Using AI-Powered Design Thinking to Foster Student Teachers' EFL Creative Writing Skills and Engagement

By

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Abstract

This research examined the effect of AI-powered design thinking on fostering EFL creative writing skills and engagement in writing for student teachers at the Faculty of Education, Mansoura University. To achieve the research purpose, the quasi-experimental design was adopted using sixty second year major education students assigned to two groups: a control group and an experimental group. Instruments designed and used included an EFL creative writing test, a creative writing analytic rubric, and an engagement scale. Throughout the treatment, the experimental group students were trained on using the five phases of design thinking (empathize, define, ideate, prototype, and test) while being engaged in multiple collaborative creative writing tasks. Two AI applications (ChatGPT and QuillBot) were employed to assist students in their creative writing. The results revealed the experimental group's high posttest scores compared to their pretest scores and to the control group's posttest scores for both the creative writing skills test and the engagement scale. Thus, AI-powered design thinking had a large effect on fostering students' EFL creative writing skills and engagement. The research recommends investigating the use of the design thinking approach assisted by AI applications to improve university and pre-university students' other English language skills.

Key words: creative writing, engagement, design thinking, AI

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مستخلص

هدف البحث إلى قياس أثر استخدام التفكير التصميمي المدعوم بالذكاء الاصطناعي في تعزيـز مهارات الكتابة الإبداعية باللغة الإنجليزية الانخراط في الكتابة لدى الطلاب المعلمين بكلية التربية جامعة المنصورة، ولتحقيق هدف البحث تم تبنى التصميم شبه التجريبي باستخدام عدد (٦٠) من طلاب الفرقــة الثانية عام شعبة اللغة الإنجليزى)، مقسمين إلى مجموعتين: مجموعة ضابطة ومجموعـة التجريبيـة، وتضمنت أدوات البحث اختبار الكتابة الإبداعية باللغة الانجليزية، ومقياس أداء تحليلى للكتابة الإبداعية، ومقياس الانخراط فى الكتابة، وقد تم تدريب طلاب المجموعة التجريبية على استخدام المراحل الخمــس للتفكير التصميمي (التعاطف، والتعريف، والتفكير، والنموذج الأولي، والاختبار) أثناء انخراطهم في مهام

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الكتابة الإبداعية التشاركية المختلفة، وتم اســتخدام تطبيقـــين للـــذكاء الاصـــطناعي (ChatGPT and QuillBot) لمساعدة الطلاب في توليد الأفكار ومراجعة منتجهم لغويا، وكشفت النتـــائج عـــن ارتفـــاع درجات الاختبار البعدي للمجموعة التجريبية مقارنة بدرجات الاختبار القبلي ودرجات المجموعة الضابطة في الاختبار البعدي لكل من اختبار مهارات الكتابة الإبداعية ومقياس الانخراط، وبالتالي، كـــان للتفكيـــر التصميمي المدعوم بالذكاء الاصطناعي تأثير كبير على تعزيز مهارات الكتابة الإبداعية والانخراط لدى الطلاب، ويوصي البحث بإجراء مزيد من الدراسات لتقييم استخدام منهج التفكير التصـــميمي بمســـاعدة تطبيقات الذكاء الاصطناعي لتحسين مهارات اللغة الإنجليزية الأخرى لدى طلاب التعليم الجامعى وما قبل الجامعة.

الكلمات المفتاحية: الكتابة الابداعية، الانخراط، التفكير التصميمى، الذكاء الاصطناعى

Introduction

In the modern era, efficient communication skills are vital for success in different sectors, from academics to professional endeavors. Writing skills are considerably required as learners need to possess an ability to communicate with and actively participate in the global society. EFL Writing is one of the most challenging tasks of English language teaching and learning even with a native speaker. Thus, Teaching writing plays a crucial role in developing students' ability to express themselves clearly, persuasively, and creatively.

Praminatih & Ardaniah (2018) and Viana & Zyngier (2018) determined two writing types: functional and creative. Functional writing refers to a type of writing aiming to convey a significant, immediate, and clear instruction to a particular audience. It involves tasks like writing e-mails, letterheads, notes, invitations, reports, and advertisements. On the contrary, creative writing is a form of writing through which learners describe their feelings, concerns, emotions, problems, reactions, and thoughts in a literary style.

In the field of education, creative writing holds equal significance to other academic subjects like mathematics or history. Students use their imagination to create their own unique writing style in classrooms all over the world, whether it be an essay, poem, or story. Creative writing enables students to explore novel ideas, concepts, issues, and subjects; thus, engaging students in creative writing experiences helps them learn more about the world and about themselves. Creative writers strive to produce something personal and expressive through their work. They select words to inspire thought, tell stories, reach creative solutions to problems, create moods and

generally enhance the readers' experience of a particular issue (Digital 360, 2023).

The need to find creative solutions to complex problems and to express creativity through writing is a twenty-first-century skill that can be mastered and taught. In teaching writing, fostering student engagement is crucial for cultivating their creativity, critical thinking skills, and overall writing proficiency (Luka, 2019). In this concern, Hung (2019) indicated that a positive correlation exists between creative writing and engagement. Creative writing, just like other aspects of teaching English, requires engagement, and different levels of learners' engagement would noticeably lead to different results.

Yet, educators encounter new challenges in engaging students and developing their writing abilities due to the quick development of technology and the abundance of digital communication platforms. The traditional methods of teaching writing, while still valuable, may not be enough to capture the attention and meet the needs of today's digitally-native learners. Thus, a comprehensible approach to teaching writing must be embraced, one that seamlessly integrates technology, real-world applications, and innovative pedagogical strategies for creating a dynamic and engaging learning environment that not only nurtures students' writing abilities but also prepares them for the demands of the twenty-first century (Shree, 2024).

Design thinking is an effective approach to framing regular approaches that integrate creativity for supporting collaborative interaction and communication and fostering the development of twenty-first century skills. Especially when integrated with innovative technology, it would have the potential to create an engaging EFL learning/teaching environment that enhances the creative production of the English language. Therefore, the current research examined the effect of using the design thinking approach assisted by some AI applications on fostering EFL creative writing skills and engagement for student teachers at the Faculty of Education.

Review of literature

This section presents a review of literature and previous studies related to the variables of the present research, which are: creative writing, engagement, design thinking, and AI, while shedding light on the relationship between them.

Creative writing

In the creative writing process, imaginative and critical skills are complementary as they adhere to forms of divergent and convergent

thought. Divergent thinking includes using imagination to come up with potential, varied solutions to a problem, while convergent thinking is the process of selecting the best solutions fit for the problem through applying logical conditions and systemized thought. The iteration of divergent and convergent thinking regarding a problem leads to the "creative flow" of generating valuable and creative solutions (Guilford, 1957).

EFL creative writing is concerned with novelty and originality. It entails using free imagination to put down one's thoughts and feelings regarding a specific issue on paper. Creative writing implies thinking outside the box and going beyond the ordinary without deviating from normal values, creating ideas that are different from others' ideas, achieving originality, and writing fluently while taking pleasure in or enjoying the act of composing (Temizkan, 2011).

Creative writing refers to an innovative writing style that stresses narrative, character development, viewpoints, and non-formal language styles. It entails using creativity to express ideas and convey thoughts in a variety of fiction and nonfiction formats. It also demands the capability of attracting attention and entertaining readers via creative outputs like poetry, short stories, novels, essays, epics, fairy tales, drama scripts, film scenarios, song lyrics, television scripts, advertising scripts, popular articles, opinions, news, etc. Creative writing in English, then, is a rewarding task that fosters students' creative thinking, improves their imagination, and enhances their overall English language skills (Fitria, 2024).

Besides, creative writing develops learners' vocabulary knowledge, where they are able to select words with similar meaning but with slightly different connotations (Smith, 2013). In addition, it offers learners the freedom to write without too many obligatory rules. Kirmizi (2015) and Pokhrel (2023) placed a special significance on innovation, ownership, subjectivity, and imagination in creative writing skills since they help students go deep into their imagination to write even unbelievable stories with a creative passion and describe them as if they are real in an established creative form of elaboration. The aesthetic feature of creative writing enables learners to enhance their self-esteem, provide freedom to play with language, and foster awareness.

Creative writing is characterized by four main elements or skills: fluency, originality, flexibility, and elaboration. Firstly, fluency reflects the ease and speed that enable a creative person to generate many ideas or solutions related to the problem or the writing task. Secondly, originality refers to the writer's ability to come up with original ideas that are new and

unique. Thirdly, flexibility stands for the ability to produce different ideas supporting the target topic. Finally, elaboration addresses the ability to highlight a topic by analyzing it and adding more details (Starko, 2005).

