Teaching English as a Second Language Quarterly (TESLQ)
(Formerly Journal of Teaching Language Skills)
44(4), Fall 2025, pp. 75-110
https://doi.org/10.22099/tesl.2025.52429.3381
Online ISSN: 2981-1546
Research Paper

Rewiring Writing: Virtual and Non-Virtual Mind Maps as Game-Changers in EFL Writing and Motivation

Asghar Moulavinafchi *

Abstract

Mind mapping has increasingly been acknowledged for its ability to improve learning outcomes, especially within language education. This research compared virtual and traditional mind mapping techniques for improving writing performance and motivation in Iranian EFL learners. The initial pool comprised 120 Iranian EFL students at the pre-intermediate level, selected based on their KET exam results. From this group, 90 participants were randomly divided into three cohorts: two experimental groups and one control group. Before the intervention, all groups completed a writing assessment designed by the instructor, along with a motivation survey. The first experimental group was taught using virtual mind mapping tools, while the second experimental group utilized conventional, paper-based mind maps. The control group received standard writing instruction without the use of mind mapping. After the instructional period, the motivation questionnaire and writing tests were re-administered to all participants. Statistical analysis demonstrated that both mind mapping groups achieved significantly higher scores in writing and motivation compared to the control group. Furthermore, an independent samples t-test comparing the two experimental groups revealed that the virtual mind mapping cohort outperformed the non-virtual group slightly in both writing achievement and motivational measures. Insights from semi-structured interviews showed that most learners held favorable views toward the use of virtual mind mapping in their English writing classes. These results highlight the benefits of incorporating virtual mind mapping into EFL teaching practices to boost writing skills and learner motivation.

Keywords: EFL Learners, English Writing, Mind Map, Motivation, Virtual and Non-Virtual Maps

English is widely acknowledged as a global lingua franca (Marlina & Xu, 2018), functioning as a crucial channel of communication across various domains such as education, science, business, and tourism. As a result, mastering all language skills in English, with particular emphasis on writing, is of critical importance for learners. Writing, classified as a productive skill, is often regarded as one of the most intricate and demanding components of language learning (Richards, 2002). This difficulty stems from the simultaneous need to generate ideas and organize them effectively while converting these thoughts into clear, logically structured compositions (Deane et al., 2008). Even native English speakers frequently

* Review History:
Received: 09/02/2025 Revised: 09/06/2025 Accepted: 10/06/2025

1. Assistant Professor of English Language and Literature Faculty of Literature and Humanities, Hakim Sabzevari University, Sabzevar, Iran; a.moulavi@hsu.ac.ir

How to cite this article:
Moulavinafchi, A. (2025). Rewiring Writing: Virtual and Non-Virtual Mind Maps as Game-Changers in EFL Writing and Motivation. *Teaching English as a Second Language Quarterly (Formerly Journal of Teaching Language Skills), 44*(4), 75-110. doi: 10.22099/tesl.2025.52429.3381

experience writing as a challenging and time-consuming activity. For second language (L2) learners, this challenge intensifies due to the necessity of balancing higher-level cognitive processes such as planning and structuring with more fundamental aspects like spelling, punctuation, and vocabulary choice (Aminah & Supriadi, 2023). Insufficient language proficiency further compounds these obstacles, rendering writing a strenuous endeavor. Nagin (2012) highlights that successful writing development depends on regular practice and the implementation of strategies that assist learners in crafting coherent and meaningful texts.

Among the strategies identified for improving writing skills, mind mapping has emerged as a powerful pedagogical tool. It provides a systematic and visual approach to organizing ideas (Bukhari, 2016; Davies, 2011; Kachak & Kachak, 2022; Luangkrajang, 2022). Originating from Buzan's (2005) theories, which were inspired by the notebooks of Leonardo da Vinci (Gelb, 2009), mind mapping is designed to visually represent ideas, aiding learners in planning and structuring their thoughts more effectively. By fostering creativity, engagement, and memory retention, mind mapping has gained recognition as an effective tool for improving writing skills (Feng et al., 2023; Mustika et al., 2025; Vijayavalsalan, 2016; Wahid & Sudirman, 2023). Its visual and interactive design motivates learners and helps them process and organize information in ways that enhance both understanding and recall (Fiktorius, 2013; Hofland, 2007; Spencer et al., 2013).

Mind maps enable learners to express their ideas visually without being constrained by structural limitations, thus encouraging creativity and clarity in thought organization (Al-Jarf, 2009). These diagrams connect central ideas to related concepts using branches, creating an intuitive and logical framework. Carpenito-Moyet (2007) describes mind maps as educational tools that visually link interconnected ideas, while Novak and Cañas (2006) highlight their hierarchical structure, with superordinate ideas at the top and subordinate details below. Grazziotin-Soares et al. (2021) emphasize the role of mind maps in highlighting temporal or conceptual relationships, making them invaluable for organizing knowledge. Doyle (2023) further advocates for student-centered approaches like mind mapping, arguing that they are more effective than traditional teacher-centered methods in fostering meaningful and organized learning experiences.

Mind mapping in second/foreign language learning has been widely studied, yielding promising results in enhancing writing skills, engagement, and organization. For instance, Uysal and Sidekli (2020) found that mind mapping improved story-writing skills among fourth-grade students in a mixed-method study, noting its role in structuring narratives and increasing motivation. However, their study's focus on a specific grade level and text genre limits its generalizability to other educational contexts and writing types. Expanding on this, Abd Karim and Abu (2018) introduced the Mobile-Assisted Mind Mapping Technique (MAMMAT), which integrates mind mapping with mobile technology to enhance writing proficiency among ESL undergraduates. While this innovative approach aligns with the increasing demand for technology integration in education, the study's small sample size raises questions about its

scalability for diverse learner populations. Similarly, Basri and Syamsia (2020) examined the impact of mind mapping on descriptive writing among Indonesian high school students, reporting significant improvements in pre- and post-test scores. However, their study overlooked qualitative dimensions, such as students' perceptions and the long-term retention of writing skills. Ngo and Tran (2021) investigated the use of mind mapping among English-majored students, finding it to be positively perceived and frequently utilized during the pre-writing phase. However, their focus on first-year students left unexplored how mind mapping usage evolves as learners advance in their language studies.

Despite its demonstrated benefits, certain challenges in applying mind mapping have been identified. Al Naqbi (2011) highlighted its effectiveness in exam settings, showing that students could use mind maps to manage time pressure and organize their writing. However, the short duration of this study limits insights into its long-term efficacy, underscoring the need for longitudinal research. Khusniyah (2019) and Al Kamli (2019) explored the impact of mind mapping on descriptive writing and writing attitudes, respectively. Both studies reported significant improvements but also noted persistent challenges, such as limited vocabulary and organizational skills. These findings suggest that while mind mapping is effective for structuring ideas, it may not fully address all linguistic obstacles faced by L2 learners.

The collective findings from these studies underscore the potential of mind mapping as a valuable tool for developing writing skills across various learner groups and educational settings. However, gaps remain in the research. Existing studies have often focused on specific contexts, such as particular grade levels, text types, or learner demographics, which limits broader applicability. Additionally, many studies have not explored qualitative aspects, such as learners' perceptions of mind mapping as a pedagogical tool. While some research has examined technology-assisted mind mapping, including mobile applications, there is still limited understanding of the comparative effectiveness and scalability of virtual versus non-virtual mind mapping approaches.

This study aims to address these gaps by investigating the impact of both virtual and non-virtual mind mapping on the writing performance and motivation of Iranian EFL learners. Using a mixed-method research design and incorporating diverse learner perspectives, the study seeks to provide a comprehensive evaluation of how mind mapping can enhance writing skills and motivation. Additionally, it aims to compare the effectiveness of mind mapping with traditional teaching methods, thereby offering valuable insights into its broader utility in EFL contexts. The research also intends to evaluate learners' perceptions of virtual and non-virtual mind mapping, contributing to a deeper understanding of its role as an instructional tool for writing. In alignment with these objectives, the following research questions were formulated:

1. Does the use of mind maps (virtual/non-virtual) have any statistically significant effect on Iranian EFL students' writing ability?
2. Does the use of mind maps (virtual/non-virtual) have any statistically significant effect on Iranian EFL students' motivation to learn writing?

3. Is there any statistically significant difference between the effects of mind mapping (virtual/non-virtual) and non-mind mapping techniques on Iranian EFL students' writing outcomes?
4. What are Iranian EFL students' perceptions of the use of virtual and non-virtual mind mapping in developing writing skills?

Literature Review

Theoretical Foundations of Mind Mapping in EFL Writing

Constructivist Foundations of Mind Mapping

Mind mapping goes with the theory of constructivism, which emphasizes that learners are unique individuals who build new knowledge based on their prior experiences and realities (Brooks & Brooks, 1993; Shapiro, 1994). The constructivist approach posits that effective learning occurs when new knowledge connects meaningfully with prior knowledge, creating a personalized and empowering learning experience (Novak, 1993).

The capacity of mind maps to incorporate multiple forms of representation, such as visual, audio, numeric, and textual elements, makes them an ideal tool for supporting this connection. By mapping ideas visually and hierarchically, learners can explore, organize, and retain concepts in a way that enhances their learning experience. Traditional teaching methods, which often rely on rote memorization, fail to achieve this depth of engagement, as learners struggle to connect new information with existing knowledge. In contrast, mind maps facilitate the establishment of meaningful connections, enhancing learner engagement, retention, and understanding.

