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Research Paper

The Function of Instruction by Mind Mapping on Iranian Students' Grammar Learning

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Abstract

English grammar is widely recognized as an indispensable component of teaching English, serving as the fundamental framework for students to comprehend and acquire the language. The acquisition of English grammar has emerged as a prominent concern for high school students during the learning process. Therefore, the identification of an efficacious approach to facilitate students' mastery of English grammar assumes paramount significance. Mind mapping, a cognitive tool that facilitates divergent thinking, offers individuals the opportunity to harness both the analytical and creative faculties of the human brain, thereby enhancing their cognitive abilities and memory retention. In this research endeavor, the primary objective is to explore the efficacy of employing the Mind Mapping technique in the context of Iranian EFL learners' grammar acquisition, specifically among tenth-grade students. To accomplish this objective, the researchers adopted a quasi-experimental methodology. The experimental group received instruction utilizing the mind mapping technique, while the control group adhered to the traditional teaching method. The findings of this study revealed statistically significant disparities between the two groups, favoring the experimental group, which can be attributed to the utilization of the mind mapping technique. The incorporation of mind mapping in grammar instruction augments students' comprehension and retention of grammatical concepts, thereby enabling educators to better cater to their educational requirements and enhance overall learning outcomes.

***Keywords*:** Mind Mapping; Grammar Learning; Strategy Learning.

1. Introduction

English grammar is a vital component that holds great significance in the process of language acquisition. Grammar serves as a structured tool that operates within a limited set of rules, allowing us to formulate sentences in a language with utmost precision. The importance of grammar in enhancing the four language skills and expanding vocabulary, to effectively carry out communicative activities, must not be underestimated (Widodo, 2006). Educators have been meticulously analyzing the most efficient strategies for imparting grammar knowledge to students, especially within the realm of English as a Foreign Language (EFL). Consequently, this subject has been extensively discussed since the inception of language education (Ellis, 2006; Brown, 2007; Nassaji & Fotos, 2011).

According to Dykes (2007), grammar frequently elicits unfavorable responses from both educators and learners. Additionally, Decapua (2008) asserts that the concept of grammar often evokes distressing recollections. Numerous researchers have put forth engaging techniques for instructing English grammar to students, recognizing the challenges associated with learning this subject. In the EFL context, grammar teaching often follows the grammar-translation method, where students are instructed to memorize grammar rules and examples. Subsequently, it is anticipated that they will implement these regulations to analyze additional instances (Widodo, 2006).

Cognitive load theory serves as a fundamental framework within the realm of educational psychology, guiding our strategies in creating optimal learning environments for skills development (Lambert et al., 2009; Farrokhi, et al., 2023). This theory explores the intricacies of how the human mind processes information and how instructional materials

influence the learning process as a whole (Sweller, 2011). Sweller (2011) categorizes cognitive load into three types: intrinsic, extraneous, and germane. Intrinsic cognitive load pertains to the inherent complexity of the material, extraneous cognitive load is caused by poorly designed instruction, and germane cognitive load involves the cognitive effort that leads to meaningful learning. Additionally, cognitive load theory focuses on how our working memory processes and stores information (Merrienboer & Ayres, 2005). Mind mapping, which involves visually organizing and connecting ideas, can help reduce cognitive load by promoting meaningful learning and enhancing working memory capacity.

According to Johnson et al. (2019), contemporary English language teaching acknowledges the significance of interactive and visual tools in the academic environment. It is now imperative to incorporate creative teaching strategies that go beyond traditional methods. Visual tools, such as mind mapping, offer a distinctive opportunity for learners to not only comprehend language structures, but also internalize and apply them in practical communication scenarios (Hwang & Kim, 2018). As stated by Namasaka (2009), visual stimuli play a crucial role in enhancing students' learning capabilities and their capacity to retain information for an extended period of time. The utilization of mind mapping in language teaching has been diverse. Yen (2010) incorporated mind maps into his instructional approach as a visual aid that facilitated students' brainstorming, organization, and retention of unfamiliar material, thereby fostering their cognitive reasoning abilities.

Tony Buzan (1970), a renowned British psychologist, introduced the concept of mind mapping based on his extensive research on brain functionality. Mind mapping, serving as a visual representation, acts as a dynamic instrument for students to externalize their thoughts and link information spatially, thereby enhancing retention and recall (Hwang and Kim, 2018). According to Zhang (2009), grammar and vocabulary are the foundation of the English language, making it imperative to prioritize grammar in second language instruction. Zhang (2009) further asserts that a strong grasp of grammar and vocabulary serves as the fundamental knowledge required for effective English language acquisition. Mastering grammar presents a significant challenge when it comes to English language acquisition (Sawir, 2005). According to Normawati (2020), there exists a difficulty among certain students when it comes to learning a language that is not their native tongue. Consequently, grammar instructors face the challenge of discovering an engaging approach that can enhance their grammar learning experience. (Normawati, 2020).

