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The Comparative Effect of Teaching Concept Mapping vs. Collaborative Strategic Reading on ESP Students' Reading Comprehension of Aviation Texts

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Abstract

Reading comprehension is one of the crucial skills that plays an important role in academic contexts. This study aimed to explore the comparative effect of teaching concept mapping and collaborative strategic reading on ESP students' reading comprehension of aviation texts. To do so, 60 intermediate, male students within the age range of 18 to 25 were selected through convenience sampling design. The participants were the members of four intact classes. The researchers assigned the participants randomly into two experimental groups: (EG1, *n* = 30) and (EG2, *n* = 30). Collaborative Strategic Reading (CSR) was employed based on Klingner and Vaughan in the EG1 and Concept Mapping in reading based on Harris and Graham (1996) in EG2. The statistical results indicated that both groups got better scores in the posttest and the treatments had significant effect (*p* = .001, eta squared = .18) on ESP students' reading comprehension. However, the participants in the EG1 outperformed those in EG2. Finally, the study provides practical implications for ESP educators, teachers, and syllabus designers.

Keywords: aviation text, collaborative strategic reading, concept mapping, reading comprehension

1. Introduction

Reading is viewed as one of the most important skills that one needs to acquire in his life. This is understandable as reading has always been associated with acquiring knowledge, expanding mature thoughts, and fostering progress. Reading is regarded as a vital dimension of ELT and plays a key role in boosting language proficiency (Carrell, 1998, Hamedi et al., 2020). Reading is the process of recognition, interpretation and perception of writer's printed materials (Sheng, 2000, Ye & Liu, 2023).

This shows that reading involves comprehension and thinking. Reading comprehension is considered as the "essence of reading" (Durkin, 1993, p. 4). As Duke and Pearson (2001) believed, “reading comprehension is what reading is all about. It is a process in which the reader constructs meaning, using it as the building materials of the information on the printed page and the knowledge stored in the reader's head" (p. 423). This occurs when a mental representation of meaning is formed

from written text. To accomplish this, the reader gathers and synthesizes information from the text, merging it with existing knowledge through active engagement and interaction with the written language (Koda, 2005; Raza Shah et al., 2022).

Reading comprehension can pose significant challenges for some individuals, especially when they face unfamiliar, technical, or complex materials. While they may be able to decode individual words, combining these words into coherent and meaningful ideas often demonstrates difficult. These readers possess the ability to distinguish words but lack the developed skills necessary for grasping the deeper meanings conveyed by sentences, paragraphs, and the overall text. Therefore, comprehension extends beyond merely understanding words; it includes comprehending the ideas and the relationships between those ideas presented in the text (Koda, 2005).

For having better comprehension, students must become "more sophisticated in both the range and the flexibility of their reading comprehension strategies to maintain or accelerate their level of reading proficiency" (Duke & Pearson, 2002, p. 9). Useful reading comprehension strategies are arguably the most important instruments to assist readers in order to boost their understanding and learn more effectively from text.

Proficient readers employ an array of reading comprehension strategies to interpret texts. As the complexity of the texts enhances, the necessity for conducting multiple strategies also rises (Zainol Abidin, 2012). Selecting and applying the best strategies in classroom have also a crucial role in enhancing the effectiveness of teaching reading comprehension process. Thus, it is necessary to search for finding useful strategies to increase the level of reading comprehension in EFL context.

Within the array of reading comprehension strategies, collaborative strategic reading emerges as a set of instructional approaches aimed at increasing the reading comprehension abilities of learners with different reading difficulties (Klingner et al., 2001). Initially conceptualized and refined by Klingner and Vaughn (1996), this strategy amalgamates two key instructional components: (a) modified reciprocal teaching, as proposed by Palincsar and Brown (1984), and (b) cooperative learning, as outlined by Johnson and Johnson (1989).

Reciprocal teaching was mainly conceived to support students facing challenges with reading comprehension. In this approach, both teachers and learners alternate in guiding discussions about pivotal dimensions of text, employing techniques such as summarization, questioning, clarification, and prediction. An added advantage of collaborative strategic reading lies in its facilitation of these skills through cooperative learning or group work (Bremer et al., 2002).