The Role of Mind Maps in EFL Writing Achievement

Mind mapping, founded on the cognitive theory of learning, is identified as a valuable tool for learning and organizing information. The process, via the method, provides a new and effective method of outlining ideas, which enables students to map and arrange their thoughts in a systematic manner (Buzan, 2002, 2006). In contrast to conventional note-taking or listing processes with their strict, hierarchical organization, mind maps offer a flexible, non-hierarchical system that invites the identification of relationships among concepts. It is this feature that makes mind maps so useful in the pre-writing process, which involves brainstorming and idea generation. Mind mapping strategies allow students to arrange ideas pertaining to the topic in the center in a logical, yet individualized, manner (Buzan, 1993). The use of imagery, symbols, vocabulary, codes, and colors greatly adds to this process, thereby engaging different forms of intelligence, as discussed by Gardner (1985, 1999).

Research has demonstrated that mind maps can scaffold learners as they structure essays, identify key arguments, and address coherence issues in their writing (Al-Jarf, 2009; Davies, 2011; Fu & Relyea, 2024; Okada, 2014; Villalon & Calvo, 2011; Wette, 2017). For Iranian EFL learners, who often face challenges due to first language (L1) interference (Khoshsima &

Banaruee, 2017), mind mapping provides a structured and visual approach to minimize errors and enhance grammar, vocabulary, accuracy, and fluency (Fu & Relyea, 2024).

Mind Maps in the EFL Writing Process

The majority of previous studies (e.g., Leeds, 1996; Richards, 1992; Scholes & Comley, 1989) on writing skill in general described the following three phases for it:

1. Pre-writing: Gathering and generating ideas.
2. Drafting: Composing, structuring, and reconstructing ideas.
3. Revision: Refining and improving the text.

Mind maps are particularly valuable during the pre-writing phase, where learners can generate, gather, and arrange their ideas in a hierarchical and connected way (Scarcella & Oxford, 1992). The idea Buzan (2000) had in mind mapping was that it is a visual tool that organizes ideas radiating from a central theme, with major categories branching out into subcategories, creating a lasting impact on learners' memory and retention. This process mirrors how the human brain works on the basis of associations, linking hundreds of ideas and information together (Anokhin, 1973).

Mind Mapping as a Tool for Writing Development

Mind maps facilitate the development of key writing skills by providing a structured yet flexible framework. They allow learners to:

- Brainstorm and explore ideas related to a central topic.
- Develop a hierarchical structure, connecting major components with minor details.
- Generate content in a way that mirrors the natural associative tendencies of the brain.

Research suggests that mind maps can be used in language classes as both a manual and digital tool. Teachers can create mind maps manually during lessons or encourage students to use online software, such as MindMeister or Think Buzan, to develop their writing proficiency (Leyden, 2014). The use of lines, arrows, symbols, and colors not only makes writing more engaging but also supports learners in connecting new knowledge with existing knowledge.

Virtual Mind Mapping in EFL Writing

The advent of digital tools has expanded the potential of mind mapping in EFL contexts. Virtual mind mapping tools, such as MindMeister and Coggle, provide opportunities for multimedia integration, real-time collaboration, and gamification, which enhance learner engagement and motivation (Chang et al., 2018; Sagita et al., 2024; Selevičienė, 2024). These tools allow learners to embed images, videos, and hyperlinks, fostering multimodal literacy and enriching the writing process (Chularut & DeBacker, 2004).

Studies comparing virtual and non-virtual mind maps suggest that digital tools positively impact writing performance, learner motivation, and self-efficacy (Hung et al., 2014; Lin & Wang, 2021; Zhang, 2022). However, non-digital mind maps remain valuable in resource-limited settings, such as many Iranian classrooms, due to their simplicity and accessibility.

Mind Maps and Motivation in EFL Writing

Writing in EFL contexts often requires sustained effort and engagement, making motivation a critical factor for success (Hidi & Boscolo, 2006). Mind maps, with their interactive and engaging format, have been shown to boost intrinsic motivation by breaking the monotony of traditional writing instruction and fostering creativity (Amin & Hina, 2018; Jones et al., 2012; Sari et al., 2021). For Iranian EFL learners, who often struggle with demotivating factors such as fear of making errors and lack of confidence (Fathi et al., 2019; Ghonsooly et al., 2017), mind mapping provides a visually appealing and learner-centered approach that reduces writing anxiety.

Virtual mind maps further enhance motivation by incorporating gamified elements, critical thinking features, and opportunities for collaboration (Sagita et al., 2024; Selevičienė, 2024). These tools increase learners' sense of accomplishment and self-efficacy, making the writing process enjoyable and rewarding (Hung et al., 2014; Lin & Wang, 2021; Zhang, 2022). However, further research is needed to explore the comparative motivational impacts of virtual and non-virtual mind maps in Iranian EFL contexts.

Mind mapping is a versatile and effective tool for enhancing EFL writing achievement and motivation. Rooted in cognitive and constructivist theories, mind maps facilitate idea generation, organization, and retention, making them particularly valuable during the pre-writing phase. Whether used as a manual or digital tool, mind maps engage multiple intelligences and cater to diverse learning styles, providing learners with a personalized and empowering writing experience. Future research should explore the comparative effects of virtual and traditional mind mapping techniques, offering deeper insights into their impact on learners' writing skills, motivation, and overall learning outcomes.

Recent Empirical Studies

Mind Mapping in EFL Writing and Motivation

Mind mapping has gradually evolved as a powerful pedagogical tool for enhancing the writing skills and motivation of EFL learners, with research exploring its cognitive, linguistic, and affective benefits. Over the years, studies have documented both traditional and digital approaches to mind mapping, reflecting its versatility and increasing relevance in modern education.

One of the earliest studies on mind mapping, conducted by Kusmaningrum (2016), demonstrated its dual ability to enhance writing performance and facilitate reading comprehension among EFL learners. This foundational work highlighted the versatility of mind mapping as an instructional strategy, paving the way for further exploration of its applications in EFL contexts. Shortly after, Yunus and Chien (2016) examined Malaysian university students' perceptions of mind mapping in the Malaysian University English Test (MUET). Their findings revealed how mind mapping not only aided planning and topic comprehension but also fostered creativity, resulting in improved writing performance and a positive attitude toward writing tasks. Around the same time, Khudhair (2016) conducted a quasi-experimental

study with 60 Iraqi EFL students, finding significant improvements in writing proficiency and enthusiasm for writing among those who used mind mapping compared to a control group.

Building on these early insights, Marashi and Kangani (2018) explored the comparative advantages of mind mapping over concept maps in a quasi-experimental study with intermediate EFL learners. Over the course of 14 sessions, their results showed that mind mapping was more effective in enhancing descriptive and narrative writing. Similarly, Wangmo's (2018) mixed-methods study with Bhutanese EFL learners confirmed the cognitive and affective benefits of mind mapping, demonstrating notable improvements in descriptive writing scores alongside increased motivation and confidence.

As research on mind mapping advanced, its application expanded into diverse educational settings. Khusniyah (2019) employed action research to investigate its impact on descriptive writing among Indonesian students, reporting significant gains in proficiency. Shortly thereafter, digital mind mapping began to gain prominence as a modernized approach to this teaching strategy. Abd Karim and Mustapha (2020) explored the use of digital mind mapping tools in Malaysian universities, finding that technology enhanced creativity, critical thinking, and engagement in ESL writing tasks. These findings were echoed by Sairo et al. (2021), whose classroom action research with 33 students revealed dramatic improvements in writing performance, with pre-test scores rising from 24% to 90% in the final post-test. The integration of technology into mind mapping not only amplified student engagement but also fostered creativity and critical thinking.

In subsequent years, new studies continued to affirm the benefits of both traditional and digital mind mapping. Subari et al. (2022) implemented classroom action research with seventh-grade students in Indonesia, demonstrating improvements in writing scores from 64.03 to 78.36 through collaborative and repetitive mind mapping activities. This study underscored how the process-oriented nature of mind mapping could enhance both writing outcomes and student participation. Similarly, Vejayan and Yunus (2022) investigated the use of the MINDOMO platform for digital mind mapping in narrative writing among Malaysian students. Their findings confirmed significant improvements in writing performance and revealed that students found the tool effective in simplifying complex ideas and improving their overall writing experience.

More recently, Ismail (2024) conducted a quasi-experimental study with university students to evaluate the effects of mind mapping on creative writing and systemic thinking. His results demonstrated significant improvements in idea generation, narrative structuring, and linguistic accuracy, emphasizing the cognitive organizational benefits of mind mapping for advanced writing tasks. Meanwhile, Alqasham and Al-Ahdal (2022) conducted an experimental study with Saudi EFL learners, showcasing how digital brainstorming tools could significantly enhance writing proficiency and motivation, further solidifying the transformative potential of technology-enhanced mind mapping.

The evolution of mind mapping research has moved from foundational studies on its cognitive and linguistic benefits to a growing emphasis on its digital applications. Across both traditional and digital approaches, the consistent findings highlight its ability to improve writing proficiency, foster creativity, and boost motivation, making it a valuable tool in modern EFL instruction.