According to Zohrabi et al. (2012), the English book for 10th grade students in Iran is primarily focused on grammar. Furthermore, within the educational context of Iran, course books are designed based on the Grammar Translation Method, where teaching predominantly revolves around translations, introductions, and deductions (Kheibari, 2019). In a traditional high school English grammar class, the teacher assumes the role of the main speaker and the center of attention. Additionally, students are expected to engage in passive learning, primarily involving listening and extensive memorization of grammatical rules and exceptions to the rules**.** Consequently, students often find themselves unable to express their own thoughts in the classroom. It is essential to recognize that students are instructed to internalize grammar knowledge through repetitive practice. Furthermore, grammar instruction has historically been delivered to students in a straightforward manner. As a result, students are required to complete numerous exercises, such as identifying whether sentences adhere to grammar rules and subsequently making modifications until the sentences are grammatically accurate. Essentially, students are lacking enthusiasm in the classroom environment.

Despite the existence of various research studies on innovative approaches to teaching and learning grammar, there is a need for further investigation into the use of mind mapping technique in English grammar instruction for Iranian EFL students. While mind mapping is employed in several countries, empirical studies on its effectiveness in Iran are lacking. Therefore, it is worthwhile to conduct an experimental study to determine the impact of using mind maps as an instructional tool on students' grammar learning. This study focuses on 10th-grade high school learners and aims to examine the role of mind maps in enhancing their understanding of grammar. The research question of the study is:

Does using the mind mapping technique in teaching have a significant role on grammar learning among Iranian EFL students?

To investigate the above-mentioned research question, the following research hypotheses were formulated:

Null hypothesis (H0): Using the mind mapping technique has no significant role on grammar learning among Iranian EFL students.

Alternative hypothesis (AH): Using the mind mapping technique has a significant role on grammar learning among Iranian EFL students.

2. Literature Review

2.1. Mind Mapping

The application of mind mapping methodology in the field of education offers a wide range of advantages. These include the promotion of critical thinking, logical reasoning, conceptual learning, and the improvement of students' academic performance (Bojana, 2002). Moreover, this approach encourages a profound comprehension of concepts and facilitates productive collaboration among students. It is worth mentioning that mature students, particularly those aged 25 years and above, demonstrate a preference for learning from experienced individuals, and by employing the mind mapping technique in an educational setting, they can enhance their motivation levels (Micheal, 2006).

According to Buzan (2005), mind mapping is a highly potent cognitive tool that accurately reflects the internal thought processes of students. It surpasses traditional methods in its ability to assist students in memorizing vast amounts of vocabulary and phrases at a significantly faster pace. This exceptional quality of mind mapping can be attributed to two primary factors. Firstly, mind mapping offers a structured approach to learning by grouping interconnected concepts together and organizing them in a manner that allows students to transfer their mental processes onto paper, thereby facilitating recall and comprehension (Buzan, 2005). Additionally, it is pertinent for this study to elucidate the workings and composition of the human brain, as it aids learners in understanding the correlation between mind mapping and cognitive functioning (Buzan, 2005).

2.2. Applications of Mind Maps in Teaching

In addition to introducing students to the theory and practice of Mind Mapping, teachers can employ Mind Maps in various practical ways to facilitate and enhance the teaching and learning experience. By utilizing Mind Maps, educators can make the process more accessible, enjoyable, and engaging for their students. It opens up possibilities for creativity, organization, and effective information retrieval, ultimately leading to a more enriched educational journey (Dobakhti & Panahi, 2024).