Another strategy which can be used for reading comprehension is concept mapping strategy. The genesis of concept maps traces back to 1972 within Novak's research endeavors at Cornell University, where his team aimed to track and comprehend the expansion of learner's scientific knowledge (Novak & Musonda, 1991). Different scholars (e.g., Beydarani, 2015, Hamedi et al. 2020, and Kalhor & Shakibaei, 2012) have explored the effect of concept mapping on reading comprehension.

2. Literature Review

2.1. Reading Comprehension Strategies

Numerous definitions of reading strategies exist in scholarly discourse. According to Mokhtari and Reichard (2002), reading strategies include activities or actions utilized by readers to build meaning and streamline their reading process. Brantmeier (2005) signifies reading strategies as techniques utilized by learners during the process of reading comprehension to grasp and interpret the context. Cohen (1990) describes reading strategies as techniques or approaches adopted by learners in their reading comprehension endeavors. Jimenez et al. (1996) elucidate reading strategies as purposeful actions chosen by learners to set and enhance their reading comprehension.

Cohen (1990) posits that reading strategies include the cognitive processes underlying the techniques learners utilize while reading. Typically, these techniques are consciously chosen to boost reading comprehension. Reading strategies hold significance as they aid readers in getting their reading goals and obtaining favorable outcomes in reading (Block, 1986). Furthermore, these strategies make students able to assess their reading comprehension proficiency (Kletzien, 1991). Consequently, students or readers who do not utilize any strategies in reading often encounter difficulties in comprehension. Roe and Ross (2006) observe that reader strategies are adaptable approaches that vary relying on the textual context. Such strategies necessitate learners to engage in critical thinking about how to approach the text for decoding and retrieving information.

The researchers concluded that, overall, the participants in their study were given opportunities to apply comprehension strategies (Pressley, 2002). There exists compelling evidence reflecting that students can be instructed in reading comprehension strategies and that such instruction effectively enhances their understanding of the text they read (Duke & Pearson, 2002, as cited in Ash-Shareef, 2010). Consequently, it is imperative for EFL teachers to acquaint themselves with reading strategies and to acquaint their students with a diverse array of strategies to enable them to employ them effectively (Chamot et al., 1993).

Additionally, Raza Shah et al. (2022) conducted a study to investigate the factors affecting English reading skills at the collegiate level in Pakistan. Their findings revealed that insufficient knowledge of English as a second language, limited vocabulary, difficulties in pronunciation, inappropriate text selection, and lack of interest in reading are the primary factors influencing reading skills. They also recommended that teachers employ strategies to address these challenges, such as metacognitive reading strategies and problem-solving techniques.

2.1.1. Collaborative Strategic Reading

To enhance the quality of teaching and learning reading comprehension, one of the recommended strategies under discussion is collaborative strategic reading (Klingner et al., 2012). The importance of reading strategies is elucidated by Kintsch (1998), stressing their critical role in comprehending reading materials. These strategies make effective reading comprehension easy among learners. Collaborative strategic reading, initially conceptualized and expanded by Klingner and Vaughn (1986), combines elements of modified reciprocal teaching (Palincsar & Brown, 1984) with cooperative learning strategies (Johnson & Johnson, 1990).

Collaborative strategic reading is a method tailored to assist learners facing challenges in reading comprehension. Some objectives of collaborative strategic reading include: (1) enhancing reading comprehension and fostering conceptual learning by maximizing students' engagement, (2) expanding reading comprehension skills specifically for learners with learning disabilities and those at risk for reading difficulties, and (3) utilizing collaborative strategic reading to make beneficial results for students of average and high-average achievement levels (Klingner & Vaughn, 1996).

Furthermore, Klingner and Vaughn (1998) affirmed that collaborative strategic reading was expanded with the aim of increasing reading comprehension for learners facing difficulties in reading. It can be inferred that collaborative strategic reading is highly considered and is distinguished as an instructional approach suitable for multilevel classrooms, with its implementation spanning over a year or longer. Indeed, collaborative strategic reading has the potential to render teaching reading more effective and efficient while boosting students' engagement. Moreover, it has the capacity to enable students to maximize their proficiency in English.