Perceptions and Pedagogical Implications

Perceptions of mind mapping among students and educators have evolved steadily, highlighting its practicality and adaptability as a tool in writing instruction. Early research, such as that by Basri and Syamsia (2020), explored its use among high school students in descriptive writing tasks. Their study revealed that mind mapping not only heightened enthusiasm but also encouraged innovative thinking. By transforming writing from a routine task into an engaging activity, this research emphasized the motivational benefits of mind mapping, setting the stage for subsequent studies to explore its broader pedagogical implications.

Building on these insights, Tarin and Yawiloeng (2023) investigated the cognitive and emotional impacts of mind mapping on Thai EFL students' writing practices. Through semi-structured interviews and observations, the researchers discovered that mind mapping significantly enhanced not only writing proficiency but also students' self-assurance and positive attitudes toward writing. These findings reinforced earlier observations by demonstrating that mind mapping can simultaneously address cognitive and affective dimensions, making it a holistic instructional tool.

Student perspectives on mind mapping were further elaborated in a study by Hanggrasawani et al. (2024), which examined its role in academic writing. Their qualitative analysis revealed that students valued mind mapping for its ability to enhance organization, idea generation, and overall clarity in writing. Students consistently reported that mind mapping helped them organize their thoughts more effectively and produce coherent essays, underscoring its practical utility in academic contexts.

Educator perspectives have also played a crucial role in shaping the understanding of mind mapping's pedagogical potential. Bui and Phan (2025) conducted a mixed-methods study to explore how Vietnamese EFL teachers perceive the effectiveness of mind mapping in writing instruction. Teachers highlighted its ability to create interactive and supportive learning environments, facilitating clarity and thoroughness in writing. This aligns with prior findings on the strategy's capacity to enhance both the teaching and learning experience, further validating its relevance in diverse educational settings.

Together, these studies reflect the growing recognition of mind mapping as a transformative tool in writing instruction. From fostering enthusiasm and creativity to improving organization and self-confidence, the positive perceptions of both students and educators underscore the educational significance of this strategy. By bridging cognitive, emotional, and practical dimensions, mind mapping has proven to be a valuable mechanism for enriching the writing process. Despite the wealth of evidence supporting mind mapping, several

gaps remain. Few studies have systematically compared virtual and non-virtual mind mapping techniques to determine their relative effectiveness in different cultural and educational contexts. Additionally, there is a need to investigate the students' perceptions regarding these innovative teaching strategies. The current study addresses these gaps by examining both virtual and non-virtual mind mapping techniques among Iranian EFL learners. By employing a mixed-methods design, it investigates not only the comparative effects of these tools on writing achievement but also their influence on student motivation and perceptions. Furthermore, the study's focus on Iranian learners provides valuable cross-cultural insights, contributing to a more comprehensive understanding of mind mapping's global applicability in EFL writing instruction.

Method

Research Design

The design combined quantitative and qualitative approaches to provide a wide-ranging understanding of the research questions. Specifically, a quasi-experimental pretest-posttest design was utilized in the quantitative phase, involving three groups: two experimental groups (virtual and non-virtual mind mapping) and a control group (traditional instruction). The quasi-experimental nature stemmed from the lack of random group assignment, as practical constraints in the language institute necessitated intact groups. In this phase, the sampling criterion was based on the availability of intact classes in the language institute, with participants grouped according to their pre-existing enrollment in specific instructional settings. This ensured that the three groups were comparable in terms of their prior exposure to language instruction, as determined by their pretest scores.

The independent variables were the instructional treatments (virtual and non-virtual mind mapping techniques), while the dependent variables included learners' writing achievement and motivation. The quantitative phase included pretests and posttests to measure changes in participants' writing skills and motivation before and after the intervention. For the qualitative phase, purposive sampling was employed to select participants for semi-structured interviews. The criterion for selection focused on ensuring diversity in performance and engagement levels (both low-achieving and high-achieving students were selected from the two experimental groups), as identified in the quantitative phase. This strategy enhanced the representativeness of the qualitative data by including participants with varying experiences and outcomes related to the intervention.

The sequential explanatory design allowed for a two-phase approach: the quantitative data were analyzed first, followed by the qualitative data. The integration of findings occurred during interpretation to ensure the results from both phases were interdependent. This approach aligns with Dornyei's (2007) emphasis on the utility of mixed-methods research in uncovering nuanced insights into complex educational phenomena.

Participants

From a group of 120 pre-intermediate EFL learners, 90 were chosen based on their performance on the Key English Test (KET). The group consisted of male and female Iranian students studying the English language at the Kanoon-e Zaban Institute in Sabzevar, Iran. While the majority of the participants were university graduates, the rest were university students aged between 25 and 35 years. All participants had Persian as their native language. The individuals scoring 40 to 50 on the KET were identified as having a pre-intermediate English language proficiency level and were then invited to take part in this study. Once participant homogeneity had been ensured by the KET, three groups of virtual, non-virtual (experimental), and traditional (control) were formed, and students were randomly assigned to each group. Table 1 illustrates participants' demographic background details.

Table 1

Participant Specifications

Category	Details
Location of Experiment	Kanoon-e Zaban Institute, Sabzevar
Duration of Study	Eight Weeks (16 Sessions, 90 Minutes Each)
Session Frequency	Two sessions per week
Total Participants	90 participants: - 30 in Exp G 1 - 30 in Exp G 2 - 30 in the Control Group
Age Range	25–35 years
Gender	Mixed (Male and Female)
Native Language	Persian

Instruments

Key English Test (KET)

At the outset of the study, the Key English Test (KET) was administered to ensure participant homogeneity. Developed by Cambridge ESOL, this test served as a proficiency measure for selecting suitable candidates from the target population. The KET is designed for non-native English speakers learning the language and assesses four key skills: Reading, Writing, Listening, and Speaking. It corresponds to Cambridge Level One, which aligns with the A2 level on the Common European Framework of Reference for Languages (CEFR). The test is divided into three main parts: Paper 1 includes a reading and writing section with nine tasks, Paper 2 contains a listening section with five tasks, and Paper 3 comprises a speaking section with two tasks.

Researcher-Made Writing Test

For both the pretest and posttest phases, the researcher employed two writing prompts adapted from traditional paper-based TOEFL examinations. Each assessment required participants to compose a paragraph on a specified topic (see Appendix A). The maximum score

attainable for each test was 30 points, with evaluations conducted according to the Jacobs et al. (1981) Analytic Rubric. This rubric assessed five key criteria: content (30 points), organization (20 points), vocabulary (20 points), language use (25 points), and mechanics (5 points), culminating in a total possible score of 100.

Prior to administration, the tests were reviewed by two EFL professors, ensuring content validity. To assess reliability, Cronbach's alpha coefficient was applied, yielding an alpha value of 0.85, confirming the tests' internal consistency. While TOEFL writing tasks are designed for higher proficiency learners, the adapted writing tests were simplified to suit the pre-intermediate level, making them appropriate for the study's participants.

Motivation Questionnaire

The Motivation Questionnaire (Appendix B), adopted from Nakhon Kitjaroonchai (2013), consisted of 20 five-point Likert scale items. This instrument measured participants' motivation for learning English before and after the intervention. To ensure accessibility and accuracy, the questionnaire was translated into Persian for ease of understanding, followed by back-translation to validate the accuracy of the Persian version. The translation addressed the participants' limited English proficiency, preventing misunderstandings and ensuring reliable responses.

The questionnaire's reliability was confirmed in a pilot study with Cronbach's alpha, yielding a value of 0.88. Nakhon Kitjaroonchai (2013) also reported high validity and reliability indices for this instrument, making it suitable for the current study.

Semi-Structured Interviews

Six interview questions (Appendix C) were developed to gather qualitative data on participants' perceptions of mind mapping techniques. The questions explored their experiences with virtual and non-virtual mind mapping, as well as its impact on their motivation and writing skills. To ensure content validity, the interview questions were reviewed and refined based on feedback from two applied linguistics experts.

Given participants' limited English proficiency, the interviews were conducted in Persian to avoid ambiguities. The interviews were audiotaped, transcribed, and analyzed thematically using MAXQDA software.

Materials

The instructional materials for the experimental groups included reading texts and writing prompts from the *Top-Notch English Series*. These were supplemented with virtual mind mapping tools (MindMeister, Edrawsoft) for the first experimental group and manual mind maps for the second group. The mind maps were designed following Buzan's (1993) guidelines, emphasizing central ideas, branching structures, and the use of colors and images to enhance creativity and comprehension.

Data Collection Procedure

In this study, the data collection was organized in three different phases: the pilot phase, the main study phase, and the follow-up phase after the intervention. Each phase of the data

collection was developed to ensure that the instruments and instructional procedures specified to address the study were effective. This section will provide a description of the procedures conducted by each group (Virtual Mind Map, Non-Virtual Mind Map, and Control) and the differences in each instructional process.

Pilot Study

With the purpose of ensuring the reliability, validity, and clarity of all research instruments, a pilot study with 15 EFL learners who had the same characteristics, in terms of age, language proficiency, etc., was conducted. One significant adjustment made during this phase was the translation of the motivation questionnaire into Persian, as participants at the pre-intermediate level struggled to fully comprehend the English version. To ensure accuracy, the Persian version underwent back-translation into English, allowing the researcher to identify and correct any discrepancies between the source and target languages. Feedback from the pilot study also helped refine the instructions for all instruments and confirmed their reliability, with Cronbach's alpha values exceeding 0.85 for both the writing test and the Motivation Questionnaire.