Despite the importance of creative writing skills, they are not given proper attention in TEFL. Maloney (2019) stressed that EFL university education neglects two important and rich facets of language development: creativity and self-expression. Creative writing was recommended to be taught alongside academic writing in any EFL program, regardless of age or ability level, with a special emphasis on university students. Consistently, Ahmadi (2019) revealed that most students did not feel that they were talented enough to write creatively, and a few of them felt insecure about their writing because it was not something they regularly did. Seleim, Badawi, and Abdel Fattah (2020) also supported the idea of creative writing as a challenging task and a neglected area in TEFL and recommended that students should receive proper training on the skills of creative writing.

Moreover, Mardiningrum, Sistyawan, and Wirantaka (2024) indicated that within the EFL context of higher education, there is a discernible focus on academic writing, often overshadowing the realm of creative writing. The perceptions of EFL students regarding the potential benefits of creative writing were examined. Employing a qualitative approach through conducting in-depth interviews to collect data reflected that the students view creative writing as intriguing, underestimating the importance of its inclusion in higher education. Simultaneously, they acknowledge its potential difficulty and stress the necessity of adopting clear and direct instructional methods that would enhance their creative skills.

Several studies were conducted to highlight the significance of creative writing skills and examine the effect of using different instructional strategies to develop such skills. For example, Bozcurt, Aydin, Taskran, and Koral (2016) assessed the use of microblogging as a social media platform for developing the creative writing skills of EFL learners. The results indicated that microblogging services, namely Twitter, can be used as a valuable platform for enhancing learners' creative writing skills. Similarly, Abu Hussein, Al Jamal, and Sadi (2020) investigated the effect of online reflective journals on Birzeit University students' creative writing. The quasi-experimental design was adopted using a creative writing pre/post-test. The results showed that online reflective journals positively influenced the skills of creative writing (originality, flexibility, fluency, and elaboration).

In addition, Kumar (2020) explored the difficulties of creative writing consistently encountered by the students. Questionnaires and interviews were administered for data collection. Findings revealed that creative writing classes are important and influential for learners; however, they face many hindrances and problems while writing creatively. Students emphasized that the regular learning modes should be changed and that they should be given more opportunities and encouragement to bring new concepts and insights while writing about any text or topic.

Consistently, Alkhaldi (2023) emphasized that although creative writing is a real challenge for EFL learners to master due to traditional ways of teaching, it is a crucial skill as it helps them improve their writing and language abilities and promotes their thinking skills. Employing technology to foster learners' creative writing skills was examined in a case study in Jordan. It was revealed that using technological tools had a positive impact on improving learners' writing performance, lexical abilities, and imagination. It was recommended that language instructors include technology-based activities to improve language learning as well as the creativity of their students.

Students' creative writing performance is particularly affected by a number of affective factors, such as motivation, engagement, apprehension, etc. Writing engagement is one of the essential factors that can boost students' motivation to write. In teaching writing, fostering student engagement is essential for enhancing their creativity, critical thinking skills, and overall writing proficiency. Thus, it is crucial to engage students in a learning environment that incorporates innovative technology, interactive activities, and real-world examples into writing tasks to capture students' interests and encourage them to actively participate in the creative writing process. The following section sheds light on engagement and its relationship to creative writing.

Engagement

Engagement is always regarded as a significant indicator determining students' success in the classroom. Students should be actively engaged, not only physically but also mentally and affectively, in order to get the most out of their learning. Sinatra, Heddy, and Lombardi (2015) mentioned that engagement pertains to the degree of learners' active participation and involvement in a language learning assignment or activity, both in terms of quantity and quality. Abla and Fraumeni (2019) also stated that engagement is a condition of emotional, social, and intellectual readiness to learn characterized by curiosity, participation, and a desire to learn more.

According to Mercer & Dörnyei (2020), engagement links motives and actions, so students who are engaged are able to transform their motivation into tangible acts even in the face of challenges and distractions. Similarly, Nurharjanto (2023) emphasized that engagement is a dynamic, multidimensional construct comprising situated notions of cognition, affect, and behaviors – including social interactions – in which action is a requisite element and is always viewed as a crucial aspect of student's success in language learning.

Fredricks et al. (2004) determined three main dimensions of engagement: behavioral, emotional, and cognitive. Behavioral engagement includes positive conduct, participation in academic tasks, and involvement in extracurricular activities. Emotional engagement refers to the display of emotions and attitudes towards teachers, peers, and school. Cognitive engagement is concerned with students' personal investment in learning, the use of learning strategies, and self-regulation.

As for writing engagement, Alexander (2018) and Parsons et al. (2023) related these three dimensions to writing, highlighting a fourth component, which is social engagement. First, affective writing engagement reflects interested and enthusiastic participation. Students who are affectively engaged in writing are eager to write and passionate about the topic or task. Second, behavioral writing engagement includes exerting energy and effort to write and staying focused on writing. Third, cognitive writing engagement refers to strategic thinking and acting. To write well, students need to be metacognitive through thinking about and evaluating their writing and cognitive through thinking deeply and acting strategically (e.g., planning, reviewing resources, etc.). Finally, social engagement reflects interacting with others to fulfill a task. Writing is inherently social since it communicates a message to a reader. When writers share their writing and ideas with others, the product is better and the process is more enjoyable.

Multiple previous studies were conducted to highlight the relationship between engagement and creative writing. For example, Larasaty and Yulianawati (2019) examined how creative writing engages students in learning poetry among EFL university students. The findings suggested that creative writing activities are able to engage students in poetry classes. It was also found that emotional or affective engagement from students' perspectives has more to do with the pleasant and unpleasant emotions students relate to the task, and it was the dominantly influential aspect of their learning.

In addition, Banegas & Lowe (2021) evaluated a project in which students were engaged in creative writing tasks for publishing their final written products. Administering group interviews and discussions led to the indication that the project positively affected the motivation and engagement of both students and teachers. Further, the study emphasized the importance of changing the writing tasks to be more student-centered and highlighted the positive teachers' role in motivating and engaging students. It was also suggested that effort should be exerted to support initiatives in formal education institutions to motivate and engage students in mandatory language study.

Moreover, Mohammadi et al. (2023) investigated the impact of prewriting planning on EFL students' writing self-efficacy and their cognitive, behavioral, and emotional engagement. Analyzing the learners' written performance and questionnaires revealed that the prewriting activities used could have their own distinguished role in learners' cognitive, emotional, and behavioral engagement as well as their self-efficacy. This supports the positive correlation between writing activities, engagement, and self-efficacy.

To conclude, engagement among students enhances their creativity as well as their academic performance. Engaged students have a huge capacity to learn, a big potential for creativity, and a special passion for topics of interest to them, as emphasized by Harmer (2001). Yet, engaging students in writing is a challenge for language instructors. Students may have low engagement in writing sessions because the genres of writing are disconnected from their real lives. Since today's students are close to technology and innovative AI applications, incorporating the trendy applications with an approach that enhances students' ideation and boosts their problem-solving skills through multiple collaborative writing activities can promote student engagement, creativity, and overall writing proficiency.

Design thinking

Design thinking is a creative process that has been researched, theorized, and codified into a learning approach that stresses the improvement of learners' creative confidence through hands-on projects, encouraging a bias toward action, enhancing ideation, and supporting active problem-solving skills (Carroll et al., 2010; Brown and Katz, 2011). Luka (2019) also regarded design thinking as a practice□oriented constructivist approach to learning supported by collaboration under the teacher's guidance.

It was thought that design thinking was not governed by one theory (Kimbell, 2011). However, research indicates that different learning theories, such as collaborative theory, social cognitive theory, and creativity theory, influence design thinking. The philosophy of design thinking is, then, based on certain principles (Carroll et al., 2010), which are:

- Humans are the center of innovation and the source of inspiration for solving problems.
- The mindfulness of the design thinking process encourages students' metacognitive awareness.
- Students develop empathy through a 'need-finding' process focusing on exploring others' explicit and implicit needs.
- Design thinking promotes prototyping culture by focusing on experimentation, thinking, and engagement.
- Design thinking encourages the 'Show Don't Tell ' approach, which involves sketching, prototyping, digital communication, and storytelling.
- Bias toward action is another design thinking principle that promotes action-oriented behavior rather than discussion-based work.
- Design thinking fosters collaboration, which emphasizes that diverse teams often generate significant innovations and creative solutions to problems.