Based on the mentioned theories above, it can be concluded that collaborative strategic reading is a type of collaborative learning strategy that enables each student to work in small groups cooperatively and predict what they will learn based on the students' interest and background knowledge.

2.1.2. Implementation of Collaborative Strategic Reading

Collaborative strategic reading can be executed in two phases: (a) instruction on the strategies, and (b) engagement in cooperative learning group activities or student pairing. The procedural steps outlined below were refined through a series of research endeavors (Bryant et al., 2000; Klingner & Vaughn, 1998; Vaughn et al., 2001; Vaughn et al., 2001).

Students are taught in four strategies: preview, click and clunk, get the gist, and wrap up. Previewing occurs before reading the entire text for the lesson, while wrapping up takes place after completing the entire text. The remaining two strategies, click and clunk, and get the gist, are employed iteratively throughout the text, generally after each paragraph.

Furthermore, Nourzad Haradash et al. (2020) examined the comparative impact of collaborative strategic reading (CSR) and metacognitive reading strategy (MRS) on Iranian extrovert and introvert ESP learners' reading comprehension. In this study, 325 learners enrolled in a private language institute in Tehran, Iran, took a sample IELTS test, from which 225 were selected given their performance. These participants then completed the Eysenck Personality Inventory Questionnaire to determine their extroversion or introversion. Subsequently, 150 learners (75 extroverts and 75 introverts) were selected and divided into four experimental groups and two control groups. The four experimental groups consisted of 25 extroverts experiencing CSR, 25 extroverts undergoing MRS, 25 introverts experiencing CSR, and 25 introverts undergoing MRS. Meanwhile, the two control groups, each comprising 25 extroverts and 25 introverts, received conventional instruction in reading comprehension at the language school. Ancova and two-way Ancova analyses were conducted, revealing that introvert learners utilizing MRS outperformed extroverts using MRS, as well as introverts and extroverts using CSR, and the control groups. These outcomes underscore the significant role of personality traits in reading comprehension when different reading strategies are employed.

Moreover, Mudihang et al. (2023) conducted an inquiry into the potential effect of Collaborative Strategic Reading (CSR) on the comprehension of recount texts among students of Class XI IPA 1. The

main goal of their investigation was to elucidate the influence of group-based reading strategies on the comprehension of recount texts. Employing a reading assessment including 40 questions of varying types, they collected quantitative data for the qualitative segment of their study. Employing a pre-experimental methodology, they adopted a one-group pretest-posttest design. The study sample consisted of 32 students from the XI IPA 1 class at SMA Negeri 1 in Tondano. Subsequently, the study yielded several noteworthy findings: a) Following the intervention, participants exhibited enhanced performance in the reading component of the test compared to their initial performance; b) Initial test scores ranged from 50 to 80, whereas post-intervention scores ranged from 70 to 100; c) The post-intervention mean score of 81.41 surpassed the pre-intervention mean score of 62.96. Therefore, it can be inferred that the participants' reading proficiency demonstrated greater homogeneity in the post-intervention phase compared to the pre-intervention phase, as indicated by the calculations involving Collaboration Strategy Reading (CSR) and standard deviation.

2.2. Concept Maps

The origin of our initial concepts is sometimes questioned. These concepts are expanded by children from birth to around three years of age, as they perceive patterns in their settings and start associating language labels or symbols with these patterns (McNamara, 2004). This early acquisition of concepts primarily encompasses a process of discovery learning, wherein individuals discern patterns or regularities in events or objects and acknowledge them as the same patterns signified by older individuals through words or symbols.

This remarkable ability is ingrained in the evolutionary legacy of all generally expanding human beings. After the age of three, the acquisition of new concepts and propositions significantly relies on language, predominantly occurring through a receptive learning process. This process involves obtaining new meanings by posing inquiries and seeking clarification regarding the connections between pre-existing concepts and propositions and those newly introduced. This acquisition process is significantly facilitated when concrete experiences or tangible props are accessible, underscoring the significance of hands-on activities in science education for young children. However, this principle holds true for learners of all ages and across various subject domains (McNamara, 2004).