Main Study Phase

The main study involved 90 pre-intermediate Iranian EFL learners, selected from an initial pool of 120 participants based on their performance on the KET. These participants were divided into three groups: the virtual mind map group, the non-virtual mind map group, and the control group. Each group participated in 16 sessions over eight weeks, with two 90-minute sessions per week. The instructional approach varied across the groups, as detailed below.

Participants in the virtual mind map group were introduced to digital mind mapping tools and received explicit, systematic instructions on how to use these tools as a prewriting strategy to enhance their organization and creativity in writing. The sessions began with an introduction to mind mapping, during which the instructor explained its benefits for brainstorming and structuring ideas. To ensure students fully understood the process, the instructor provided step-by-step demonstrations of how to create a mind map, starting with a central idea and branching into subtopics and supporting details. For instance, the instructor showed how a central idea like "A Memorable Trip" could branch into details such as the destination, activities, and personal reflections, forming a clear hierarchical structure of related concepts. Next, students were trained in the use of digital tools such as MindMeister, iMindMap, and Edrawsoft, which allowed them to create visually engaging mind maps. The training included specific guidance on how to utilize these tools effectively, such as selecting appropriate colors, images, and shapes to make the maps more memorable and organized. Students practiced these skills during the sessions by working on writing prompts (e.g., "Describe a memorable trip"), brainstorming ideas, and creating digital mind maps for each topic. These maps were then shared in small group discussions, where students exchanged feedback and refined their ideas. The group discussions also provided an additional layer of instruction, as students received peer input and guidance on improving their brainstorming and organization techniques. After completing their

mind maps, students wrote a paragraph based on the visual structure they had created. The instructor evaluated their writing using Jacobs et al.'s Analytic Rubric, which assessed traits like content, organization, and language use. The structured approach ensured that students received ongoing feedback on both their mind maps and their written paragraphs, reinforcing the connection between planning and writing. Additionally, the use of virtual tools allowed for easy revisions and encouraged students to explore connections between ideas more effectively. This group benefited not only from the collaborative discussions but also from the dynamic and interactive nature of the digital tools.

The Non-Virtual Mind Map Group followed a similar instructional approach but relied on hand-drawn mind maps instead of digital tools. At the start of each session, the instructor provided a brief introduction to the selected writing topic and explained the steps for creating a mind map manually. Students were provided with blank sheets of paper, colored pencils, and markers to design their maps. To begin, students wrote the central idea of the given writing prompt in the middle of the paper and branched out with subtopics and examples. They were encouraged to use colors and simple illustrations to make their maps visually appealing. The instructor guided the process, offering feedback and suggestions for improvement. In contrast to the virtual group, revisions in the non-virtual group required students to redraw sections of their maps, which made the process more time-consuming but also allowed for deeper engagement with the material. Once their maps were completed, students participated in classroom discussions, where they shared their work with peers and received feedback from both classmates and the instructor. Following this, they wrote paragraphs or essays based on their mind maps. As with the Virtual Mind Map Group, their writing was evaluated using the same rubric. While the conceptual steps were similar to the virtual group, the tactile, hands-on approach of drawing maps manually provided a more grounded experience for participants who preferred working on paper.

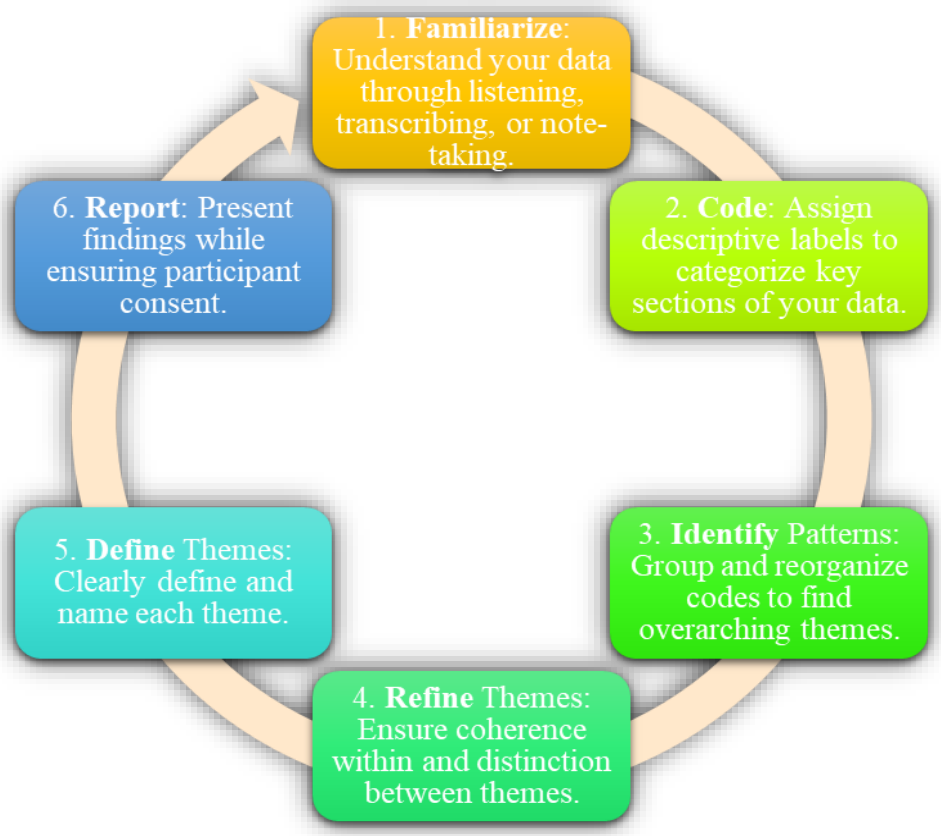
The control group followed a traditional approach to writing instruction, which did not involve the use of mind mapping techniques. At the start of each session, the instructor introduced a writing prompt and asked students to think about the topic individually. Unlike the experimental groups, students in the control group were not provided with any specific brainstorming or organizational strategies. Instead, they were expected to write directly, using their existing knowledge and skills. After completing their writing tasks, the instructor collected the assignments, provided corrective feedback on areas such as grammar, vocabulary, and sentence structure, and returned them for revision. The instructional approach in this group emphasized linear writing processes without visual aids or collaborative brainstorming. This method, while familiar to the participants, lacked the interactive and creative elements present in the experimental groups. As a result, students often struggled with organizing their ideas and producing cohesive writing.

When this eight-week intervention ended, all participants completed the posttest writing task and the motivation questionnaire, which mirrored the instruments used in the pretest. This

allowed the researcher to measure changes in writing achievement and motivation across the three groups. The interviews with the students occurred after the experiment, too. Twenty students (10 from the virtual and 10 from the non-virtual group) who showed their willingness to be part of the second phase of the study (qualitative phase) were interviewed. The interviews explored participants' perceptions of the mind mapping techniques, their impact on motivation and writing skills, and any challenges encountered during the intervention.

Figure 1

Cohen et al.'s (2002) six-stage framework for thematic analysis



Data Analysis Procedure

The researcher utilized SPSS version 24.0 for analyzing quantitative data such as scores obtained from the KET, pretests, and post-tests. Statistical measurements like mean and standard deviation were computed to illustrate the data. The normality of distributions was examined using the Kolmogorov-Smirnov test. Although ANCOVA was considered as a potential statistical method for controlling the effect of pre-test scores, it was ultimately not employed in this study due to two primary reasons: (1) the groups were already equivalent in their pre-test scores, as confirmed by preliminary statistical analyses, and (2) the study's design and research questions prioritized analyzing raw post-test scores to capture the overall effectiveness of the interventions without adjusting for covariates. Instead, a one-way ANOVA

was conducted to assess variations in writing achievement among the groups in relation to research questions one and two. To investigate research question three, a t-test (independent samples) was employed to compare motivation levels across the experimental groups. Additionally, effect sizes were determined to evaluate the magnitude of these discrepancies.

Data from the interviews were thematically analyzed using Cohen et al.'s (2002) six-stage framework (Figure 1). All of the interviews were transcribed, the data were coded, patterns were identified, and themes were generated. The researchers used MAXQDA (computer-assisted qualitative data analysis software) to help organize and analyse the data. The analysis resulted in themes related to participants' perceptions of the use of virtual vs. non-virtual mind mapping in writing, including engagement, creativity, and organizational skills.

Results

Quantitative Phase

Regarding the first question of the study, the mean scores of the pre-test and post-test for the three groups (virtual mind map group, non-virtual mind map group, and control group) were compared (Table 2).

Table 2

Descriptive Statistics for Writing Achievement

Group	Test	N	Mean	Standard Deviation	Min	Max
Virtual Mind Maps	Pre-Test	30	20.00	3.74	13.0	27.0
	Post-Test	30	25.10	3.75	17.0	30.0
Non-Virtual Mind Maps	Pre-Test	30	20.40	5.31	10.0	30.0
	Post-Test	30	22.50	3.53	17.0	30.0
Control Group	Pre-Test	30	20.27	5.67	11.0	30.0
	Post-Test	30	20.13	5.46	11.0	29.0

The findings presented in Table 2 indicate that the post-test mean score for the virtual mind map group (M = 25.10, SD = 3.75) was significantly higher than their pre-test score (M = 20.00, SD = 3.74), showing a mean improvement of 5.10 points. Similarly, the non-virtual mind map group showed an increase of 2.10 points, from M = 20.40 (SD = 5.31) in the pre-test to M = 22.50 (SD = 3.53) in the post-test. However, the control group showed minimal improvement, with a slight decrease in the post-test mean (M = 20.13, SD = 5.46) compared to the pre-test mean (M = 20.27, SD = 5.67). These numerical differences clearly demonstrate the positive effect of using mind maps, particularly virtual ones, on improving students' writing skills. To confirm the significance of these differences, a one-way ANOVA was conducted (Table 3).