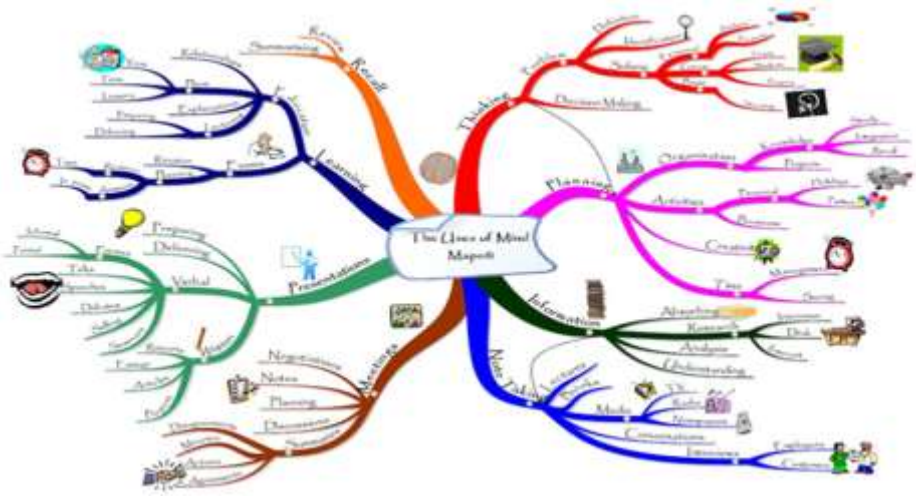

Figure 1. The Uses of Mind Maps

Marashi and Kangani (2018) investigated the fusion of idea mapping and mind mapping in Iranian descriptive and narrative writing lessons. The research involved selecting 60 intermediate EFL students randomly, who were then divided into two experimental groups. The intervention included 14 sessions, each lasting 90 minutes, dedicated to teaching mind mapping. The outcomes indicated a significant difference between the two groups, with the mind-mapping group performing better than the control group in both descriptive and narrative writing post-tests.

In their study, Sebit and Yildiz (2020) examined the effects of computerized mind mapping on the essays of EFL students. The researchers specifically looked at various aspects including organization, language usage, vocabulary, and mechanics. The results of the study showed that the group using independent mind mapping demonstrated superior performance compared to the control group in terms of content and organization across all essay tasks. Additionally, interviews conducted with the learners indicated that they had a positive attitude towards using computerized mind mapping as a pre-writing practice in the context of EFL.

In the realm of English grammar teaching, Wang (2019) embarked on a comprehensive investigation to explore the potential benefits of integrating Mind map as a pedagogical tool. The primary objective was to ascertain whether the utilization of Mind map could effectively enhance students' enthusiasm and efficacy in grammar learning, thereby establishing its viability as a practical teaching approach within the grammar teaching process. The findings of the study unequivocally demonstrated that the incorporation of Mind map in English grammar instruction not only bolstered students' proactive engagement but also fostered a heightened interest in learning, improved learning efficiency, and facilitated a more proficient acquisition of grammar knowledge.

Furthermore, Normawati (2020) conducted a study on the utilization of digital mind-mapping in the learning process to enhance learners' grammatical competence. The research employed different platforms such as Instagram and WhatsApp, allowing students to utilize digital tools to create mind maps and share them on social media channels. The implementation of the mind-mapping approach proved beneficial as it facilitated the organization of materials and concepts, enabling students to grasp their interrelationships. Moreover, this method aided in focusing students' attention during lectures and discussions on grammar points while promoting logical thinking.

Anggraini et al. (2023) undertook a qualitative case study to examine the ramifications of integrating mind mapping into the process of English language acquisition, with a specific focus on student engagement and efficacy. The study encompassed a cohort of 30 individuals enrolled in an English language course. Employing purposive sampling and data triangulation with the utilization of mind mapping in the context of English language learning. To summarize, this study has provided valuable knowledge about the benefits of incorporating mind mapping into the English language learning process, aligning with current educational research that supports interactive and student-centered methods. The favorable feedback received from the participants highlights the potential of mind mapping to enhance the language acquisition journey by making it more engaging, effective, and personalized to learners' cognitive processes.

3. Methodology

The design of the study was quasi-experimental. Quasi-experimental research is often used when conducting studies that involve human subjects and ethical considerations prevent the use of a true experimental design. It allows researchers to make comparisons and draw conclusions about the effects of certain interventions or treatments, even though random assignment to groups is not possible. Quasi-experimental research also can be a valuable approach in situations where it is difficult to manipulate variables or control all factors that may influence the outcome. It provides a way to gather data and analyze relationships between variables, even if the study lacks the strict control of a true experiment. The aim of this research was to explore the impact of using mind mapping for instruction on the grammar learning of Iranian EFL students. The study involved two types of variables: the independent variable, which was the mind mapping technique, and the dependent variable, which was grammar learning. The experimental group received instruction using the mind mapping technique, while the control group was taught using the conventional method. Both groups took a pre-test before the treatment and a post-test after the treatment. The data collected from the tests were analyzed and interpreted statistically.

3.1. Participants

The research was conducted at a high school in Azarshahr, Iran, during the second semester of the 2022 – 2023 academic year. Convenience sampling, also referred to as convenient sampling, was utilized for this study. This method involved selecting participants based on their accessibility and availability to the researcher, making it a practical choice. The study included 75 female Iranian EFL students from Maktab high school in Azarshahr, East Azerbaijan. Additionally, the students took Cambridge University's Preliminary English Test (PET) to confirm their intermediate level. Prior to commencing the study, the researchers met with the high school principal to discuss the study's significance and objectives. The participants were 10th-grade students with a Turkish L1 background, aged between 16 and 17 years old, and had an intermediate proficiency level in English. These students had been studying English for nearly three years, with an average of two to three hours of class per week. The study was conducted during the second semester of their 10th-grade year, with the participants divided into two groups: the control group (35 students) and the experimental group (40 students). Table 1 outlines the demographic characteristics of the participants in the study.