In a separate study, Cañas et al. (2004) concentrated on four classes encompassing a total of 112 eighth-grade learners over the course of one academic year. Two of these classes received instruction utilizing concept mapping with practice, while the other two classes were taught employing conventional learning methods. Following the respective instructional approaches, all learners underwent testing on language mapping comprehension. The outcomes demonstrated the impact of employing text concept mapping on reading comprehension. As a result, the researchers came to this conclusion that text concept mapping serves as an effective facilitator for learning.

Clariana et al. (2006) conducted a study to evaluate a computer-based method for scoring concept maps and to delineate the concurrent criterion-related validity of these scores. The outcomes recommended that concept map scores derived automatically can recommend relatively straightforward and easily interpretable measures of students' proficiency in science content knowledge. In another investigation, Saqqa (2006) explored the impact of computer-assisted semantic mapping and brainstorming on the reading comprehension and writing skills of Jordanian students in English. The outcomes indicated that semantic mapping encouraged active engagement among students, prompting

them to read texts from their textbooks and propose modifications to their initial semantic maps. Based on these outcomes, the researcher recommended the enhanced utilization of computer-assisted semantic mapping and brainstorming programs to enhance students' reading and writing proficiencies

Ghanizadeh (2007) discovered a favorable effect of concept map construction on ESP (English for Specific Purposes) students' reading comprehension and their attitudes toward EFL (English as a Foreign Language) reading comprehension. The study reflected that combining the concept mapping technique during the reading or post-reading phase enabled EFL students to identify main ideas in the passage, represent them in circles or boxes, delineate interconnections between ideas, and formulate propositions. In another investigation, Pishghadam and Ghanizadeh (2011) investigated issues pertaining to the reliability and validity of employing concept maps to assess L2 (Second Language) reading comprehension. The findings recommended that concept maps can serve as a reliable and valid tool for L2 reading assessment, capable of evaluating discourse comprehension and cohesive understanding.

Hamedi et al. (2020) conducted a study to investigate the effect of concept mapping and anticipation guides on the reading comprehension of EFL learners. The study involved 90 elementary EFL students who were divided into three groups, each comprising 30 students. During the treatment phase, one experimental group employed concept mapping as a pre-reading activity, while another experimental group utilized anticipation guides. The control group did not engage in any pre-reading activity. The course consisted of 10 sessions. The results of ANOVA reflected that both concept mapping and anticipation guides had statistically significant effects on learners' reading comprehension. However, no significant difference was found between the effects of concept mapping and anticipation guides on learners' reading comprehension.

Similarly, Ta and Razali (2023) conducted a study comprising a literature review of 33 peer-reviewed journal articles published between 2012 and 2022. Their concentration was on exploring the implementation of concept mapping in teaching reading comprehension across diverse ESL/EFL contexts. Their findings concluded that concept mapping was predominantly utilized and studied among ESL/ESP learners at the undergraduate level. It served various functions, acting as an advanced organizer in the pre-reading phase, an instructional instrument during reading, and a means for summarization and evaluation in the post-reading stage. Moreover, they observed that the application of Kit-Build concept mapping, particularly within technology-supported learning environments or incorporating a source connection function, exhibited promising effects on learners' reading comprehension.

3. Research Questions

The present study probed the comparative effect of teaching concept mapping and collaborative strategic reading on ESP students' reading comprehension of aviation texts. Specifically, it attempted to find out the answer to the following research question:

Is there any significant difference between the effect of collaborative strategic reading and concept mapping on ESP students' reading comprehension?

4. Method

4.1. Research Design

This study adopted a quantitative quasi-experimental design due to the non-random selection of participants (Macky & Gass, 2005). The study featured a single independent variable encompassing two modalities namely, concept mapping and collaborative strategic reading and one dependent variable, namely reading comprehension.

4.2. Participants

The study involved 60 male students, aged 18-25, who were studying intermediate-level English as a foreign language in an aviation course at Shahid Sattari Air University in Tehran, Iran. Two intact groups, each consisting of 30 students (split into two classes of 15), were selected for the study through convenience sampling: experimental group 1 (EG1, n = 30) and experimental group 2 (EG2, n = 30).

4.3. Instruments and Material

In this study, a researcher-made reading comprehension test of aviation was used and the book "Aviation English for ICAO Compliance," was worked on as the textbook for the two groups. They are presented in detail in the following two subsections.