Table 3

One-Way ANOVA for Writing Achievement

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.714	2	1.857	0.140	0.000
Within Groups	357.786	27	13.251		
Total	361.500	29			

The results of the ANOVA indicated a statistically significant difference in post-test scores among the groups (F = 0.140, p = 0.000). The virtual mind map group outperformed the other groups, followed by the non-virtual group, while the control group showed negligible improvements. This further confirms the effectiveness of using mind maps as a teaching method for improving writing skills.

The second part of the study focused on assessing the impact of mind mapping on students' motivation to learn writing. Table 4 presents the descriptive statistics for motivation levels.

Table 4

Descriptive Statistics for Motivation Levels

Group	Test	N	M	SD	Min	Max
Virtual Mind Maps	Pre-Motivation	30	1.93	1.33	1.0	5.0
	Post-Motivation	30	3.79	1.06	1.0	5.0
Non-Virtual Mind Maps	Pre-Motivation	30	1.95	1.35	1.0	5.0
	Post-Motivation	30	3.52	1.10	1.0	5.0
Control Group	Pre-Motivation	30	1.92	1.31	1.0	5.0
	Post-Motivation	30	2.00	1.28	1.0	5.0

The data in Table 4 reveal that students in the experimental groups (virtual and non-virtual mind maps) experienced significant increases in motivation. Specifically, the virtual mind map group's motivation levels increased by 1.86 points, from M = 1.93 (SD = 1.33) pre-test to M = 3.79 (SD = 1.06) post-test. The non-virtual group also showed an increase of 1.57 points, from M = 1.95 (SD = 1.35) to M = 3.52 (SD = 1.10). In contrast, the control group's motivation levels remained almost unchanged, with a negligible increase from M = 1.92 (SD = 1.31) to M = 2.00 (SD = 1.28). These results highlight the effectiveness of mind mapping techniques, particularly virtual ones, in enhancing students' motivation to write. ANOVA was used to statistically analyze these differences, as shown in Table 5.

Table 5

One-Way ANOVA for Motivation Levels

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.929	2	0.964	0.795	0.002
Within Groups	32.738	27	1.213		
Total	34.667	29			

The results of the ANOVA showed a statistically significant difference in motivation levels (F = 0.795, p = 0.002) between the groups. Both experimental groups demonstrated significant improvements in motivation, with the virtual mind map group showing the highest post-test motivation scores (M = 3.79). To compare the effectiveness of virtual and non-virtual mind maps, an independent samples t-test was performed (Table 6).

Table 6

Independent Sample T-Test Results for Virtual vs. Non-Virtual Mind Maps

Group Comparison	Mean Difference	t	df	Sig. (2-Tailed)
Virtual Mind Maps vs. Non-Virtual	3.57	6.88	89	0.002

The t-test results revealed a significant difference between the virtual and non-virtual mind map groups ($t = 6.88$, $p = 0.002$), with the virtual mind map group scoring 3.57 points higher on average.

Qualitative Phase

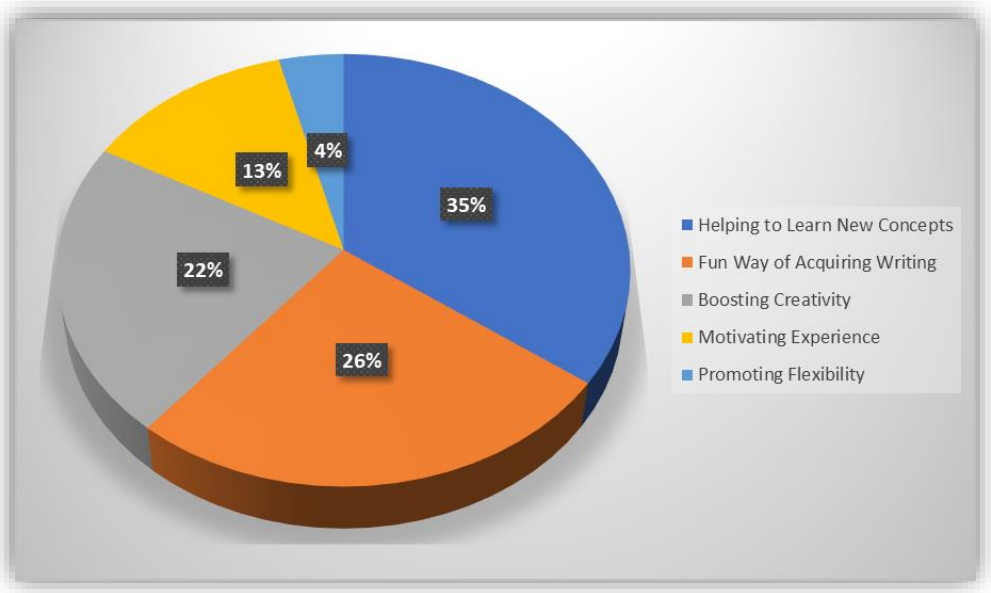
The interviews aimed to capture the participants' perceptions of learning and practicing writing skills in both experimental groups. After collecting the data, thematic analysis was utilized, and key themes were identified and categorized for both groups.

Findings from the First Experimental Group (EG1): Virtual Mind Mapping

Virtual mind mapping is a digital tool that enables students to create diagrams and visually organize information. The analysis of interviews with EG1 participants revealed five recurring themes regarding the benefits and perceptions of virtual mind mapping. These themes and adjusted percentages are summarized in Figure 2.

Figure 2

Major Themes for Virtual Mind Mapping (EG1)



Theme Analysis with Explanations and Participant Excerpts

Helping to Learn New Concepts (35%)

Thirty-five percent of students believed that virtual mind mapping significantly enhanced their ability to understand and learn new concepts more effectively. By visually connecting

ideas, students were able to grasp relationships between concepts and apply them in writing structures. This visual representation of ideas allowed students to break down complex topics into more manageable parts, facilitating deeper comprehension. Moreover, the interactive aspect of virtual mind mapping encouraged active engagement with the material, making the learning experience more dynamic and meaningful. Students reported that this method helped them to not only identify key concepts but also to see how these concepts interconnected, leading to a more holistic understanding of the subject matter.

One participant explained, "With virtual mind mappings, I can find a focus question or concept and identify more concepts that relate to the main concept and place them around it" (Participant 1). This highlights how virtual mind mapping serves as a tool for problem-solving and brainstorming, helping students organize their thoughts in a structured way.

Another participant shared the following:

Online mind mapping allows me to explore ideas, concepts, and other types of information visually. It makes me think and explore concepts, connecting them in ways that make sense to me. Building a mind map amplifies meaningful learning since you aren't simply connecting previous information but linking new subjects and ideas in a way that aids in faster learning and understanding. (Participant 5)

This statement emphasizes the personalized nature of virtual mind mapping, as students can tailor the process to fit their learning styles. The ability to visualize connections fosters a sense of clarity and helps students retain information better by linking abstract ideas into a coherent framework. Additionally, virtual mind mapping provides a sense of ownership over the learning process, as students actively build their knowledge maps. This interactive strategy not only boosts comprehension but also enhances critical thinking skills, as learners are required to analyze, categorize, and synthesize information.

Fun Way of Acquiring Writing (26%)

Twenty-six percent of the students described virtual mind mapping as an enjoyable and creative way to improve their writing skills. The use of colors, symbols, and creative diagrams made the learning process less monotonous and more engaging. This element of fun and creativity helps to reduce the stress often associated with academic writing, transforming it into an activity that students look forward to. By incorporating visual and artistic elements, the process of developing ideas and structuring them becomes more appealing and less rigid. Students found that the visual and interactive nature of mind mapping allowed them to express their thoughts freely, making it easier to organize their ideas in a coherent way and boosting their confidence in writing.

One participant noted, "You may use different colors, symbols, shapes, and fonts in your diagram. Writing doesn't have to be boring; you can make it funnier through mind maps" (Participant 3). This highlights how using a variety of visual tools not only injects creativity into the writing process but also provides a sense of personalization that makes learning more enjoyable.

The flexibility of virtual mind mapping ensures that students can adapt the process to match their preferences and keep themselves motivated. Another participant shared, "Unlike linear notes, creating a mind map doesn't feel like work. It's fun and interesting to write points using charts and figures" (Participant 4). This reflects how virtual mind mapping breaks away from the traditional, rigid formats of note-taking or writing outlines. By introducing an element of playfulness, it transforms the task into an engaging experience, allowing students to explore new ideas and refine their writing skills intuitively and enjoyably. Moreover, the gamified aspect of virtual mind mapping encourages active participation, making the learning process not just educational but also entertaining. The ability to experiment with different layouts, designs, and connections fosters a sense of creativity and ownership, enabling students to approach writing in a more relaxed and enthusiastic manner. This positive association with writing tasks can lead to sustained improvements in both motivation and output quality.

Boosting Creativity (22%)

Twenty-two percent of the students identified virtual mind mapping as a powerful tool for stimulating creativity. It allowed students to explore innovative ideas and approach writing tasks in a more dynamic and imaginative way. By visually organizing thoughts and connecting ideas, students were able to think outside the box and generate unique perspectives. This process encouraged them to go beyond conventional approaches to problem-solving and writing, fostering originality and innovation. Virtual mind mapping provided a flexible framework that inspired students to experiment with their ideas, enabling them to discover creative solutions more effectively.