Table 1. *Demographic Background of the Participant*

Number of Students	75 Intermediate
Gender	Female
Native language	Turkish
Major	Science
Academic year	2022 – 2023

3.2. Materials and Instruments

Materials and instruments that were utilized in this study to collect data were high school tenth-grade grammar in Mind-Mapping format, *Cambridge University's Preliminary English Test* (PET), and grammar test as a pre- and post-test. They have been described in detail below.

3.2.1. Instrument 1 (Grammar Pre-test)

To check the homogeneity of both groups, a grammar test from the book Grammar in Use by Raymond Murphy was administrated. All the students had 20 minutes to complete the test. This test consisted of four sections, and it included 20 items. The first section had 4 multiple-choice questions of modals, the second section contained 5 questions and answer pairs (past continuous), the third question had 6 filling the gap questions (modals), and the last part contained 5 filling the gap questions (past continuous).

3.2.2. Instrument 2 (Grammar Post-test)

At the end of the course, in order to check the influence of treatment, a grammar test which was a teacher-made test based on the presented materials from Grammar in Use by Raymond Murphy was administrated. Like the pre-test, this test was also in four sections. The first section contained 4 multiple-choice questions (modals), the second one included 6 items of filling the gap questions (modals), the third one included 4 filling the gap questions using pictures (past continuous), and the fourth one had 6 filling the gap questions (past continuous).

3.2.3. Instrument 3 (Mind Map Grammar leaflet)

To develop a supplemental learning resource and teach grammar by mind mapping to the participants of the experimental group, the researchers needed to write the grammar section of the 10th grade's textbook based on mind mapping. First, the researchers extracted the key grammar concepts from the textbook and organized them in a visual and interactive mind map format. Specific for each key-point, various colors were used to make them more recognizable and easier to remember. Then, the researchers used the projector to teach and present the grammar materials by the electronic mind map leaflet. The leaflet was copied and handed out to each student at the beginning of each session, so they could have the material in mind map format for further revision.

Figure 2. Modal Verbs in Mind Map Format

3.3. Procedure

In order to create mind maps to teach in a creative and engaging manner, the researchers re-wrote the grammar parts of the 10th grade's English book in mind map format. Here is the procedure for creating modals. The researchers started with a main branch labeled "Modals". From there, the sub-branches were created for different types of modals like "ability," "permission," "obligation," and "advice." Each sub-branch was further broken down into specific modals like "can," "could," "may," "might," "must," "should," and "ought to." Using different colors or symbols for each category could add a visually appealing touch to the mind map. The same procedure was also followed for the past continuous. The mind map serves as a visual representation of the grammar rules, presenting them in a hierarchical and cohesive format. It allows learners to see the relationships between different grammar concepts, facilitating a deeper understanding of how they fit together.

The informed consent form was distributed among the students. In the experimental group, the grammar participants were taught in mind map format by using a video projector during the treatment period. The mind map format was specifically designed to visually represent grammar rules and facilitate comprehension. This means that instead of traditional teaching methods, the students in the experimental group were exposed to a visual representation of the grammar rules through the use of mind maps. This took two sessions for both groups and during the class sections. The control group also was taught those subjects by conventional method. After two sessions, the students were asked to participate in grammar posttest. The post-test was designed to assess the effect of using the mind mapping technique on grammar learning among 10th grades. The researchers applied a valid and reliable grammar pre-test and post-test of the book of Grammar in Use intermediate by Raymond Murphy. The test scores were later analyzed to reveal the results and compare the performance of the control and experimental groups in grammar tests.

The accuracy of scoring ensures teachers that the rating scales of the project have adequate validity and enables teachers to produce accurate scores based on which instructional decisions can be made (Dobakhti, 2020). In this study, the grammar questions were chosen from the *English Grammar in Use* intermediate by Raymond Murphy, which contains a valid and a reliable resource for testing students' grammar skill.

In this research, grammar knowledge of the students was assessed by a grammar test. There were 20 tests, which were scored from 0 to 20. Every question had one point, and the incorrect answer had zero point.

3.4. Data Analysis

The study utilized the scores obtained from grammar pre-tests and post-tests of students in the experimental group as the primary data source. Quantitative data from grammar tests were analyzed using the Statistical Package for Social Science (SPSS). An independent samples t-test was conducted to assess the homogeneity of the experimental and control groups in general English proficiency based on PET scores. The research question focused on examining the effectiveness of learning grammar through mind mapping among 10th-grade Iranian high school students. Data from grammar tests were analyzed using SPSS, and an ANCOVA test was performed to compare the performances of the experimental and control groups in grammar before and after the treatment period.