Stanford d. school (2010) clarified the implementation of the design thinking stages in Figure 1. Wible (2020) illustrated this figure highlighting that design thinkers creatively solve problems in writing by following these five stages or modes:

1- Empathy: students conduct empathetic observations and interviews to understand people's everyday experiences as well as their physical, intellectual, and emotional reactions to the problem.
2- Define: students use this empathy research with their own ideas to create a coherent, actionable problem statement that outlines the design challenge they will attempt to resolve.
3- Ideate: divergent thinking is initially encouraged, and students engage in collaborative, semi-structured brainstorming, generating many ideas for possible solutions. In the latter stage of ideation, convergent thinking is employed for selecting the greatest potential designs for solving the problem.
4- Prototyping: students create artifacts that represent particular aspects of the solution.

5- Test: the prototype or the creatively written product is assessed, and modifications are made in light of the provided feedback to make sure the solution is fit for the task.

Figure 1
Design thinking stages
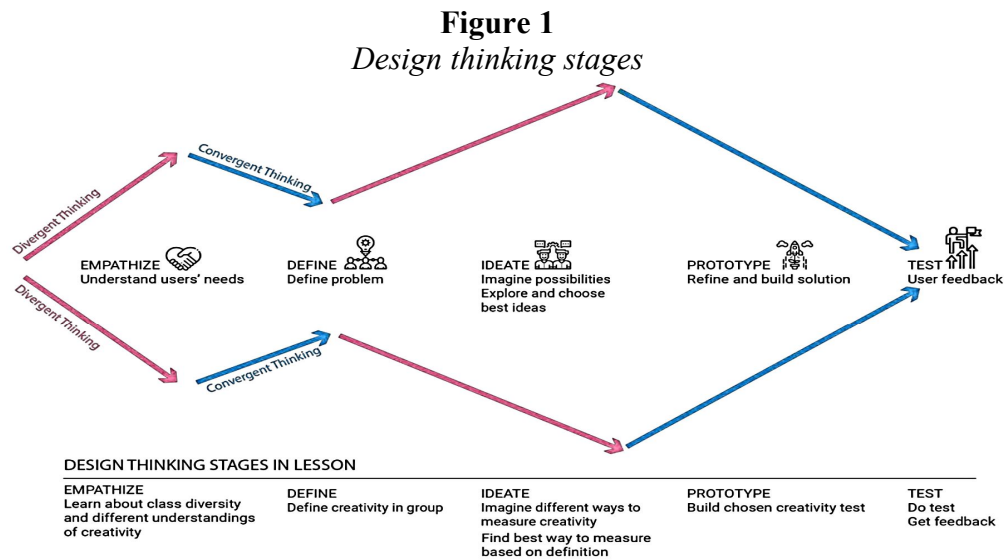
Source: **Stanford d. school (2010)**

Accordingly, design thinking can help solve some of the writing challenges by increasing student engagement because it stresses creative responses to problems and innovative development for concerned issues. It offers students a feeling of agency since they can choose more freely what to write about and how to write about it, and it promotes taking chances and rewards failure as a way to learn. Design thinking is transferable to other situations since it permits teaching multimodal writing because it is about solving problems, not creating certain forms (Goss, 2021).

Several previous studies were done to confirm the significance of the design thinking approach. For instance, Alrehaili and Alhawsawi (2020) investigated design thinking as a creative solution to learners' EFL writing challenges. The findings showed that teaching writing through the design thinking process has developed learners' writing skills, which are organization, development, cohesion, structure, vocabulary, and mechanism, as well as their active engagement and satisfaction.

Besides, Addawiyah (2020) examined whether using the Collaborative Design Thinking (CoDeT) method would result in a significant development in students' writing skills. The results of the research revealed that the CoDeT method for teaching writing skills led to encouraging students to be

actively involved in the writing process and facilitating their comprehension of teaching materials through discussion.

Cleminson and Cowie (2021) indicated that design thinking could provide an important method to develop 21st-century skills in EFL classrooms; however, its potential is not clearly understood. To examine this potential, two Japanese university teachers prepared a design thinking course in which students built a creativity measure and wrote academic reflections. Student work displayed creative thinking, insight, and language play. The results revealed that correlations exist between design thinking, student enjoyment, confidence in communicating, and thinking flexibly. It was also concluded that design thinking can facilitate students' collaborative engagement and creative thinking.

Based on what has been previously mentioned about design thinking, it can be concluded that it is a several stage-learning approach that fosters students' creativity, collaboration, problem-solving, and engagement. The significance of this approach might be maximized if integrated with AI, owing to its ability to personalize the learning experience for each student's learning preferences and pace, making the learning process more effective and enjoyable.

Artificial Intelligence (AI)

AI, often known as machine intelligence, is intelligence demonstrated by machines as opposed to natural intelligence demonstrated by humans. It is intended to do tasks such as speech recognition, learning, planning, and problem solving. It is a technology that assists individuals in reevaluating how they analyze data and integrate information to reach new insights and apply them to improve their decision-making. AI can supplement human intelligence, provide insights, and increase learning efficiency. It can anticipate and adjust by employing algorithms that identify patterns in vast amounts of data (Saleh, 2019).

Fitria (2021) stated that AI creates a realistic simulated dialog platform, like speaking, and enhances practical skills, like writing. It promotes learners' practice capacity and leverages the teaching effect of English in ELT. The advancement of technology and platforms has made it easier to learn English. Many ELT programs are based on AI technologies, which are clever devices that think and act like humans, having the potential to mimic intelligence and make choices that are very similar to those made by humans using a method that both computers and mobiles can use, such as Google Translate and Text to Speech. In addition, AI provides a personalized learning atmosphere in which learners use their senses to

continuously practice linguistic skills and activities appropriate to their current English level, needs, or interests.

Several foreign and Arab studies were conducted to investigate the use of AI for improving different English language skills. For example, Al-Mukhallafi (2020) assessed the strategies used for applying AI applications in teaching and learning English based on university students' viewpoints. The findings revealed that the strategies required for implementing AI in teaching and learning English are weakly employed and that their effect might be increased if used properly in this field.

In addition, Ali (2020) evaluated the effectiveness of using an AI application on improving oral Language skills (listening comprehension and speaking skills) of the sixth-year primary school pupils. The results confirmed the statistically significant impact of integrating AI on developing listening comprehension and speaking skills. Similarly, Ghoneim & Elghotmy (2020) reached similar results when examined the impact of an AI-based program on Enhancing EFL listening skills among sixth year primary stage pupils. Consistently, Abdalkader (2022) conducted a study to determine the impact of using some proposed AI activities on promoting EFL writing fluency for the preparatory stage students in Distinguished Governmental Language Schools. The results emphasized the positive effect of using AI applications on enhancing third preparatory stage students` writing fluency.

In fact, the use of AI-powered writing tools in the EFL classroom is increasing rapidly. These tools include grammar checks, writing aids, and programs that can produce written works like essays easily and effectively, saving students' and educators' time and effort (Gayed et al., 2022 ; Jeanjaroonsri, 2023). Additionally, AI writing tools might be particularly important for EFL learners with low English proficiency because these tools can offer learners immediate feedback and assistance, improving their writing skills faster.

Marzuki et al. (2023) examined the available AI writing tools and assessed their influence on students' writing, particularly in terms of content and organization. The findings identified the varied AI writing tools used by EFL teachers. These applications included QuillBot, WordTune, Jenni, Chat-GPT, Paperpal, Copy.ai, and Essay Writer. It was also implied that integrating AI writing tools can be beneficial in elevating the quality of students' EFL writing.

ChatGPT, or "Conversational Generative Pre-Training Transformer," is a large language model employing deep learning algorithms to create

human-like coherent and compelling written texts supported by its advanced understanding of grammar, vocabulary, and style. Using ChatGPT as a writing prompt generator is among the most popular applications of the platform for creative writing. By inputting a seed text or topic, ChatGPT can inspire writers by generating a wide variety of potential stories or ideas. Additionally, ChatGPT can also be used to generate character descriptions, story summaries, and even entire scenes or chapters (AIContentfy team, 2023).

