kaur, S. (2015). Teaching strategies used by Thai EFL lecturers to teach argumentative writing. *Procedia – Social and Behavioral Sciences, 208*, 143-156. https://doi.org/10.1016/j.sbspro.2015.11.191

Karim, R. A., Abu, A. G., & Khaja, F. N. M. (2016, November 12-13). Brainstorming approach and mind mapping in writing activity [Paper presentation]. *The 1st English Education International Conference (EEIC) in conjunction with the 2nd Reciprocal Graduate Research Symposium (RGRS) of the Consortium of Asia-Pacific Education Universities (CAPEU) between Sultan Idris Education University and Syiah Kuala University*. Banda Aceh, Indonsia.

Khalilii, M., Tahriri, A., & Ghorbanpour, E. (2015). The effects of brainstorming strategy on writing skill of Iranian EFL learners. *Modern Journal of Language Teaching Methods, 5*(1), 111-124. https://mjltm.org/article-1-51-en.pdf

Kochery, T. (1996). Inhibitions within idea generating groups: An alternative method of brainstorming [Paper presentation]. *The 1996 National Convention of the Association for Educational Communications and Technology*. Indianapolis, India. https://files.eric.ed.gov/fulltext/ED397806.pdf

Kovanović, V., Joksimović, S., Gašević, D., Siemens, G., & Hatala, M. (2018). Does chatbot aid in literacy learning? A case study. *Proceedings of the 8th International Conference on Learning Analytics and Knowledge* (pp. 324-333).

Liu, Y., Ott, M., Goyal, N., Du, J., Joshi, M., Chen, D., Levyo O., Lewis, M., Zettlemoyer, L., and Stoyanov, V. (2019). RoBERTa: A robustly pptimized BERT pretraining approach. *ArXiv (Cornell University).* https://arxiv.org/abs/1907.11692

Michel-Villarreal, R., Vilalta-Perdomo, E., Salinas-Navarro, D. E., Thierry-Aguilera, R., & Gerardou, F. S. (2023). Challenges and opportunities of generative AI for higher education as explained by ChatGPT. *Education Sciences (Basel)*, *13*(9), 856. https://doi.org/10.3390/educsci13090856

Microsoft. (2023). *Bing: Intelligent search, chat, and creation*. https://www.bing.com/new

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). Sage.

Monserrat, M. D. P., Mas A., Mesquida, A. L., & Clarke, P. M. (2022, August 24). Investigating the use of artificial intelligence (AI) in educational setting: A systematic review [Paper presentation]. *Software Process Improvement*. https://link.springer.com/chapter/10.1007/978-3-031-15559-8_1

Murray, D. M. (1977). *A writer teaches writing: A practical guide for teachers***.** Houghton Mifflin.

Nazari, N., Shabbir, M. S., & Setiawan, R. (2021). Application of artificial intelligence powered digital writing assistant in higher education: Randomized controlled trial. *Heliyon, 7*(5), 1-9. https://doi.org/10.1016/j.heliyon.2021.e07014

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods, 16*(1), 1-13.

Oliva, D., & Elaziz, M. A. (2020). An improved brainstorm optimization using chaotic opposite-based learning with disruption operator for global optimization and feature selection. *Methodologies and Application, 24*, 14051-14072. https://link.springer.com/article/10.1007/s00500-020-04781-3#citeas

OpenAI. (2020). *ChatGPT: Language Models are Few-Shot Learners*. https://openai.com/blog/chatgpt

Perrodin, D. D. (2021). Assessment by Thai academic English writing teachers of the flow of given to new topic information within academic writing. *Journal on English as a Foreign Language, 11*(2), 318-334. https://doi.org/10.23971/jefl.v11i2.2684

Phan, T., Bowman, D. A., & Lee, S. W. (2022, December 1-2). Integrating traditional input devices to support rapid ideation in an augmented-reality-based brainstorming [Paper presentation]. *The 2022 ACM Symposium on Spatial User Interaction. California, USA*. https://dl.acm.org/doi/10.1145/3565970.3567692

Pongsermpol, C. (2009). Adaptive use situation for urban conservation in Thai context. *Journal of the Faculty of Architecture, King Mongkut's Institute of Technology Ladkrabang, 8*(1), 22-32.

Pratiwi, D. F., & Julianti, R. (2022). Improving students' expressive writing ability using brainstorming techniques. *Journal of English Linguistics and Literature Studies, 2*(3), 107-117.