4. Results

4.1. Descriptive Statistics

The total number of the research sample was 75 students of 10th grade who were assigned into one experimental (n=40) and one control group (n=35).

First of all, it should be mentioned that PET test was performed for screening the sample. The results showed that the students are at intermediate level.

The groups under study were tested in two stages of pre-, and post-test. In the following Table (2), descriptive indices of the research variables are presented separately for the experimental and control groups in two stages of pre-, and post-test.

Table 2. *Descriptive Indices of the Dependent Variables Separately for the Groups in Pre-, and Post-test*

Group	Statistics		Pre-test	Post-test
Experimental	N	Valid	40	40
		Missing	0	0
	Mean		13.8750	15.5250
	Std. Deviation		1.86997	1.48475
	Skewness		.364	.246
	Std. Error of Skewness		.374	.374
	Kurtosis		-.808	-1.047
	Std. Error of Kurtosis		.733	.733
	Minimum		11.00	13.00
	Maximum		18.00	18.00
Control	N	Valid	35	35
		Missing	0	0
	Mean		13.3429	14.0000
	Std. Deviation		1.49397	1.60880
	Skewness		.491	-.045
	Std. Error of Skewness		.398	.398
	Kurtosis		-.227	-.623
	Std. Error of Kurtosis		.778	.778
	Minimum		11.00	11.00
	Maximum		17.00	17.00

As it is observed in Table (2), in pre-test stage, the mean of the experimental group (m=13.87), and control group (m=13.42) is almost equal. But in the post-test, the mean of the experimental group increased significantly (m=15.57); but in the control group, minor difference was made (14.00). The indices of skewness and Kortosis were in the range of +2 to -2 that shows normality of the scores distribution in pre-, and post-test.

4.2. Response to Research Question:

Research Question: Does using the mind mapping technique have a significant effect on grammar learning among Iranian EFL students?

In order to test the research question, ANCOVA method was used. At first, pre-assumptions of this method were studied:

a) Methodological pre-assumption: ANCOVA in this research was of one-variate inter-group experimental designs with pre-, and post-test. This statistical test was selected because in this test the effects of pre-test from the groups mean is modified in the post-test stage and after that mean of two groups are compared with each other.

b) Pre-assumption of the scores of dependent variables: In this research, regarding that grammar scores are as scores and the scores interval is considered equal and the existing zero is a contractual, so this pre-assumption is fulfilled.

c) Pre-assumption of normality of data distribution: In order to examine the normality of data distribution, the indices of skewness and Kurtosis were used in which the results are reported in table 4.1. The values of these indices are in the range of +2 to -2.

d) Pre-assumption of the homogeneity of variance in the dependent variables: In order to examine this pre-assumption, Leven's test results are presented in Table 3.

Table 3. *Leven's Test of the Homogeneity of Variance of the Dependent Variable Error*

Levene's Test of Equality of Error Variances[a] Dependent Variable: Posttest			
F	df1	df2	Sig.
2.095	1	73	.152

Table 3 shows that variances of the dependent variables error are not significant at the level of 0.05, this indicates the equality pre-assumption of the error variances for each variable.

e) Pre-assumption of the homogeneity of interaction effects of pre-test× the dependent variables: To examine this pre-assumption, variance analysis of interaction effects was used. The results are presented in table 4.

Table 4. *Variance Analysis of Interaction Effects*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Group * Pretest	2.419	1	2.419	3.657	.060	.049
Error	46.960	71	.661			
Corrected Total	217.387	74				

Table (4) shows that the pre-assumption of the homogeneity of interaction effects is fulfilled; because the calculated F-values are not significant at the level of 0.01 ($p<0.01$). In addition to the statistical method of interaction analysis of variance, and graphically by drawing scatter plot, the homogeneity of regression line slop was examined and simultaneously the presence of linear relation among the dependent and covariate variables for the studied groups were examined and confirmed. In the scatter plots that follow, regression line slop of the variable of the groups is presented respectively:

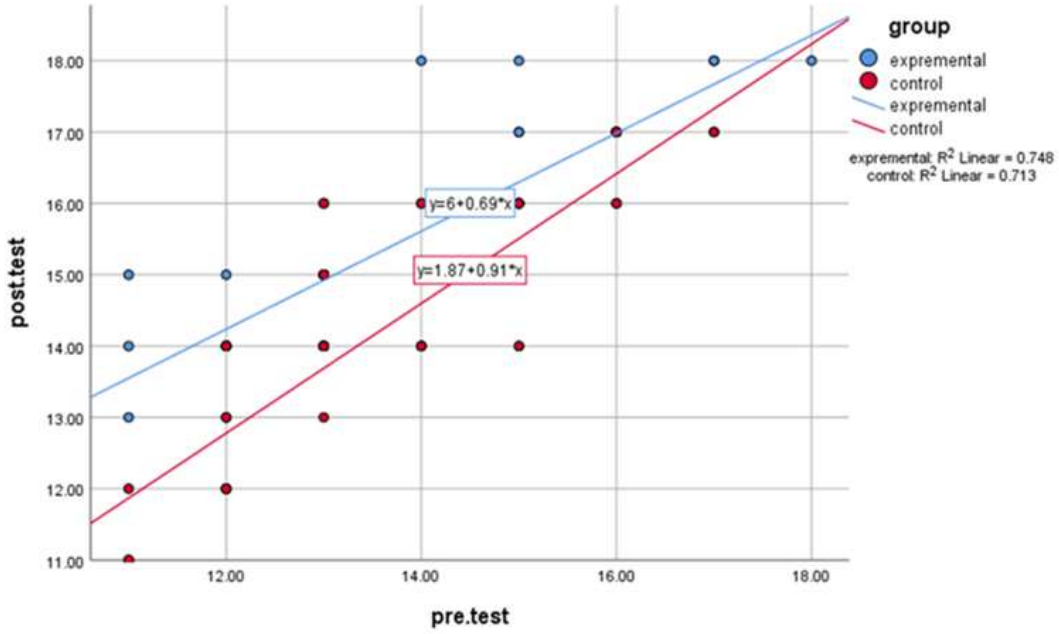

Figure 4. Grouped Scatter of Posttest by Pretest by Group

As it is observed, regression line slop in both groups is very similar and the linear relation of pre-, and post-test of the groups is fulfilled.

a) similarity of the groups mean in pre-test: one of the cases that is examined in the comparison of mean in post-test is lack of presence of significant difference of the groups mean in post-test. In order to examine this issue, means of both groups in the stage of pre-test were compared by independent t-test. The results of the mentioned test showed that there is no significant difference in means of both groups in the stage of pre-test (t=1.34; sig=0.182).

Considering the fulfilment of pre-assumptions of this method, it could use ANCOVA method to answer the main research question in which results are reported in the following table:

Table 5. *ANCOVA Results of the Effectiveness of the Independent Variable on the Dependent Variable*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Pretest	124.596	1	124.596	181.676	.0001	.716
Group	22.736	1	22.736	33.152	.0001	.315
Error	49.379	72	.686			
Corrected Total	217.387	74				

The results of the above table show that the effect of pre-test is significant. Also, there is significant difference between both the experimental and control group in post-test of grammar score (F=33.15; sig=0.001). Regarding the comparison of the means, it could be said that in post-test stage, the mean of the experimental group is significantly more than the control group and performing mind mapping had positive influence on increased learning, and the research

hypothesis is confirmed. The value of separated eta square as one of the effect size indices does also show that the severity of the effect is 0.315.

In the following table, the modified mean in the group after the modification of pre-test effects is reported:

Table 6. *The Modified Mean of Grammar Scores in the Group*

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experimental	15.335[a]	.132	15.072	15.597
Control	14.217[a]	.141	13.937	14.498

As it is observed in the above table, the modified mean of the experimental group after the modification of pre-test effects decreased a little and became 15.33, and the control group mean after the modification of pre-test effects increased a little and became 14.21. The observed mean of these two groups after the modification of pre-test effects were 15.52 and 14.00 respectively.

In the following table, the results of couple comparison of the modified mean in both groups are reported:

Table 7. *Couple Comparison of the Modified Mean in the Experimental and Control Groups in Post-test*

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Experimental	Control	1.117*	.194	.0001	.730	1.504

The results of couple comparison shows that mean difference between these groups is 1.117 unit that is significant in the level of 0.001.

5. Discussion

This study was guided by one research question and the researchers tried to check the research hypotheses formulated based on the research question. However, before testing the research hypotheses, the researchers ensured the homogeneity of the experimental group and control group in terms of language proficiency and grammar. Furthermore, aiming to investigate that the data gathered from students' pre-tests and post-tests are normally distributed, the indices of skewness and Kurtosis were used and the normality distribution was assured. The result of ANCOVA showed that implementation of mind mapping had positive influence on increasing grammar learning, so it is concluded that this method of teaching could be successfully used on high school 10th grade female students.