Susanto, Woo, and Guo (2023) explored how ChatGPT can be used to help with the ideation aspect of creative writing. Findings indicated that students can utilize AI-based sentence generator tools like ChatGPT to trigger ideas to further develop a story. It was emphasized that students can use ChatGPT differently to be more creative in their writing and to produce different written products. This goes in one line with Tsao and Nogues (2024) who examined university students' engagement with Generative Artificial Intelligence (GenAI) tools for creative writing and graphic storytelling. Analyzing data obtained from reflections, surveys, and focus-group interviews led to indicating that creative collaborations with GenAI may be a promising way to nurture creative writing and critical skills.

However, it also has its limitations and ethical concerns that need to be considered when using it in creative writing. For example, ChatGPT can sometimes generate nonsensical or irrelevant text as it is trained on a large corpus of text and is not always able to comprehend the context of a certain writing prompt. Another limitation is that ChatGPT lacks human-like emotions, creativity, and imagination. ChatGPT can produce a text that is coherent and grammatically correct, but it could not have the same artistic flare or emotional depth that a human could. Additionally, ChatGPT's output may be biased due to the bias that is present in the dataset it was trained on. Despite these limitations, ChatGPT in creative writing has the ability to revolutionize the way students think about writing and storytelling, provided it is used as inspiration rather than a replacement for human ingenuity (AIContentfy team, 2023; Koshti, 2023; and Fiialka, Kornieva, & Honcharuk, 2024).

In addition to ChatGPT, QuillBot is a widely used digital tool that employs AI to assist learners with writing. It allows students to paraphrase, check grammar errors, summarize, translate, detect plagiarism, co-write, and even generate citations within an application (Ariyanti, 2021). The significance of this application for writing skills has been previously researched. Mohammad, Alzubi, Nazim, and Khan (2023) assessed how

effective QuillBot was as an AI-mediated tool for improving university students' writing skills. It was revealed that the QuillBot-based instructional program highly benefited students' paraphrasing skills in technical writing. Students perceived QuillBot as a user-friendly, simplified, and adaptable tool that helped them improve vocabulary, sentence structure, the substitution of grammar units, and comprehensibility.

Similarly, Ha (2023) reached the same results when examining the effect of QuillBot on enhancing EFL university sophomores' academic writing and essay writing. It was indicated that the AI-assisted QuillBot application can help students improve their' essay-writing skills. Students also enjoyed their experience with the application, indicating that QuillBot can improve their grammar, vocabulary, and cohesion and coherence.

Based on the previously mentioned review of literature, it can be confirmed that creative writing skills are crucial for students as they assist them in communication and dissemination of ideas and information and support their development of critical thinking, imagination, vocabulary, and expressiveness. One important factor affecting students' ability to write creatively is engagement. It is essential to engage students in a learning environment that integrates innovative AI applications within the design thinking process to enhance students' creative writing and support their engagement in writing. Thus, the current research examined the effect of AI-powered design thinking on fostering students' EFL creative writing skills and engagement.

Context of the problem

Despite the importance of creative writing and the significance of teaching it alongside academic writing, reviewing literature reveals that it is not given proper attention in EFL university education (Maloney, 2019; Ahmadi, 2019; Seleim, Badawi, & Abdel Fattah, 2020; and Mardiningrum, Sistyawan, & Wirantaka, 2024). In addition, the researcher's experience in teaching the English majors at Mansoura Faculty of Education revealed that the students feel the importance of creative writing but face many challenges and problems while writing creatively, and even many of them believe they do not have the talent or ability to write creatively. The same challenges were also emphasized by Kumar (2020) and Alkhaldi (2023).

These challenges might be attributed to a lack of adequate practice time and inappropriate writing techniques disconnected from students' real-life preferences or interests. Teaching creative writing is not an easy task because it is a real difficulty for teachers to engage students in writing activities, particularly creative writing. Engagement is a key factor in the

successful learning process. Thus, in order to boost students' creative writing and engagement, educators must adopt innovative strategies and approaches that leverage the power of technology while fostering critical thinking, creativity, and effective communication skills. Accordingly, the problem of the current research was crystalized in fostering students' EFL creative writing skills and engagement through AI-powered design thinking.

Statement of the problem

Based on the previous related studies and the researcher's experience while teaching sophomores, the research problem was represented by the need for student teachers (sophomores) at the Faculty of Education to improve their EFL creative writing skills and their engagement in writing. Thus, the current research examined the effect of AI-powered design thinking on fostering student teachers' EFL creative writing skills and engagement.

Questions

The research answered the following questions:

1. How can AI-powered design thinking be used to foster student teachers' EFL creative writing skills and engagement?
2. What is the effect of AI-powered design thinking on fostering student teachers' EFL creative writing skills?
3. What is the effect of AI-powered design thinking on fostering student teachers' engagement in writing?
4. What is relationship between student teachers' scores in creative writing and theirs in engagement?

Purpose

The present study aimed at investigating the effect of AI-powered design thinking on fostering EFL creative writing skills and engagement in writing among second year major education students at the Faculty of Education, Mansoura University.

Delimitations

The study was delimited to the following:

1. A group of EFL second year major education student teachers (N= 60) from the Faculty of Education, Mansoura University, in the first semester of the academic year 2023-2024.
2. EFL creative writing skills needed for student teachers to master (namely, originality, flexibility, fluency, and elaboration).
3. Using two AI applications (ChatGPT and QuilBot) in an integration with the phases of the design thinking approach to foster student teachers' EFL creative writing skills and engagement.

Operational definition of terms

Creative writing skills are the abilities that help students formulate their ideas into words in a deliberate and logical manner to put their feelings and ideas about certain topics or problems on paper, using their imagination freely, while making use of four creative scopes, specifically flexibility, elaboration, proficiency, and fluency.

Engagement refers to a state of intellectual, social, and emotional readiness for learning characterized by curiosity, active participation, and a desire to learn more. Students' engagement in writing reflects their commitment to their writing through active, intentional, and thoughtful participation in the creative writing task. Engagement is a multidimensional construct with four types: affective, behavioral, cognitive, and social.

Design thinking is a human-centered approach to innovation and creative problem-solving. It stresses the development of students' creative confidence in finding practical and meaningful solutions to complex problems. It encourages collaboration and repetition of the process to learn from failures, get a perfect solution to the problem, and develop a good version of the creative written output. Design thinking is a non-linear and iterative process based on how the student thinks, feels, and behaves. It involves five main phases: empathy, define, ideate, prototype, and test.

Artificial Intelligence (AI), often known as machine intelligence, is intelligence demonstrated by machines as opposed to natural intelligence demonstrated by humans. It is intended to do tasks such as speech recognition, learning, planning, and problem solving. The current research adopts the definition of Harry (2023), which claims that AI in education refers to the application of artificial intelligence technologies to enhance learning, including natural language processing and machine learning, through the use of algorithms to tailor learning for each student by analyzing data, finding patterns, and making predictions. Examples of AI applications are ChatGPT and QuillBot.

Hypotheses

The present study tested the following hypotheses:

1. There is a statistically significant difference at 0.05 level between the mean score of the control and the experimental groups in the post administration of the EFL creative writing test in favor of the experimental group.

2. There is a statistically significant difference at 0.05 level between the mean score of the experimental group pre-post administrations of the EFL creative writing test in favor of the post administration.

3. There is a statistically significant difference at 0.05 level between the mean score of the control and the experimental groups in the post administration of the engagement in writing scale in favor of the experimental group.
4. There is a statistically significant difference at 0.05 level between the mean score of the experimental group pre-post administrations of the engagement in writing scale in favor of the post administration.
5. There is a positive correlation between student teachers' EFL creative writing performance and their engagement in writing.

Method

● **Participants**

The participants of the research were sixty second-year major education students at the Faculty of Education, Mansoura University. Two micro-teaching groups were chosen: one group (N = 30) represented the experimental group and was trained using AI-powered design thinking, whereas the other group (N = 30) was assigned as the control group and was trained according to regular instruction. The age range of the students in both groups was nineteen to twenty years old, and they all had similar backgrounds in the English language because they had begun receiving EFL instruction in the first year of primary school.

● **Design**

The study adopted a quasi-experimental design using two groups: an experimental group and a control group. The experimental group studied through AI-powered design thinking, while the control group received regular instruction. Both groups received the pre- and post-administration of the EFL creative writing skills test and the engagement in writing scale.

● **Instruments**

The following instruments were designed and used to achieve the purpose of the current research:

A. An EFL creative writing skills test.
B. An analytic creative writing skills rubric.
C. An engagement in writing scale.

A detailed description of each one of these instruments is presented in the following section.