Radford, A., We, J., Child, R., Luan, D., Amodei, D., & Sutskever, I. (2018). *Language model are unsupervised multitask learners*. https://d4mucfpksywv.cloudfront.net/better-language-models/language_models_are_unsupervised_multitask_learners.pdf

Ramadhanti, D., & Mana, L. H. A. (2018). Comparison of brainstorming and mind mapping techniques in argumentation writing learning. *ReasearchGate*. https://www.researchgate.net/publication/330024239_Comparison_of_Brainstorming_and_Mind_Mapping_Techniques_in_Argumentation_Writing_Learning

Rao, Z. (2007). Training in brainstorming and developing writing skills. *ELT Journal, 61*(2), 100-106. https://doi.org/10.1093/elt/ccm002

Rashid, A. (2020). Using group brainstorming to help chemical engineering students in solving problems [Paper presentation]. *2020 Sixth International Conference on e-Learning. Sakheer, Bahrain*. https://ieeexplore.ieee.org/document/9385504

Ray, P. P. (2023). ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope. *Internet of Things and Cyber-Physical Systems*, *3*, 121–154. https://doi.org/10.1016/j.iotcps.2023.04.003

Saldaña, J. (2021). *The coding manual for qualitative researchers* (4th ed.). Sage.

Santos, R. P. D. (2023). Enhancing physic learning with ChatGPT, Bing Chat, and Bard as Agents-to-Think-With: A comparative case study. *Physics Education*. https://arxiv.org/abs/2306.00724

Sasikumar, A., & Sunil, M V. (2023). Students' preference in using chatbots for academic writing. *Indian Journal of Science and Technology, 16*(36), 2912-2919. https ://doi.org/10.17485/IJST/v16i36.1850

Shanto, S. S., Ahmed, Z., & Jony, A. I. (2024). Enriching the learning process with generative AI: A proposed framework to cultivate critical thinking in higher education using ChatGPT. *ResearchGate*. https://doi.org/10.52783/tjjpt.v45.i01.4680

Strohmann, T., Siemon, D., & Robra-Bissantz, S. (2017, May 23). Brainstorm: Intelligent assistance in group idea generation [Paper presentation]. DESRIST 2017. Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-319-59144-5_31#citeas

Strunk, W., Jr., & White, E. B. (2002). *The elements of style*. Pearson.

Suseno, Y., & Pinnington, A. H. (2018). The war for talent: Human capital challenges for professional service firms. *Asia Pacific Business Review, 24*(2), 205-229. https://doi.org/10.1080/13602381.2017.1287830

Bibi, Z., & Atta, A. (2024). The role of CHATGPT as AI English Writing Assistant: A study of student's perceptions, experiences, and satisfaction. *Annals of Human and Social Sciences*, *5*(I). https://doi.org/10.35484/ahss.2024(5-i)39

Utami, S. P. T., Andayani, A., & Winami, R., Sumarwati, S. (2023). Utilization of artificial intelligence technology in an academic writing class: How do Indonesian students perceive? *Contemporary Educational Technology, 15*(4), 1-13. https://doi.org/10.30935/cedtech/13419

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., Kaiser, Ł., & Polosukhin, I. (2017). Attention is all you need. *arXiv (Cornell University)*. https://arxiv.org/abs/1706.03762

Wang, H., & Tian, H. (2021). The impact of online collaborative writing on L2 writing development: A longitudinal study. *Computer Assisted Language Learning*, 1-23. https://doi.org/10.1080/09588221.2021.1888754

Wu, Y., Schuster, M., Chen, Z., Le, Q. V., Norouzi, M., Macherey, W., Krikun, M., Cao, Y., Gao, Q., Macherey, K., Klingner, J., Shah, A., Johnson, M., Liu, X., Kaiser, L., Gouws, S., Kato, Y., Kudo, T., Kazawa, H., Stwens, K., Kurian, G., Patil, N., Wang, W., Young, C., Smith, J., Riesa, J., Rudnick, A., Vinyals, O., Corrado, G., Hughes, M., & Dean, J. (2016). Google's neural machine translation system: Bridging the language gap. *arXiv (Cornell University)*. https://arxiv.org/abs/1609.08144

Xia, J., Liu, H., & Liu, W. (2021). AI-based iWrite assisted English writing teaching [Paper presentation]. *The 2021 International Conference on Machine Learning and Big Data Analytics for IoT Security and Privacy*. https://link.springer.com/chapter/10.1007/978-3-030-89511-2_19

Yin, R. K. (2015). *Qualitative research from start to finish* (2nd ed.). Guilford Press.

Zhang, Y., Sun, S., Galley, M., Chen, Y., Brockett, C., Gao, X., Gao, J., Liu, J., & Dolan, B. (2019). DIALoGPT: Large-Scale Generative Pre-training for Conversational Response Generation. *arXiv (Cornell University)*. https://arxiv.org/abs/1911.00536

Zinsser, W. (2006). *On writing well***.** HarperCollins.