One participant explained, "It helps you find more creative solutions, retain key information, and collaborate better" (Participant 2). This statement highlights how virtual mind mapping not only enhances individual creativity but also facilitates teamwork and collaboration. The ability to visually share and expand upon ideas with others nurtures a collaborative environment that sparks further innovation.

Additionally, the retention of key information through creative representations ensures that students remain focused on their goals while exploring new possibilities. Another participant shared, "Creating a mind map boosts creativity and productivity, helping to identify the purpose and boosting confidence" (Participant 10). This emphasizes how virtual mind mapping serves a dual purpose: it simultaneously enhances creativity and increases productivity. By enabling students to clearly identify their goals and the steps needed to achieve them, the tool fosters a sense of direction and purpose. This clarity, combined with the creative freedom offered by mind mapping, builds confidence in tackling complex tasks.

Motivating Experience (13%)

Thirteen percent of the students highlighted virtual mind mapping as a motivating tool that helped them set clear goals and visualize their progress. The ability to break down tasks into smaller, manageable components provided a sense of direction and accomplishment, which kept students motivated throughout the process. By visually mapping their objectives and

tracking their progress, students were able to stay focused and maintain a sense of purpose. This clarity not only helped them organize their thoughts but also reinforced their commitment to completing tasks effectively.

One participant shared the following:

You basically start with a central word and draw branches with related word nodes expanding out indefinitely. You can add color and images to make it more fun and impactful. This method can help clarify what you want and don't want, set clear goals, and set goals to help in motivation and success. (Participant 7)

This underscores how virtual mind mapping is not just a tool for organizing ideas but also a means of self-reflection. By identifying priorities and eliminating distractions, students could focus on their key objectives with greater determination. The visualization of goals acted as a constant reminder of their purpose, further driving their motivation.

Another participant added, "When you connect ideas creatively, new thoughts emerge, motivating you to plan and execute tasks" (Participant 2). This highlights how the creative aspect of virtual mind mapping plays a critical role in maintaining motivation. The act of connecting ideas visually and discovering new insights fosters a sense of excitement and engagement. This process encourages students to think critically and proactively plan their next steps, making the execution of tasks feel more achievable and rewarding.

Promoting Flexibility (4%)

A few students appreciated the flexibility of virtual mind mapping tools, which allowed them to access and use the software at their convenience. The ability to work on mind maps anytime and anywhere made the tools especially beneficial for students with busy schedules. This flexibility ensured that learners could adapt the process to their individual needs and timelines, reducing the pressure of adhering to rigid schedules or deadlines. By offering on-demand access, virtual mind mapping tools supported a more personalized and stress-free learning experience.

One participant noted, "I was loaded with work, but this virtual course was flexible. I didn't have to force myself to join at specific times" (Participant 6). This highlights how virtual mind mapping tools and courses accommodate students' varying workloads and commitments. By removing the constraints of fixed schedules, these tools empower students to engage with their learning materials at their own pace, fostering a sense of autonomy and control over their educational journey.

Another participant stated, "Great virtual tools are accessible via web browsers and mobile devices, making them highly flexible" (Participant 10). This emphasizes the accessibility of virtual mind mapping tools, which are compatible with multiple platforms, including web browsers and mobile devices. The ability to switch between devices ensures that students can work on their mind maps seamlessly, whether they are at home, on campus, or on the go. This level of accessibility makes the tools more inclusive and practical for diverse learning environments. Furthermore, the flexibility of these tools not only supports time management

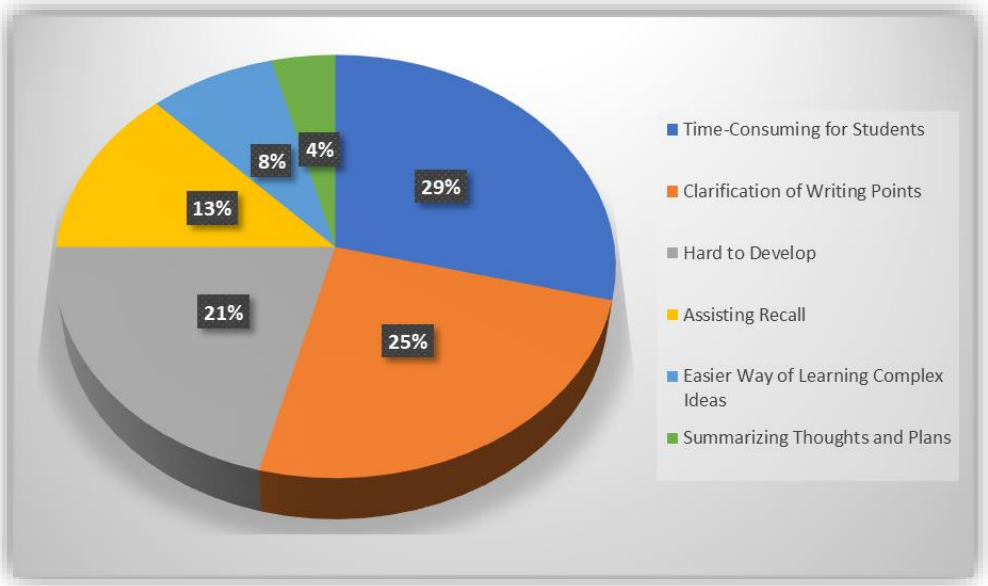
but also enhances productivity. By allowing students to revisit and revise their mind maps as needed, the tools encourage continuous learning and improvement. This adaptability ensures that students can integrate virtual mind mapping into their daily routines without feeling overwhelmed, making it a valuable resource for both academic and personal development.

Findings from the Second Experimental Group (EG2): Non-Virtual Mind Mapping

Non-virtual mind mapping involves manually drawing diagrams and organizing information on paper. For some students, this method was effective in understanding writing structures, but others found it challenging and time-consuming. The analysis of interviews with EG2 participants revealed six major themes, which are summarized in Figure 3 below.

Figure 3

Major Themes for Non-Virtual Mind Mapping (EG2)



Theme Analysis with Explanations and Participant Excerpts

Time-Consuming for Students (29%)

Twenty-nine percent of students identified the time-consuming nature of non-virtual mind mapping as a significant challenge. The process of manually creating diagrams and organizing information required considerable effort, often detracting from the overall efficiency of the learning experience. On average, students reported spending approximately 30 to 45 minutes per session creating and organizing a single mind map. This included brainstorming ideas, structuring them logically, and refining the layout to ensure clarity. Such time demands were seen as a major barrier, especially when compared to the faster, more efficient workflows enabled by virtual mind mapping tools.

One participant remarked,

Drawing a mind map on a class board is very time-consuming, and it takes a lot of time for each student in the class, not to mention using any software and drawing images, lines,

relating concepts together, and correcting and expanding them one by one. Finding the right image takes a lot of time for students. Perhaps I find it and add it to the map, it doesn't really fit well, and I start all over again. (Participant 9)

This illustrates the frustration students experienced when forced to rely on manual methods that lacked the convenience and speed of digital tools. The physical effort required to draw and connect ideas made the process tedious, particularly when revisions or updates were needed, further slowing down their workflow.

Another participant shared, "Using colorful pencils and connecting ideas manually is very time-consuming" (Participant 7). This highlights how traditional methods, while visually appealing, often demanded significant time and effort to achieve the desired results. The need to repeatedly switch between tools, such as pencils or markers, and rework connections manually added to the burden, making the process less practical for time-constrained tasks.

Clarification of Writing Points (25%)

Twenty-five percent of the students found non-virtual mind mapping to be a valuable tool for clarifying writing structures and organizing ideas. The tactile and visual nature of creating manual mind maps helped students break down complex topics into manageable components while providing a clear overview of their thought processes. This method was particularly beneficial for structuring essays or projects, as it allowed students to see the logical flow of their ideas and identify gaps or redundancies.

One participant noted, "With non-virtual mind mapping, it's like that you always know the points of the information from the textbook; make us easier in getting detail information; give clear definition of the teacher explanation by providing some branches in mind mapping" (Participant 3). This highlights how traditional mind mapping techniques aid in simplifying and organizing thoughts, giving students a clear roadmap for their writing.

By physically drawing connections between ideas, students could better understand how individual components fit into the larger narrative or argument, enabling them to create well-structured and cohesive pieces of work. Another participant shared, "It makes meaningful relationships between ideas easier to see" (Participant 7). This emphasizes the ability of non-virtual mind mapping to reveal connections and relationships between concepts that might not be immediately apparent in linear note-taking. The visual representation of ideas allowed students to better grasp the interplay between different points, aiding in the development of more comprehensive and insightful writing.

While non-virtual methods might lack the efficiency of digital tools, the hands-on approach encouraged deeper engagement with the material. The process of manually creating and organizing ideas forced students to carefully think through their writing structure, leading to a more thorough understanding of the topic. This tactile interaction also helped reinforce memory and understanding, as students actively participated in the visualization of their ideas. For many, non-virtual mind mapping served as a foundational tool for organizing their thoughts and translating them into clear, logical writing.