A. **The EFL creative writing skills test**

The EFL creative writing skills test was prepared for: identifying the homogeneity level of the control and experimental groups and determining the participants' pre-and post-creative writing levels; thus, investigating the effect of AI-powered design thinking on fostering student teachers' creative

writing. The test consisted of two questions, each of which assessed the four main EFL creative writing skills: originality, flexibility, fluency, and elaboration.

To establish the validity of the test, it was submitted to a number of TEFL specialists to evaluate the questions according to the appropriateness of the test to the level of the second-year English major student teachers, the suitability of the test questions to measure the target skills, and the clarity of the questions and instructions. The jury comments indicated that the test questions are appropriate to the students' language level and would properly measure the required creative writing skills.

The internal consistency and reliability of the EFL creative writing skills test were estimated through the test pilot administration conducted to (30) student teachers, other than the main research participants. ***Firstly***, the internal consistency was estimated by calculating the correlation coefficient between the score of each skill and the total score of the creative writing test; the results are shown in Table 1.

Table 1

The correlation between the score of each skill and total score of the test

Skills	NO	Correlation Coefficient	Skills	NO	Correlation Coefficient
Originality	1	0.878**	*Flexibility*	1	0.74**
	2	0.871**		2	0.76**
Fluency	1	0.92**	*Elaboration*	1	0.808**
	2	0.93**		2	0.805**

Note. **Correlation is significant at the 0.01 level.

Table 1 illustrates that the correlation coefficients are positive at 0.01 level, which emphasizes the valid internal consistency of the EFL creative writing skills test.

Secondly, the Cronbach Alpha (α) value of 0.897 was obtained to measure the reliability of the EFL creative writing skills test. Consequently, the reliability of the test was demonstrated, allowing it to be used as a research tool. The test in its final version is presented in Appendix A.

The test time was also estimated by calculating the total time taken by all the pilot participants to complete the test and dividing it by their number (30). The mean time was, then, obtained as 900/30= 30 minutes (+5 minutes for test instructions). Thus, it was found that (35) minutes would be regarded as a suitable time for the students to complete the test.

B.   The analytic creative writing skills rubric

In order to score the EFL creative writing skills test, an analytic scoring rubric was designed based on the four target EFL creative writing

skills: originality, flexibility, fluency, and elaboration. The scoring rubric included a 4-point scale ranging from 1 (the minimum score) to 4 (the maximum score), and it was applied to each of the two test questions. Thus, the total score for each skill was 8 and for the whole test was 32. The rubric was presented to a group of TEFL professors in order to assess its validity in terms of accuracy, clarity, suitability for measuring the target skills. Based on the jurors' comments, the rubric is linguistically clear and it properly covered the EFL creative writing skills under investigation.

The multi-observer method for the same student's performance was used for estimating the inter-rater reliability of the rubric. A colleague was required to serve as a co-rater with the researcher to assess the writing performance of 15 students, not among the main participants of the present research. "Cooper" equation was used to calculate the coefficient of agreement between the raters' estimates as follows:

Percentage of agreement= (The number of times of agreement/ the total number of performances) χ100.

It was found that the mean of the agreement coefficient between the two raters was (88%), which reflects a strong agreement level. This indicates that the test and its scoring rubric are reliable assessment tools. The final form of the rubric is presented in Appendix B.

C. __The engagement in writing scale__

The engagement in writing scale was prepared for measuring students' engagement level in creative writing tasks before and after implementing the AI-powered design thinking. The items of the scale were adapted from Larasaty and Yulianawati (2019) and Parsons et al. (2023). The scale included 33 items addressing four main types of engagement, distributed as shown in Table 2.

Table 2

Types of learner engagement

Types	Definition	Statements
Affective engagement	Interest, enjoyment, and enthusiastic participation	*1- 12*
Behavioral engagement	Effort and focus	*13- 18*
Cognitive engagement	Strategic thinking and acting	*19- 28*
Social engagement	Interacting with others to complete a task	*29-33*
Total		*33*

For maintaining objectivity, the scale included the use of positive and negative statements. A 5-point Likert scale (①︎ never true, ②︎ Rarely True, ③︎ Sometimes True, ④︎ Mostly True, and ⑤︎ Always True) was used to reflect students' points of view. To evaluate the validity of the scale, it was submitted to a number of TEFL and psychology professors to assess its statements in terms of clarity and appropriateness. The opinions of the jurors showed that the scale is comprehensive and appropriate to evaluate students' engagement in writing level.

The scale's internal consistency and reliability were measured by administering it to a pilot group of thirty 2nd year English majors other than the main research participants. **Firstly**, Pearson correlation coefficients between the score of each item and the total score of the engagement type to which it belongs were estimated. The results are shown in Table 3.

Table 3

The correlation between the score of each item and the total score of the engagement type to which it belongs

Engagement types	NO	Correlation Coefficient	Dimensions	NO	Correlation Coefficient	Dimensions	NO	Correlation Coefficient
Affective	1	0.791**	Affective	12	0.675**	Cognitive	23	0.899**
	2	0.465**	Behavioral	13	0.402*		24	0.769**
	3	0.861**		14	0.44*		25	0.472**
	4	0.673**		15	0.831**		26	0.472**
	5	0.46**		16	0.843**		27	0.763**
	6	0.721**		17	0.848**		28	0.795**
	7	0.732**		18	0.9**	Social	29	0.843**
	8	0.663**	Cognitive	19	0.628**		30	0.802**
	9	0.693**		20	0.649**		31	0.629**
	10	0661**		21	0.867**		32	0.639**
	11	0.698**		22	0.448*		33	0.629**

Note. **Correlation is significant at the 0.01 level

Table 3 shows that that the correlation coefficients are significant at the 0.01 level, which indicates the strength of the relationship between the score of each item and the total score of the engagement type to which it belongs.

Secondly, the correlation coefficient between the score of each engagement type and the total score of the engagement scale was calculated and the results are presented in Table 4.

Table 4

The correlation between the score of each engagement type and total score of the engagement scale

Engagement Types	Correlation Coefficient	Sig
Affective	0.921	0.01
Behavioral	0.664	0.01
Cognitive	0.918	0.01
Social	0.558	0.01

Table 4 reflects that the correlation coefficients are positive at 0.01 level, which supports the valid internal consistency of the engagement in writing scale. ***Thirdly***, the reliability of the scale was also estimated by getting the value of Cronbach Alpha (α) for calculating the variance of the scale items to highlight the extent to which the scale items relate to each other and the correlation of each item with the total score of the scale, as shown in Table 5.

Table 5

Values of Cronbach's Alpha for the engagement scale

Engagement Types	No of Items	Cronbach's Alpha
Affective	12	0.89
Behavioral	6	0.822
Cognitive	10	0.873
Social	٥	0.755
Total	33	0.93

Table 5 clarifies that the reliability coefficient for the total scale is 0.93, which emphasizes that the engagement scale is reliable and can be administered as one of the research instruments. The final form of the engagement in writing scale is presented in Appendix C.

Additionally, the time needed to complete the scale was calculated by dividing the total amount of time spent by all the students in the pilot administration by their total number (30). It was found that giving students instructions for five minutes on top of the 25 minutes would give them an adequate thirty minutes to complete the scale.

Treatment: AI-powered design thinking

Based on reviewing literature related to creative writing, learner engagement, the design thinking approach, and AI applications, the AI-powered design thinking treatment was constructed mainly for fostering student teachers' EFL creative writing skills and engagement.

Objectives

The target objectives of the AI-powered design thinking were determined as follows:

- Fostering EFL creative writing skills for student teachers who are expected to be capable of:
    - Generating novel ideas and unique solutions to problems (originality).
    - Producing different ideas that can support the main topic (flexibility).
    - Generating many ideas relevant to the topic of writing (fluency).
    - Expanding in detail by providing more details and analysis to the topic of writing (elaboration)
- Fostering student teachers' engagement in writing.

Content

The AI-powered design thinking content is mainly task-based, and it was delivered in seven EFL creative writing modules (Appendix D), including an orientation module presented to the experimental group students at the beginning of the experimental treatment to familiarize them with the target objectives, content, procedures, and the AI applications used. The other main modules engaged the students in multiple EFL creative writing tasks. Each of the six modules centered around one topic and was divided into two sessions that were implemented in two meetings per week. Each module was organized into seven main steps (objectives, materials and media, warm-up, presentation, practice, assessment, and reflection).