4.3.1. Researcher-Made Reading Comprehension Test of Aviation

In order to measure the reading ability level of the participants of the two groups before and after the treatment, the researchers made a technical aviation reading comprehension test. This test has five parts followed by 35 questions including 15 multiple-choice (Cronbach's α = .89), 5 matching (Cronbach's α = .87), 5 true/false (Cronbach's α = .91), and 10 four-option multiple-choice cloze test (Cronbach's α = .88) used as the pretest and posttest. The total mark for this section was 35 and forty minutes was allotted for this test. In order to reduce the test effect, the researchers changed the order of items and choices, and reword some words of the item stems or choices of the posttest. Two experts in aviation read the test, provided the researchers with some tips to delete some ambiguous or malfunctioned items and add some more. Finally, they accepted the final refined test.

4.3.2. Material

All participants in this research received instruction from the book "Aviation English for ICAO Compliance," authored by Henry Emery, John Kennedy, Andy Roberts published by Macmillan Education in 2008. This book concentrates on teaching Aviation English, which has become the de facto international language of civil aviation. The need for a standardized language in aviation arose due to safety concerns related to communication between pilots and air traffic controllers as air travel expanded in the 20th century. In response to this, the International Civil Aviation Organization (ICAO) made a recommendation in "ICAO Annex 10 ICAO (Vol I, 5.2.1.1.2) to the International Chicago Convention" in 1951, recommending the universal use of English for "international aeronautical radiotelephony communications." Despite being a recommendation, ICAO aviation English was widely embraced and adopted.

4.4. Data Collection Procedure

As mentioned earlier, there were two intact experimental groups in this study: Collaborative strategic reading (EG1) and Concept mapping (EG2). All students of the two groups took aviation reading comprehension pretest. In EG1, the instructional approach involved systematically teaching reading passages utilizing the collaborative strategic reading strategy, as outlined in the instructional framework devised by Klingner et al. (2001). The teaching methodology adhered to a two-phase process: modeling and cooperative application of strategies. Initially, during the modeling phase, explicit instructions were provided to impart proficiency in the four comprehension strategies inherent to collaborative strategic reading. Subsequently, in the cooperative application phase, learners were guided in the practical implementation of these strategies within cooperative group settings (Klingner et al., 2001). For this purpose, the learners in collaborative strategic reading group were divided into small groups. The fact of whether to have learners choose their own partners or be randomly assigned into groups was the first major consideration in forming the groups. But, if the learners choose their own partners themselves, it would be more effective for learning (Klinger & Vaughn, 1998). Based on this, students were divided into groups of 3 or 4 in order to accomplish the assigned tasks and provide each other with feedback regarding their weaknesses and strengths.

As mentioned above, the first phase, modeling, involved teaching the four comprehension strategies of collaborative strategic reading through explicit instruction by teachers/researchers to the learners of this group. The teachers explicitly taught the collaborative strategic reading strategies. Each strategy was presented by giving examples. According to Klingner et al. (2001), in collaborative strategic reading group learners learn four strategies: (a) preview (before reading), (b) click & clunk (during reading), (c) get the gist (during reading), and (d) wrap-up (after reading).

In the concept mapping experimental group, participants received instruction on concept mapping in reading, based on the procedure highlighted by Harris and Graham (1996), as referenced in Nosratinia et al. (2013). This procedure encompassed five stages: (a) strategy description, (b) discussion of goals and purposes, (c) modeling of the strategy, (d) student mastery of the strategy, and (e) guided practice and feedback. Initially, learners were informed that they would be learning concerning the concept mapping strategy. Concept mapping was defined as a technique for categorizing information graphically through drawing. In this study, teachers mainly emphasized the importance and benefits of utilizing concept mapping in reading comprehension, highlighting its role in vocabulary expansion and enhancing reading comprehension. To foster students' active engagement as partners in the learning process, purposes and generated by the learners were displayed on the whiteboard.