By visually representing grammar concepts in a structured and organized manner, it can be inferred that mind maps aim to reduce the cognitive load on students' working memory. Moreover, the implementation of mind mapping reduced extraneous cognitive load associated with grammar learning, enabling students to focus more on meaningful comprehension. This reduction in extraneous load was particularly evident in the visual organization of information, allowing students to quickly grasp complex grammatical structures. Furthermore, the use of mind maps enhanced students' germane cognitive load, encouraging a deeper level of processing and facilitating a better understanding of grammar rules. Overall, these findings support the integration of mind mapping techniques into grammar instruction for Iranian students, as it effectively reduces cognitive load and enhances learning outcomes.

The outcomes of this research carry significant implications for the realm of grammar acquisition among Iranian students. Primarily, the findings indicate that the integration of mind mapping as a pedagogical approach can greatly enhance the process of acquiring grammar skills. This implies that educators in Iranian educational settings can utilize mind mapping as a potent instrument to augment students' comprehension and retention of grammar principles. Moreover, the favorable influence of mind mapping on grammar learning is consistent with prior scholarly works on instructional methodologies in grammar education. These results substantiate the idea that the utilization of visual and graphical techniques, such as mind mapping, can promote more efficacious grammar instruction. Notably, various studies such as Alqasham, et al. (2022); Shi and Tsai (2024); Mantra, et al (2021); Purwanto and Marsinah (2021); Ngo and Tran (2021); Sapitri, et al (2019); Heidari and Karimi (2015); Marashi and Kangani (2018); Suseno, and Setyawan (2014); Sebit and Yildiz (2020); Ling Wang (2019); and Alkaraawi (2011) have demonstrated a markedly positive impact of the mind-mapping technique in the learning phase.

The present study's findings exhibit a certain degree of congruity with prior research. Nidayanti et al. (2022) concluded in their study that the utilization of the mind mapping technique also enhanced students' proficiency in various writing aspects, including grammar, vocabulary, and idea organization. Furthermore, it was observed that this technique bolstered students' motivation. These researchers highlighted a glaring hurdle encountered during the implementation of the mind mapping technique, namely, a lack of comprehension among certain students regarding the fundamental nature of mind mapping. These students tended to excessively populate their mind maps with sentences, displaying a lack of confidence in their writing abilities and occasionally resorting to copying from textbooks. Moreover, in terms of content, the students' written work was characterized by brevity and a dearth of innovative ideas. As for text organization, the students' compositions exhibited incoherence and an abundance of disjointed thoughts. Thus, the primary challenge associated with implementing the mind mapping technique lies in addressing the inadequate understanding of its core principles among certain students, leading to an overemphasis on sentence construction within their mind maps.

The findings of Alqasham, et al. (2022) underscored the significance of effective employment of mind mapping in prompting and empowering educators to consciously consider alternative methodologies or techniques tailored to their teaching. By employing mind mapping, students' attention is captured, enabling them to utilize their creative faculties for critical thinking. Additionally, it provides students with the opportunity to reinforce their understanding of concepts prior to studying. A recent research study carried out by Feng, et al. (2023) examined the impact of utilizing mind-mapping technique on Iranian English as a foreign language (EFL) students. The statistical analysis findings indicated that the group that underwent the experiment outperformed the control group in enhancing vocabulary recall and retention, boosting learning motivation, and increasing willingness to communicate (WTC).

In general, it is crucial to emphasize the significance of English grammar as a fundamental component in language acquisition. When students possess a strong command of English grammar, they are capable of constructing accurate sentences and communicating effectively (Suseno, & Setyawan, 2014; Dobakhti, & Shams Khorrami, 2020b). Moreover, a proficient understanding of English grammar enables students to comprehend written or spoken English texts effortlessly (Widodo, 2006). Recognizing the challenges associated with learning grammar, numerous researchers have proposed intriguing approaches to teaching English grammar to students.

In elucidating the findings of this study, it can be posited that educators employ a diverse array of methodologies and strategies to facilitate student learning. Among these pedagogical approaches is the utilization of mind-mapping. This technique or framework illustrates how the human brain can assimilate various interconnected concepts and information (Muhib, et al, 2014). Mind-mapping serves as a potent visual tool that aims to harness the brain's cognitive capacities to the fullest extent (Buzan, 2010). It serves as a departure from linear thinking and serves as a means to unearth the cognitive processes that the brain undergoes in relation to a specific subject or idea.

According to the research conducted by Fu et al. (2019), Karim et al. (2019), and Panggabean et al. (2019), it has been contended that the aforementioned teaching technique involves the act of the student transcribing superordinate concepts onto paper and subsequently establishing connections with subordinate concepts as necessitated. Mind mapping, as a cognitive process, serves as a means of constructing knowledge within the human mind and extracting valuable information from it. Undoubtedly, this innovative and efficacious technique offers a remarkable approach to visually organize and articulate one's ideas.