The phases of the ***design thinking*** process were integrated into the steps of each module in order for the students to produce creative writing outputs by the end of each module. These phases were applied as follows:

- **Empathy**: Students were encouraged to put themselves in other people's shoes and connect with how they might be feeling about their problem or situation. Empathy Cards or Empathy Maps can be used to engage the students in writing about what they might say, think, do, and feel to help them define the central problem or theme. Figure 2 presents a sample empathy map.

Figure 2
Sample empathy map
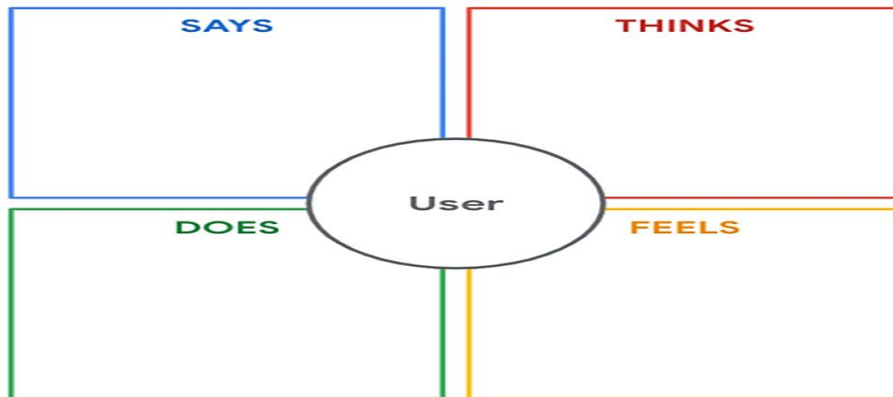
- **Define**: Students articulate and define the core problem or theme in a human-centered manner, including a user, a need, and an insight.
- **Ideate**: Students, in teams, are asked to brainstorm their ideas to write down many insights and solutions to the problem or story theme assigned. They are encouraged to follow the rules of brainstorming, which are: defer judgment, encourage wild ideas, stay focused on the topic, and build on the ideas of others. Students' ideas should be creative, original, and outside the box. Sample brainstorming templates can be used.

Figure 3
A brainstorming template for the ideation phase
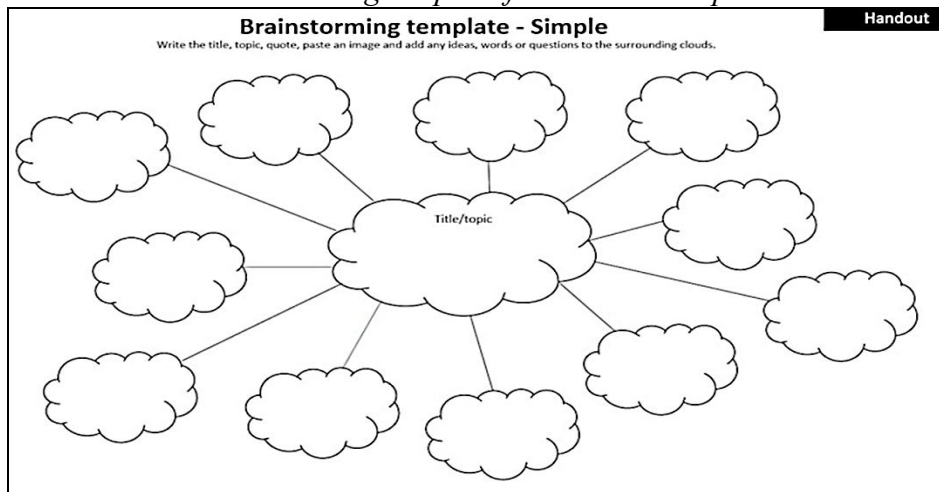
- **Prototype**: Each student thinks about the insights or ideas generated in the ideation phase and produces a scaled-down version of the creative written product. This product might be a paragraph, an essay, or a short story. These prototypes are like written drafts that are supposed to be assessed in the next phase.
- **Test and feedback**: Students' creative written outputs are tested, and constructive formative feedback is provided to them.

Materials & media

Multiple materials were employed in each module to support the presentation of tasks, such as pictures, online videos, and worksheets. Besides, two AI applications (ChatGPT and QuillBot) were used to maximize the significance of design thinking in fostering students' creativity and engagement.

ChatGPT is a user-friendly platform used by the students, especially in the ideation phase, to generate as many ideas, solutions, or prompts as required for the assigned creativity-based writing task. Students can simply input their questions or preferred keywords, and they will generate a list of prompts or ideas tailored to their interests. Students can then select from the given ideas or customize the prompts by adding their own twists or combining different ideas flexibly. Screenshots from ChatGPT in response to creative writing tasks are presented in Figure 4.

Figure 4

Screenshots from ChatGPT
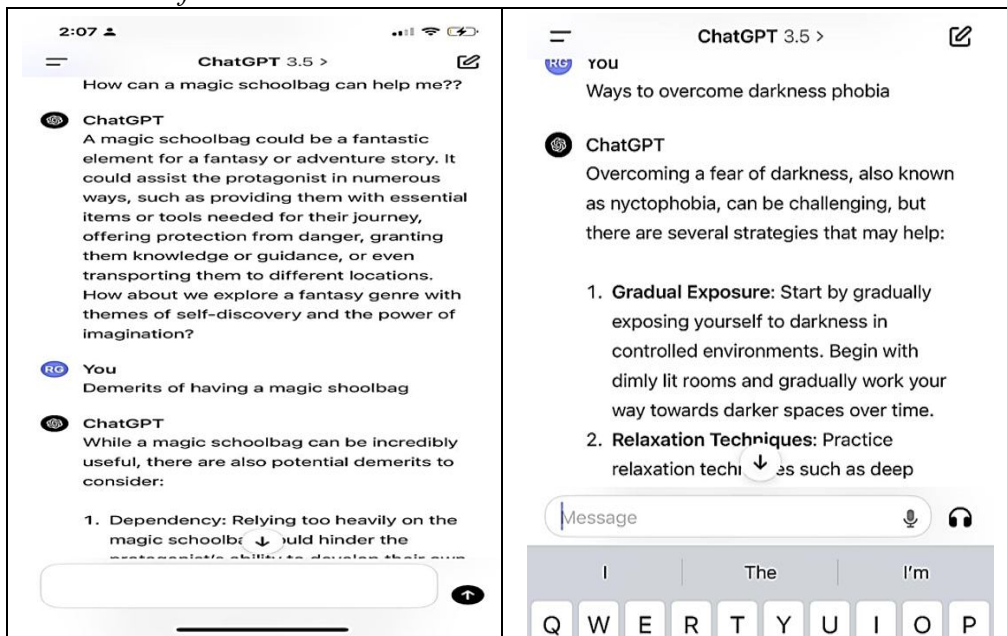
QuillBot is an AI-powered writing tool used by the students in the prototyping and testing phases to allow them to paraphrase, check grammar errors, summarize, translate, detect plagiarism, co-write, and even generate citations. QuillBot assists the students in creating well-structured sentences and improving their overall writing quality. A screenshot illustrating QuillBot and its various tools is presented in Figure 5.

Figure 5

Screenshot of QuillBot and its AI-assisted tools
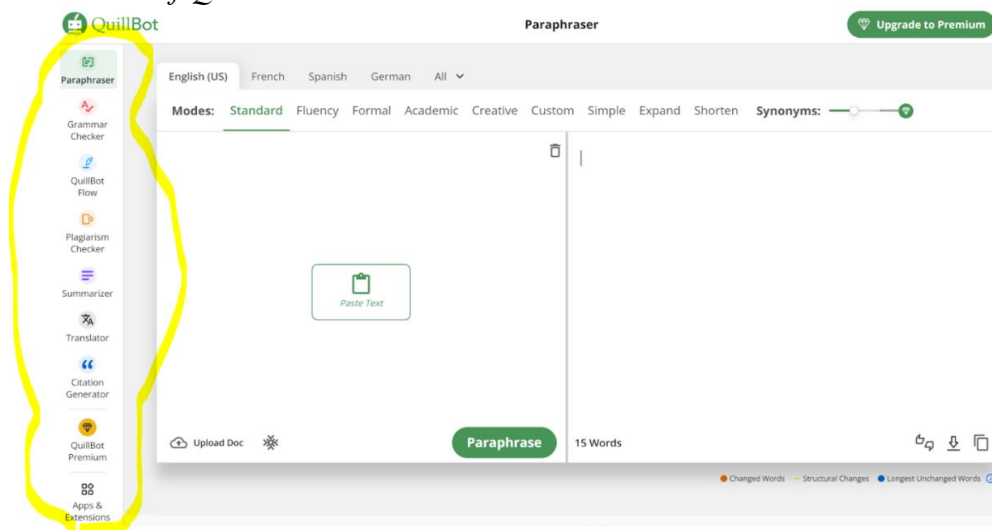
Experimental procedures

Pre-administration: the experiment started with pre-administering the research instruments (the EFL creative writing test and the engagement in writing scale) to students of the control and experimental groups at the beginning of the first semester of the academic year 2023/2024, to assess their actual levels regarding the target variables, in addition to establishing the homogeneity between the two groups.