Hard to Develop (21%)

Twenty-one percent of the participants reported struggling with the manual nature of non-virtual mind mapping, particularly when working on complex topics. The process of physically drawing and connecting ideas often felt overwhelming for students who were unfamiliar with this method or lacked confidence in their artistic or organizational skills. This challenge was compounded when dealing with intricate or multifaceted subjects, as manually structuring numerous interconnected ideas could quickly become confusing and time-intensive.

One participant explained, "It's hard to connect and develop ideas when you're new to this method" (Participant 6). This highlights how the steep learning curve associated with manual mind mapping can discourage students, especially those unfamiliar with its techniques. Without prior experience, students may struggle to effectively organize their thoughts or identify relationships between ideas, leading to frustration and inefficiency.

Another participant stated, "Logical thinkers may struggle with creating mind maps manually" (Participant 10). This demonstrates that students who prefer structured, linear approaches may find the freeform nature of manual mind mapping challenging. The lack of predefined templates or guidelines often left students unsure of how to begin or how to organize their ideas systematically, making the process feel disorganized or counterproductive.

Assisting Recall (13%)

Thirteen percent of the students highlighted that non-virtual mind mapping significantly aided their ability to retain and recall information more effectively. The process of manually creating diagrams engaged multiple senses—visual, tactile, and cognitive—which helped reinforce memory. By actively linking ideas and organizing them in a visual format, students could strengthen their understanding of the material and improve their ability to retrieve information when needed. This method leveraged the brain's natural preference for visual and spatial learning, making recall faster and more intuitive.

One participant explained, "It is easier for the brain to store diagrams than other representational formats. You tend to scan information in a nonlinear way, information is encoded separately in memory" (Participant 1). This underscores the cognitive benefits of visual learning techniques, as diagrams provide clear and memorable representations of information.

The act of manually drawing the mind map further enhances retention by requiring students to process and structure the material in a meaningful way. Another participant shared, "By linking ideas visually, I can recall information faster" (Participant 2). This emphasizes the role of visual connections in improving memory. The physical act of linking ideas on a mind map creates mental associations that make it easier for students to access the information later. These connections often serve as mental cues, helping students retrieve related concepts with greater ease.

Easier Way of Learning Complex Ideas (8%)

Non-virtual mind mapping was highlighted as an effective tool for simplifying the process of understanding and organizing complex concepts. Participants emphasized how this approach allowed them to visually break down intricate ideas into manageable components, fostering clarity and comprehension.

One participant noted,

It also makes it really easier to continue learning, as we can extend our mind map by connecting different concepts together, enriching our understanding. Another benefit of using mind mapping is that it helps form an understanding of complicated issues. (Participant 9)

The act of arranging information spatially, as opposed to relying solely on traditional linear note-taking, was particularly beneficial. By mapping out ideas, participants were able to see relationships and dependencies between concepts more clearly, which supported their understanding of the bigger picture.

Another participant mentioned, “The advantage of using mind mapping is that it helps form an understanding of complicated issues. With mind maps, we can connect these facts together and link them to different concepts within the same framework” (Participant 4).

Overall, the sentiment was that this approach offered a more intuitive and accessible way of learning, making complex ideas not only easier to understand but also more enjoyable to engage with.

Summarizing Thoughts and Plans (4%)

A few participants valued non-virtual mind mapping as an effective tool for summarizing ideas and developing concise plans. The process of visually organizing thoughts into a clear structure helped participants distill complex information into its essential components, making it easier to focus on key points and overarching themes.

One participant explained, “Mind maps summarize thoughts and link them to broader concepts” (Participant 8). This approach was particularly appreciated for its ability to condense large amounts of information into a simplified and visually digestible format. Participants found that creating mind maps enabled them to organize their thoughts systematically, which was especially helpful during tasks such as planning projects, preparing presentations, or studying for exams.

Both virtual and non-virtual mind mapping were viewed positively by most participants. Virtual mind mapping was praised for its flexibility, creativity, and engagement, while non-virtual mind mapping was appreciated for its ability to clarify ideas and assist with memory recall. However, participants also highlighted limitations, such as the time-consuming nature of non-virtual methods and the need for more teacher creativity in designing mind maps.

Discussion

The present study examined the effect of both virtual and non-virtual mind mapping on Iranian EFL learners' writing skills and motivation. In both experimental groups, the levels of writing ability and motivation were increased significantly compared to the control group.

Quantitative results indicated that virtual mind mapping yielded slightly higher post-test scores than non-virtual methods. Meanwhile, qualitative data highlighted that participants perceived both methods as effective, with virtual mind mapping being particularly appealing for its creativity, flexibility, and engagement. The study also highlighted some challenges. Non-virtual mind mapping, while effective, was perceived as time-consuming and less adaptable, particularly for complex writing tasks. In contrast, virtual techniques offered greater flexibility but required technological training, which could pose accessibility concerns in resource-limited settings. These findings underscore the importance of tailoring instructional strategies to the specific needs and contexts of learners, balancing the strengths and limitations of both virtual and non-virtual approaches.

The results of this study align with and add to a body of literature describing the effectiveness of mind mapping in EFL writing instruction, specifically in relation to improving writing accomplishment and enhancing student motivation (e.g., Al Naqbi, 2011; Alqasham & Al-Ahdal, 2022; Amin & Hina, 2018; Bukhari, 2016; Fu et al., 2019; Jones et al., 2012; Khudhair, 2016; Kurniawan et al., 2020; Mantra et al., 2021; Naghmeh-Abbaspour & Rastgoo, 2020; Ngo & Tran, 2021; Ningrum et al., 2016; Wahid & Sudirman, 2023; Zhang, 2018). The results of this study revealed that the use of mind maps—particularly virtual ones—significantly enhanced EFL students' writing performance. The virtual mind map group achieved the highest post-test scores, with an average improvement of 5.10 points compared to their pre-test scores. Non-virtual mind mapping also had a positive, albeit smaller, impact (mean improvement of 2.10 points), while the control group showed negligible progress. These findings are consistent with prior research, such as that of Marashi and Kangani (2018) and Basri and Syamsia (2020), who also reported significant improvements in writing performance among learners exposed to mind mapping. However, the superiority of virtual mind mapping observed in this study underscores the added value of digital tools in enhancing writing skills, a dimension that has been less emphasized in earlier studies. The significant difference between the experimental groups and the control group aligns with Buzan's (2005) and Novak's (1993) theories, which posit that mind mapping enhances learners' ability to organize and synthesize information. Virtual mind mapping, with its multimodal capabilities, further amplifies this effect by allowing learners to integrate colors, symbols, and multimedia elements, which likely explain the greater gains in this group. Studies by Hung et al. (2014) and Lin and Wang (2021) similarly found that digital mind mapping tools facilitate creativity and critical thinking, resulting in higher writing proficiency. Importantly, this study contributes to the literature by comparing virtual and non-virtual mind mapping directly, offering empirical evidence for the relative efficacy of these approaches in EFL contexts.

The findings also demonstrated a significant increase in motivation among students in both experimental groups, with the virtual mind map group exhibiting the highest post-test motivation scores (M = 3.79). This increase mirrors the results of studies by Amin and Hina (2018) and Sari et al. (2021), who highlighted the motivational benefits of mind mapping in

breaking the monotony of traditional instruction. The superior performance of the virtual group in this regard aligns with research by Sagita et al. (2024) and Selevičienė (2024), which attributed higher motivation levels to the gamified and interactive features of digital tools. The negligible improvement in the control group's motivation (from M = 1.92 to M = 2.00) further underscores the limitations of traditional teaching methods in engaging learners. This finding echoes Fathi et al. (2019), who noted that Iranian EFL learners often struggle with demotivating factors such as fear of errors and lack of confidence. By contrast, the visually engaging and learner-centered nature of mind mapping appears to alleviate such barriers, fostering a more positive attitude toward writing. This study advances the field by highlighting the comparative motivational advantages of virtual mind mapping, an area underexplored in previous research.

The qualitative findings of this study provide nuanced insights into Iranian EFL students' perceptions of both virtual and non-virtual mind mapping in developing writing skills, revealing a complex interplay of cognitive, affective, and practical dimensions that both align with and expand upon prior research. Helping to Learn New Concepts emerged as the most prominent theme for virtual mind mapping, with students recognizing its efficacy in breaking down complex topics and making conceptual relationships more visible—a finding strongly supported by Al-Jarf (2009) and Grazziotin-Soares et al. (2021), who argue that mind maps foster clarity by visualizing hierarchical and associative connections. The current results also extend the work of Erdem (2017), suggesting that the interactive nature of digital mind maps amplifies these cognitive benefits by enabling dynamic revision and exploration, thus supporting a constructivist approach (Brooks & Brooks, 1993). The Fun Way of Acquiring Writing theme highlights how virtual mind mapping transforms the writing process from a rote, stressful task into an engaging, creative activity. This echoes the findings of Yunus and Chien (2016), who observed increased student enjoyment and positive attitudes toward writing when mind mapping was integrated, as well as Amin and Hina (2018), who noted its motivational value. However, our findings indicate that the gamified, multimedia elements of virtual tools further enhance this enjoyment, a dimension less emphasized in earlier studies focused on traditional mind mapping (Basri & Syamsia, 2020).