Utilizing mind-mapping strategies in an EFL environment not only aids students in grasping content through various learning resources but also assists in structuring ideas to enhance their proficiency in professional communication (Orlova, 2017). Furthermore, interventions involving mind-mapping have the potential to boost learners' listening skills and facilitate their acquisition of grammar (Wang, 2019). It has been suggested that employing the Mind Mapping Technique to stimulate prior knowledge among students can result in heightened capacities for knowledge acquisition, comprehension, application, and synthesis within the cognitive domain.

This method has the potential to inspire students to engage with grammar learning (Nidayanti, et al, 2022). As indicated by the scholars, the utilization of mind maps serves as a valuable instrument in facilitating students' comprehension of subject matter and enhancing academic performance (Buzan, 2006). The outcomes of this research align with Windura's theory (cited in Sapitri, et al, 2019) which asserts that mind mapping is an efficient approach to note-taking. Furthermore, it aids in addressing students' writing challenges and streamlines the process of information retention through the incorporation of symbols, images, and colors.

Moving forward, it would be beneficial to explore the long-term effects of employing mind mapping in grammar learning. Additionally, investigating the potential benefits of integrating mind mapping with other instructional approaches, such as collaborative learning or multimedia tools, could provide further insights into optimizing grammar teaching in Iranian classrooms. Overall, these findings encourage educators to consider the implementation of mind mapping as a valuable instructional tool for enhancing grammar learning outcomes in Iranian students.

6. Conclusion

Despite endeavors to effectively incorporate a range of second-language instructional methodologies, educators and learners continue to encounter numerous challenges within their language learning environments. Within the realm of education, it is imperative to embrace certain modifications. Robust, pioneering, and flexible pedagogical approaches are essential. The implications derived from the study's results are noteworthy. EFL instructors can reap substantial benefits from these findings by understanding the effectiveness of the mind-mapping technique in the context of task-based and problem-solving learning objectives. By integrating this technique into their teaching practices, EFL teachers can cultivate enjoyable and relaxed classroom atmospheres. Furthermore, they can aim to introduce their students to innovative teaching methods, such as the incorporation of mind-mapping. Concurrently, EFL students can take advantage of the benefits provided by the mind-mapping technique, as it has the potential to enhance their productivity and creativity. The organization of their ideas into a vibrant and enlightening diagram inspires EFL students to engage in further study, as they can promptly witness the tangible outcomes of their endeavors.

Like any study, certain limitations and delimitations were imposed in this study. During the conduct of every research, some infeasibilities act as like as obstacle in the process of research. The current study fell prey to several design limitations. Although it was representative of EFL learners' population due to convenient sampling, the study was limited to the west-eastern part of Iran, so the results may not be generalized to all Iranian advanced EFL learners. Considering the participants, as stated earlier, the age range of the participants of this study were 16-17 years old. Therefore, it is not generalizable to all age ranges. In addition, this study is limited to female learners. However, it may lead to different results with male learners. Another limitation was the size of the sample which was low (N= 75). This would not be adequate to make generalizations about grammar learning by mind mapping of all Iranian learners of English or learners from other educational and cultural environments. Moreover, this study included intermediate learners of English as a foreign language. Other proficiency levels were not taken into account. Finally, focusing solely on some parts of grammar could be another limitation.

About the delimitations of the present research, firstly, mind-mapping strategy alone was used to focus on the effect of it on grammar learning. The second delimitation is applying mind-mapping technique to teach grammar and not to teach other aspects of language learning. Since the sample size was limited in this study and the research was done in a town in north-west of Iran, the results may be different in other parts of the country and in larger suburban areas. Conducting the same study with larger sample size, with different proficiency levels and more diverse sample of participants in different parts of Iran could be suggested to truly determine the ultimate findings on this research topic. Furthermore, as stated earlier, female participants at intermediate level were considered as one of the limitations of this study. Therefore, future studies could also include students from higher or lower levels and both male and female students with the aim of having more vision about the effectiveness of mind mapping on grammar learning in terms of different levels and gender.

Additional studies can explore the application of the mind mapping technique by examining research participants with diverse levels of English proficiency or age, or by employing alternative research designs to investigate various grammatical aspects or language skills. Finally, it is also recommended for the future researchers to study the effect of mind mapping method on other variables on grammar learning. According to the results of the present study, it could be concluded that the method of mind mapping had positive influence on increased learning, so this method could be applied in EFL learning settings. Regarding the findings, this method will be helpful in the EFL classroom for both teachers and students and has many advantages in learning context like improving motivation and academic performance to name a few.

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Conflict of Interest

The authors have no conflicts of interest to declare.

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