Firstly, to establish the homogeneity between the experimental and control groups concerning students' EFL creative writing skills level, *t*-test for independent samples was used, as illustrated in Table 6.

Table 6

Establishing homogeneity between the control and experimental groups in the pre-administration of the creative writing skills

Skills	Groups	N	Mean	Std. Deviation	t	DF	Sig
Originality	Experimental	30	2.63	0.85	0.451	58	Not Sig at 0.05
	Control	30	2.73	0.868			
Flexibility	Experimental	30	2.53	0.681	0.694	58	Not Sig at 0.05
	Control	30	2.67	0.802			
Fluency	Experimental	30	2.43	0.568	1.404	58	Not Sig at 0.05
	Control	30	2.67	0.711			
Elaboration	Experimental	30	2.63	0.49	1.46	58	Not Sig at 0.05
	Control	30	2.43	0.568			
Total	Experimental	30	10.23	1.547	0.663	58	Not Sig at 0.05
	Control	30	10.50	1.57			

Table 6 shows that *t*-value is not significant for each of the creative writing skills as well as for the total test, which means that there was no significant difference between the two groups. Thus, the homogeneity between the experimental and control groups regarding their level of creative writing was confirmed.

In addition, the engagement in writing scale was administered to both groups before the treatment to measure students' engagement level and establish homogeneity between the two groups. The results of the pre-administration of the engagement scale are presented in Table 7.

Table 7

Establishing homogeneity between the control and experimental groups in the pre-administration of the engagement scale

Engagement types	Groups	N	Mean	SD	t	DF	Sig
Affective	Experimental	30	14.73	1.741	0.763	58	Not Sig at 0.05
	Control	30	15.13	2.285			
Behavioral	Experimental	30	7.5	1.075	0.523	58	Not Sig at 0.05
	Control	30	7.37	0.89			
Cognitive	Experimental	30	12.83	1.234	1.307	58	Not Sig at 0.05
	Control	30	13.23	1.135			
Social	Experimental	30	6.5	0.777	0.189	58	Not Sig at 0.05
	Control	30	6.53	0.571			
Total	Experimental	30	41.57	2.921	0.894	58	Not Sig at 0.05
	Control	30	42.27	3.14			

The results in Table 7 illustrate that t-value is not significant for each of the engagement types as well as for the total scale, which indicates that the engagement scale did not show a statistically significant difference in the mean scores of the experimental and control groups. Therefore, the engagement levels of both groups were homogeneous prior to implementing the experimental treatment.

The AI-powered design thinking treatment

The AI-powered design thinking modules were then implemented throughout the first semester of the 2023/2024 academic year through the following procedures:

- An orientation module was introduced to the target student teachers of the experimental group to help them become familiar with the training, its objectives, content, media, and the AI applications used. The students were also given an introduction about the design thinking approach, its philosophy, and the phases through which they were going to be trained. In addition, students were trained on how to use ChatGPT to generate multiple ideas or solutions about the assigned task or problem and QuillBot for paraphrasing, checking errors, etc., to help them elevate their writing performance level.

- The students studied the six modules, where each module followed the same phases (objectives, materials and media, warm-up, presentation, practice, assessment, and reflection). Each module was delivered into two sessions implemented in two meetings per week (one face-to-face meeting and the other an online meeting delivered through Microsoft Teams for assessment and receiving feedback). Throughout the phases of each module, the five design thinking steps (empathize, define, ideate, prototype, and test) were employed to help the students produce their final creative output.

- At the end of each module, students were asked to briefly mention their overall opinions and feelings by responding to an online reflective form prepared via the Microsoft Forms application. They were also asked to suggest further recommendations for the upcoming modules.

Post-administration

After finishing the experimental treatment, the research instruments (the EFL creative writing skills test and the engagement in writing scale) were administered to students of both the experimental and control groups to investigate the effect of AI-powered design thinking on fostering student teachers' EFL creative writing skills and engagement. Then, the obtained data were analyzed using the appropriate statistical techniques, the results

were interpreted, and consequently, the conclusion and proposed suggestions and recommendations were provided, as illustrated in the following section.

Results

Testing the first hypothesis

The first hypothesis stated that "there is a statistically significant difference at 0.05 level between the mean score of the control and the experimental groups in the post administration of the EFL creative writing test in favor of the experimental group." To verify this hypothesis, t-test for independent samples was used, and the related results are presented in Table 8.

Table 8

Comparison between the control and experimental groups in the post-administration of the EFL creative writing skills test

Skills	Groups	N	Mean	SD	t	DF	Sig
Originality	Experimental	30	7.1	0.759	16.11	58	0.01
	Control	30	3.4	1.003			
Flexibility	Experimental	30	6.93	0.828	14.21	58	0.01
	Control	30	3.77	0.898			
Fluency	Experimental	30	7.1	0.885	13.752	58	0.01
	Control	30	4.1	0.803			
Elaboration	Experimental	30	7.57	0.626	18.49	58	0.01
	Control	30	3.57	1.006			
Total	Experimental	30	28.7	1.932	26.27	58	0.01
	Control	30	14.83	2.151			

Table 8 illustrates that the mean scores of the experimental group are higher than those of the control group for each single subskill and for the total creative writing performance. Besides, t-values are significant at 0.01 level for each subskill as well as for the total, which reflects that the experimental group students outperformed their counterparts in the control group in their creative writing level. Thus, a statistically significant difference exists between the experimental and control groups in the post-administration of the EFL creative writing skills test in favor of the experimental group, and the first hypothesis, therefore, is accepted.

Testing the second hypothesis

For testing the second hypothesis, which addressed the significant difference between the mean scores of the experimental group's pre- and post-administrations of the EFL creative writing skills test, t-test for dependent samples was used, and the results are shown in Table 9.

Table 9

Comparison between the experimental group's pre-post administrations of the EFL creative writing skills test

Skills	Measurement	N	Mean	SD	*t*	DF	Sig	(η2)
Originality	Pre	30	2.63	0.85	19.54	29	0.01	0.929
	Post		7.1	0.759				
Flexibility	Pre	30	2.53	0.681	21.28	29	0.01	0.94
	Post		6.93	0.828				
Fluency	Pre	30	2.43	0.568	23.38	29	0.01	0.948
	Post		7.1	0.885				
Elaboration	Pre	30	2.63	0.49	34.43	29	0.01	0.976
	Post		7.57	0.626				
Total	Pre	30	10.23	1.547	41.84	29	0.01	0.984
	Post		28.7	1.932				

Table 9 indicates that the estimated *t*-values are significant at 0.01 level for each particular skill and for the total creative writing performance. This emphasizes the statistically significant difference between the mean score of the experimental group's pre- and post-administrations of the creative writing skills test in favor of the post-administration owing to implementing the AI-powered design thinking intervention. Moreover, the values of (η2) support the large effect size levels of the approach used on the four main skills and the total. Consequently, these results led to accepting the second hypothesis.

Testing the third hypothesis

The results of testing and verifying the third hypothesis, which claimed that "there is a statistically significant difference at 0.05 level between the mean score of the control and experimental groups in the post-administration of the engagement scale in favor of the experimental group," are illustrated in Table 10.

Table 10

Comparison between the control and experimental groups in the post-administration of the engagement scale

Engagement types	Groups	N	Mean	SD	*t*	DF	Sig
Affective	Experimental	30	52.23	2.445	61.296	58	0.01
	Control	30	22.97	0.928			
Behavioral	Experimental	30	26.63	3.499	22.458	58	0.01
	Control	30	11.13	1.432			
Cognitive	Experimental	30	46.1	0.995	44.26	58	0.01
	Control	30	19.6	3.125			
Social	Experimental	30	22.5	0.974	29.31	58	0.01
	Control	30	11.73	1.76			
Total	Experimental	30	147.47	4.754	65.98	58	0.01
	Control	30	65.43	4.876			

Table (10) shows that the *t*-values are significant at 0.01 level, which supports the statistically significant differences between the control and experimental groups in each of the engagement types as well as in the total score of the scale in favor of the experimental group. Accordingly, the third hypothesis of the study is proved and accepted.