Boosting Creativity was another salient theme, with students attributing their ability to generate original ideas and solutions to the flexible, visual format of mind mapping. This supports the cognitive-organizational benefits described by Ismail (2024) and aligns with Gardner's (1985, 1999) theory of multiple intelligences, which posits that engaging visual and spatial skills can promote divergent thinking. Interestingly, students also linked creativity with increased productivity, suggesting that the freedom to experiment in a non-linear environment fosters both innovation and goal-oriented writing—a synergy that builds upon but is not always explicitly addressed in prior literature (Marashi & Kangani, 2018). The Motivating Experience subtheme further illustrates how virtual mind mapping supports motivation by clarifying goals and visualizing progress. This finding resonates with the work of Sari et al. (2021) and Hung et al. (2014), who documented increased student motivation and self-efficacy with mind mapping,

particularly when technology was involved. However, the current study's emphasis on self-reflection and the visualization of achievement adds depth to our understanding of how digital mind mapping sustains engagement over time. Promoting Flexibility, though mentioned by fewer students, underscores the practical advantage of virtual tools—the ability to access, revise, and collaborate on mind maps asynchronously and across devices. This feature is especially salient in contexts with diverse student schedules and learning environments, expanding upon the accessibility arguments made by Sagita et al. (2024) and Chang et al. (2018), and highlighting the inclusiveness of technology-mediated approaches for Iranian learners.

Turning to non-virtual mind mapping, Time-Consuming for Students was the most frequently cited challenge, with participants highlighting the tediousness and inefficiency of manual diagramming—a limitation echoed in Al Kamli's (2019) observations about the practical barriers to traditional mind mapping. This contrasts sharply with the streamlined processes afforded by virtual tools and suggests that time investment may deter sustained use in fast-paced academic contexts—a finding less emphasized in studies from resource-rich settings where digital tools are the norm (Abd Karim & Mustapha, 2020). Nonetheless, Clarification of Writing Points emerged as a key benefit of manual mind mapping, with students valuing its tactile and visual nature for organizing and structuring their writing. This finding is consistent with the hierarchical and relationship-building benefits described by Erdem (2017), as well as Khusniyah (2019), who found that traditional mind mapping could improve coherence and organization in student writing. The hands-on process also appeared to foster deeper engagement and understanding, supporting Brooks & Brooks' (1993) constructivist perspective that active involvement enhances learning. However, despite these advantages, Hard to Develop was a recurrent theme, particularly for students new to mind mapping or those with a preference for linear thinking. This aligns with the findings of Bui and Phan (2025), who noted that the unstructured format of manual mind maps can be daunting for some learners, and suggests that differentiated instruction or scaffolding may be necessary for effective implementation.

The cognitive benefits of non-virtual mind mapping were further underscored by the Assisting Recall theme, where students reported improved memory and information retrieval—an outcome supported by Chularut & DeBacker (2004) and reinforced by the theory that multisensory engagement (visual, tactile, and cognitive) enhances retention. The participants' accounts align with Anokhin's (1973) associative model of memory, indicating that the physical act of creating mind maps strengthens mental connections and recall, a benefit also highlighted in Ngo and Tran's (2021) qualitative study. The theme of Easier Way of Learning Complex Ideas reveals that manual mind mapping, despite being time-consuming, enables students to decompose and interconnect complicated issues, making them more accessible—a finding that corroborates Buzan's (2000) assertion that mind maps mirror the brain's natural associative processes. Finally, Summarizing Thoughts and Plans reflects students' appreciation for the

concise, holistic overviews that mind mapping provides, supporting the utility of these tools for planning and organization as described by Leyden (2014) and Wangmo (2018). Notably, both virtual and non-virtual mind mapping were perceived as beneficial, but for different reasons: the former for its flexibility, creativity, and motivational features, and the latter for its ability to clarify, structure, and reinforce memory. This duality affirms the versatility of mind mapping as highlighted by Doyle (2023), while also pointing to context-dependent preferences and practical constraints.

Collectively, the 11 themes from this study enrich the existing literature by offering a comparative and context-sensitive account of mind mapping's role in EFL writing. The findings affirm past research on the cognitive, affective, and organizational benefits of mind mapping (Al-Jarf, 2009; Abd Karim & Abu, 2018; Sairo et al., 2021), while highlighting the added value of virtual tools in fostering engagement, creativity, and autonomy. At the same time, the persistent appeal of non-virtual mind mapping for memory and structural clarity underscores the continued relevance of traditional methods, particularly in resource-limited or technology-constrained settings.

Conclusion

The findings of this study clearly demonstrate that both virtual and non-virtual mind mapping techniques serve as highly effective strategies for enhancing the writing performance and motivation of Iranian EFL learners, with the virtual approach proving especially impactful. Quantitative data revealed that students in the virtual mind mapping group achieved the greatest improvements in their post-test writing scores and motivation levels, followed by those in the non-virtual group, while the control group exhibited negligible change. The qualitative phase provided important context for these results, as participants highlighted that virtual mind mapping not only made writing more engaging and creative but also facilitated a deeper understanding of how to organize and connect ideas. Students appreciated the flexibility, visual stimulation, and collaborative potential offered by digital mind mapping tools, all of which contributed to a more enjoyable and effective writing process. Meanwhile, non-virtual mind mapping was valued for its ability to clarify writing structures and aid memory recall, though it was sometimes considered time-consuming and difficult to develop, particularly for more complex or abstract topics.

These results have several noteworthy implications for EFL teaching and curriculum development. First, the demonstrated effectiveness of mind mapping—especially in its virtual form—suggests that incorporating these visual-organizational strategies into regular writing instruction can transform writing from a linear, often stressful activity into a dynamic, student-centered process. Mind mapping supports cognitive organization and creativity, helping students generate, connect, and structure ideas more effectively, which in turn can lead to higher-quality written work. Furthermore, the significant increase in motivation observed among students using mind mapping techniques highlights the potential of such approaches to

foster greater learner engagement, persistence, and enjoyment—factors that are crucial for sustained language development. Importantly, the differences in student preferences and experiences with virtual versus non-virtual mind mapping indicate that a differentiated approach, offering both digital and manual options, may be most effective for accommodating diverse learning needs and styles. For educators, this calls for ongoing professional development not only in the technical use of digital tools but also in creative pedagogical design, ensuring that mind mapping activities are well-integrated, purposeful, and accessible to all learners.

Despite its valuable contributions, this study is not without limitations. The sample was limited to pre-intermediate adult learners at a single language institute in Iran, which may restrict the generalizability of the results to other age groups, proficiency levels, or educational and cultural contexts. The relatively short duration of the intervention—eight weeks—does not allow for assessment of the long-term retention of writing skills or sustained motivational benefits, and the focus on paragraph writing using TOEFL-style prompts leaves open the question of how mind mapping might influence other genres or more advanced forms of writing. Additionally, the reliance on self-reported data for motivation and perception introduces potential bias. Future research should therefore extend this line of inquiry to broader and more diverse populations, explore the effects of mind mapping over longer periods and across different types of writing tasks, and incorporate additional data sources such as classroom observations and teacher perspectives. Comparative studies of different digital mind mapping platforms and investigations into teachers' experiences with implementing mind mapping would also provide valuable insights. By addressing these areas, future research can further clarify the optimal conditions and strategies for leveraging mind mapping to support EFL learners' writing achievement and motivation worldwide.

Acknowledgments

We would like to thank the editorial team of TESL Quarterly for granting us the opportunity to submit and publish the current synthesis. We would also like to express our appreciation to the anonymous reviewers for their careful, detailed reading of our manuscript and their many insightful comments and suggestions.

Declaration of conflicting interests

The authors declare no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for this article's research, authorship, and/or publication.

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Appendices

Appendix A

Two Topics for Writing

1. Some people believe that success in life is determined by hard work, while others think it is influenced mostly by luck. Which do you think plays a greater role in achieving success? Use specific reasons and examples to support your answer.
2. Modern technology has made life more convenient, but it has also reduced personal interactions among people. Do you agree or disagree with this statement? Use specific reasons and examples to support your opinion.

Appendix B

Motivation Questionnaire

Motivational Items	5	4	3	2	1
1. Studying English is important to me because I can understand the cultures and traditions of the English countries.					
2. Studying English is important to me because I can understand English stories, novels, and literature.					
3. Studying English can be important for me because I will be able to communicate with my neighbors in the English countries.					
4. Studying English can be important for me because it will help me to get an ideal job in the future.					
5. Studying English can be important for me because I will need it for my future career.					
6. Studying English can be important for me because it will make me a more knowledgeable person.					
7. Studying English helps me to better understand the ways of life of the English countries.					
8. Studying English helps me to easily make friends with foreigners.					
9. Studying English helps me to associate with the neighbors in the English countries and learn about their values and beliefs.					
10. Studying English can be important for me because other people will respect me more if I know a foreign language.					
11. Studying English can be important for me because it will help me to further my studies.					
12. Studying English can be important for me because it will help me search for information and materials in English on the Internet.					
13. Studying English helps me to be open-minded and friendly like native English speakers.					
14. Studying English is important to me because it will help me when I travel abroad.					
15. Studying English is important to me because it will help me to achieve at school.					
16. The Americans and British are kind and cheerful.					

Appendix C

Interview Questions

1. How long have you been learning English?
2. How significant is teaching writing structures in language lessons?
3. What methods or activities did you encounter for learning writing during the term, and how did you incorporate them into your assignments?
4. Which aspects of mind mapping did you find the most engaging or beneficial?
5. What difficulties did you encounter in the language class while learning writing through mind mapping, and how did you overcome them?
6. Do mind mapping techniques help in learning writing structures? If yes, which features of mind mapping did you find the most helpful for improving your writing?