APPENDIX

General and specific comments of foreign English lecturers towards the students' brainstorming results generated by AI chatbots versus students

General Comments	Specific Comments		
	People	Places	Things
(1) The AI ideas were incredibly imaginative and took the brainstorming in directions I never would have anticipated. (2) I was impressed by how unconventional and 'outside the box' many of the AI-generated concepts were. (3) While some AI ideas seemed a bit too outlandish, there were several novel angles that really sparked my curiosity. (4) The AI brainstorming pushed students to consider perspectives and scenarios that were highly creative and unique. (5) Compared to the student ideas which tended to be more conventional, the AI output exhibited a refreshing level of novelty.	(A1) AI idea - "A person who can manipulate the fabric of space-time, exploring parallel universes." Lecturer note - "Wildly imaginative and hooks the reader's interest immediately."	(A2) AI idea - "A city that exists in a perpetual state of twilight, where the boundaries between day and night blur." Lecturer note - "Highly creative setting that sparks curiosity about the world-building details."	(A3) AI idea - "An ancient artifact that can reveal a person's deepest fears when held." Lecturer note - "Novel magic concept that lends itself to compelling character arcs."
(6) While the AI brainstorming provided a large quantity of ideas, the student work demonstrated more potential for in-depth exploration and development. (7) The student ideas, though fewer in number, often had more layers and nuances that could be unpacked further. (8) I found the AI concepts to be broad strokes, whereas the student work showed more thoughtful details and avenues for elaboration. (9) The human brainstorming tended to have a stronger throughline and cohesiveness, making it easier to envision how those ideas could be developed into a full narrative. (10) For characterization and world-building, the student ideas had more inherent depth that could be capitalized on in the writing process.	(B1) Student idea - "A former child prodigy struggling with the pressures of living up to expectations as an adult." Lecturer note - "Solid premise with stakes that could be explored through character arcs, relationships, and internal conflicts."	(B2) Student idea - "A secluded village where the traditions of ancient folklore and magic are still practiced." Lecturer note - "Rich setting with opportunities to expand on customs, beliefs, and the juxtaposition of modern and arcane elements."	(B3) Student idea - "A musical instrument crafted from rare materials that can influence the emotions of those who hear its melodies." Lecturer note - "Intriguing magical object with built-in potential for thematic exploration of power, control, and the human condition."

General Comments	Specific Comments		
	People	Places	Things
(11) The language and grammar in the AI brainstorming output was consistently polished and error-free. (12) I was impressed by the AI's command of vocabulary, phrasing, and sentence structure. The writing was very natural and fluent. (13) While the students' ideas were creative, their language use often contained basic errors and lacked the sophistication of the AI output. (14) The AI demonstrated a wider range of descriptive language and more varied sentence constructions compared to the student work. (15) For non-native English students, the AI examples provided excellent models of proper language use and writing conventions.	(C1) AI idea - "A enigmatic drifter whose path intertwines with those he encounters, leaving an indelible impact on their lives." Lecturer note - "Skilful use of descriptive language like 'enigmatic' and 'indelible' elevates the writing."	(C2) Student idea - "A city were the streets are made of water and people travel by boat." Lecturer note - "Spelling/grammar issues ('were' instead of 'where') detract from the quality."	(C3) AI idea - "An ornate timepiece that harbours the power to manipulate the river of chronology, granting its wielder sovereignty over the past, present, and future." Lecturer note - "Rich vocabulary like 'ornate', 'harbours', 'chronology', and 'sovereignty' demonstrate excellent language skills."
(16) Comparing the AI output side-by-side with student work creates opportunities for meaningful feedback and learning. (17) The AI examples can serve as useful models to highlight areas where students need to improve their language use or idea development. (18) Having the AI brainstorming as a benchmark allows us to have productive discussions about creativity, originality, and pushing boundaries. (19) The AI ideas provide a great starting point for feedback on how students can further explore and expand on their initial concepts. (20) Using the AI output judiciously can facilitate feedback dialogues that enhance students' brainstorming and writing skills.	(D1) idea: "A shy girl who loves books and dreams of adventure." AI idea: "A young bibliophile whose passion for the written word unlocks a gateway to a realm where fiction and reality intertwine." Lecturer note: "Discuss how the AI example uses more vivid language and worldbuilding to elevate a simple premise."	(D2) Student idea: "A forest where the trees can walk and talk." AI idea: "An ancient arboreal kingdom, where towering sentient trees have presided over the land for millennia, their roots intertwined with the very fabric of nature's secrets." Lecturer note: "Explore how the AI builds a rich, immersive setting compared to the student's surface-level idea."	(D3) Student idea: "A mirror that shows your future self." AI idea: "An obsidian mirror, forged in the fires of an ancient realm, that allows its wielder to gaze upon the infinite branches of potential futures, each path a tapestry woven by the consequences of their choices." Lecturer note: "Analyse how the AI fleshes out the concept with vivid details and metaphysical depth as a model for students."