Testing the fourth hypothesis

The *t*-test for dependent samples was used to verify the fourth hypothesis, which stated that "there is a significant difference between the mean score of the experimental group's pre- and post-administrations of the engagement scale in favor of the post administration." Results are shown in Table 11.

Table 11

Comparison between the experimental group's pre-post administrations of the engagement scale

Engagement types	Measurement	N	Mean	SD	t	DF	Sig	(η2)
Affective engagement	Pre	30	14.73	1.741	70.03	29	0.01	0.994
	Post		52.23	2.445				
Behavioral	Pre	30	7.5	1.075	28.45	29	0.01	0.965
	Post		26.63	3.499				
Cognitive	Pre	30	12.83	1.234	159.45	29	0.01	0.999
	Post		46.1	0.995				
Social	Pre	30	6.5	0.777	58.1	29	0.01	0.991
	Post		22.5	0.974				
Total	Pre	30	41.57	2.921	113.1	29	0.01	0.998
	Post		147.47	4.754				

Table 11 illustrates that all *t*-values of the four types and the total scale are significant at 0.01 level, which emphasizes the statistically significant difference between the experimental group students' mean scores in the pre- and post-administrations of the engagement scale in favor of the post-administration. Additionally, the values of effect size (η2) support the large effect size of AI-powered design thinking on fostering students' engagement in writing. Consequently, the fourth hypothesis is accepted.

Testing the fifth hypothesis

The fifth hypothesis claimed that "there is a positive correlation between student teachers' EFL creative writing performance and their engagement in writing," Pearson correlation coefficient was used to verify this relationship. Table 12 presents the value of the correlation coefficient and its significance.

Table 12

Establishing the correlation between creative writing and engagement in writing

Correlation coefficient	Listening	Sig. level	Direction
Online learning autonomy	0.957	0.01	Positive

Table 12 indicates that the value of "r" is significant at 0.01 level, which reveals that there is a strong positive correlation between student teachers' improvement in creative writing skills and their level of engagement. As a result, the fifth and last hypothesis of the research is verified and accepted.

Discussion

The current research investigated the effect of AI-powered design thinking on fostering second-year major education student teachers' EFL creative writing skills and engagement in writing. For this purpose, both the experimental and control groups administered an EFL creative writing skills test and an engagement in writing scale before and after being exposed to the experimental treatment. In light of the previously mentioned statistical results, the experimental group students' mean score was significantly higher than that of the control group in the EFL creative writing test. In addition, the creative writing performance of the experimental group students was significantly higher than their pre-level, which supported the positive impact of AI-powered design thinking on fostering students' creative writing.

These results go in line with Addawiyah (2020), Alrehaili and Alhawsawi (2020), and Wible (2020), who reached a similar conclusion and emphasized that design thinking improved students' writing skills in relation to organization, development, cohesion, structure, vocabulary, and mechanism, as well as their active engagement and creativity. Furthermore, it was confirmed that adopting the design thinking approach stressed students' creative responses to problems and innovative development to assigned issues, offering students a feeling of responsibility since they can freely determine what to write about and how to write about it.

Thus, it might be said that design thinking has the potential to positively affect students' creative writing. Goss (2021) interpreted this indicating that design thinking has the potential to enable students to address many of the challenges of college writing instruction, especially the tension between creativity and convention. It focuses on designing solutions to problems rather than creating forms for their own sake. It also privileges the new and encourages the use of conventional resources in unexpected ways.

By focusing on creative responses to complex problems, design thinking has the potential to increase student engagement in any writing task.

Concerning the use of AI, it was found that ChatGPT and QuillBot enabled the students to improve the quality of their writing performance. This is consistent with Al-Mukhallafi (2020), Ali (2020), Ghoneim and Elghotmy (2020), and Fitria (2021), who emphasized the significant role of AI applications in enhancing students' multiple English language skills. Additionally, Abdalkader (2022), Arnold (2023), Marzuki et al. (2023), Susanto, Woo, and Guo (2023), and Tsao and Nogues (2024) reached similar results emphasizing the positive impact of AI on students' fluent and creative writing. It was confirmed that ChatGPT supports the ideation aspect of creative writing and help students trigger ideas to further develop a story or write an essay.

Furthermore, QuillBot proved to have significant potential for enhancing students' writing performance, particularly for EFL students with low English proficiency. This was also supported by Ha (2023) and Mohammad, Alzubi, Nazim, and Khan (2023), who revealed that QuillBot led to improving students' vocabulary, sentence structure and grammar, and comprehensibility. It enabled the students to receive immediate feedback and assistance, thus improving their writing skills faster.

Concerning the engagement scale, the statistical results section clarified that there was a statistically significant difference between the mean score of the experimental and control groups in the post-administration of the engagement scale in favor of the experimental group. Besides, the experimental group students' level of engagement in writing was significantly higher than their pre-level. This indicates that AI-powered design thinking has considerable potential for enhancing students' engagement in writing. This is consistent with the earlier studies conducted by Larasaty and Yulianawati (2019), Alrehaili and Alhawsawi (2020), Cleminson and Cowie (2021), and Tsao and Nogues (2024), who supported the positive impact of design thinking and AI on students' engagement in writing, and thus, the positive correlation between engagement and students' creative writing was confirmed.

Analyzing students' responses to the questions of the reflective log and observing them while working in teams revealed that they enjoyed the creativity-based tasks and gained confidence about their communication and thinking skills. Design thinking gave students greater autonomy and allowed their creative written products to emerge from being immersed in the problem-solving process. Furthermore, the assigned tasks assisted students'

active communication and gave students the experience of creating an English output while getting genuine feedback. Moreover, students considered the AI applications used (ChatGPT and QuillBot) to be user-friendly, simplified, and adaptable. They enhanced their skills in problem solving, creative writing, and collaborative engagement.

It is worth noting that students were sometimes heavily reliant on using ChatGPT, in particular, to fulfill the collaborative creative writing assignments due to being an effective writing tool for generating content quickly and efficiently. However, ChatGPT cannot replace human creativity but rather is used as an inspiration, not a replacement for human ingenuity. In other words, it is essential to use it as a supplement to the writing process rather than a substitute for it.

Conclusions

The current research investigated the effect of AI-powered design thinking on fostering student teachers' EFL creative writing skills and engagement. The practical evidence gained from the statistical analysis of the research data emphasized the significant potential of AI-assisted design thinking for enhancing creative writing and students' engagement in writing. As a result, the following conclusions are highlighted:

- Creative writing collaborative tasks played a significant role in developing EFL students' creative writing competence in both fiction and nonfiction essays.
- The creative writing tasks provided EFL students with an opportunity to experience, taste, and sense the beauty of the English language.
- The regular feedback on the students' written outputs helped the students to discover the areas that require more efforts.
- The design thinking approach assisted the students in following the logical phases of scientific thinking in problem solving to develop an essay or a short story.
- The AI-assisted design thinking approach not only improved the creative writing competence of the students, but also enhanced their essay formatting, sentence construction, and basic writing techniques.

Recommendations

Based on the research results and discussion, the following recommendations are presented:

1- Creative writing tasks should be integrated within the EFL curricula to foster learners' thinking skills and genuine language use.

2- Collaborative creative writing tasks should be employed within the English course to support students' positive engagement in the English class generally and in writing specifically.
3- Undergraduate and postgraduate students should be trained on the phases of the design thinking approach to enhance their problem-solving competency.
4- Curriculum designers at the university and pre-university stages should employ AI applications (e.g., ChatGPT, QuillBot, etc.) to enhance students' writing skills as well as other language skills.
5- Students should be encouraged to use ChatGPT for generating ideas and problem solutions as a supplement, not a replacement for their human creativity.
6- Students should be motivated and rewarded for using applications like QuillBot to help them self-assess their writing and, thus, elevate the quality of their written products.

Suggestions for further research
The following research suggestions are presented based on the research results and recommendations:
1- The impact of AI applications on improving students' EFL academic writing skills.
2- The effectiveness of a program based on AI-assisted design thinking in enhancing university students' critical or expressive reading skills.
3- The effect of AI-creative tasks on developing the EFL speaking and reading skills of secondary stage students.
4- The impact of the design thinking approach on developing ESP students' critical listening and critical writing skills.

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