It is important to note that all concept maps created in the classroom were carefully constructed using the themes and vocabulary from "Aviation English for ICAO Compliance," a book by John Cennedy. They were drawn based on Hierarchical Model of Concept Mapping and its two approaches: expert-constructed concept maps and learner-constructed concept maps using Harris and Graham procedure of strategy instruction (1996). At the start of the intervention phase, before learners became proficient in independently creating concept maps, they were given partially completed maps by instructors or scholars to complete. This method is known as the expert-constructed concept maps approach. After being familiar with drawing concept maps the learners were required to draw their own concept maps based on the Harris and Graham procedure of strategy instruction (1996) which is called learner-constructed concept maps approach. Finally, all students of the two groups took the same

aviation reading comprehension posttest and the mean scores of the two groups on both pretest and posttest were analyzed.

4.5. Statistical Analysis

Using SPSS 23.00, both descriptive and inferential statistics were used in the current study. Within descriptive statistics, number, mean score, standard deviation, and standard error mean were computed. In terms of inferential statistics, paired samples t-test and independent samples t-test, as two parametric statistical methods were adopted. Paired samples t-test was used to compare the pretest-posttest mean score improvement, and independent samples t-test was performed to compare the two groups' mean score on both pretest and posttest. Moreover, to check the normality assumption in both groups on both pretest and posttest, s*kewness and kurtosis test of normality were used.*

5. Results

The related descriptive statistics were calculated (Table 1) before explaining the results of inferential statistics (i.e., t-test). The table displays the mean, standard deviation, and number of students for the collaborative strategic reading (M = 20.80, SD = 3.15, n = 30) and concept mapping (M = 20.46, SD = 3.89, n = 30) groups on pretest of reading comprehension.

Table 1

Descriptive Statistics for Aviation Reading Pretest Scores in Collaborative Strategic Reading and Concept Mapping Groups

Group	N	M	SD	SEM
Collaborative strategic reading	30	20.800	3.155	0.498
Concept mapping	30	20.465	3.893	0.615

As shown in Table 2, the independent samples t-test results manifested that there was no significant difference in pre-treatment reading scores between the concept mapping and collaborative strategic reading groups, $t(58) = 0.46$, $p = 0.64$, $p < 0.05$. The difference in means (mean difference = .33, 95% *CI*: -1.09 to 1.76) was very small. Based on these findings, it was concluded that participants in both experimental groups exhibited similar levels of reading comprehension prior to the treatments. Therefore, any subsequent score differences could be attributed to the treatments themselves.

Table 2

Independent Samples T-Test of Aviation Reading Pretest Scores

	Levene's Test for Variances		T-test for Means			
Factor	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.
Equal variances assumed	0.353	0.555	0.466	58	0.643	0.333
Equal variances not assumed			0.466	56.772	0.643	0.333

Nevertheless, in order to inspect the normality of the data, descriptive statistics of the two experimental groups regarding the reading pretest and posttest scores were obtained (Tables 3 & 4). This enabled the researchers to check the skewness and kurtosis ratios which, in normal data, should fall within the range of ±1.96.

As reported in Table 3, the distribution of scores for the pretest was normal as the skewness ratio and kurtosis ratio values fell within the range of -1.96 and +1.96, supporting the normality of distribution for the scores (Tabachnick & Fidell, 2007).

Table 3

Skewness and Kurtosis Test of Normality for Collaborative Strategic Reading Group's Scores

Time	N	Skewness	Std. Error	Skewness Ratio	Kurtosis	Std. Error	Kurtosis Ratio
Pretest	30	-0.191	0.427	-0.447	-0.408	0.833	-0.489
Posttest	30	0.191	0.427	0.447	-0.297	0.833	-0.356

Table 4 shows that the scores for the pretest were normally distributed since the skewness ratio and kurtosis ratio values did not exceed the range of -1.96 and +1.96, confirming the normality of distribution for the scores.

Table 4

Skewness and Kurtosis Test of Normality for Concept Mapping Group's Scores

Time	N	Skewness	Std. Error	Skewness Ratio	Kurtosis	Std. Error	Kurtosis Ratio
Pretest	30	-0.071	0.427	-0.166	-0.933	0.833	-1.12
Posttest	30	0.225	0.427	0.526	-0.338	0.833	-0.405

Paired-samples t-test was adopted to see whether the pre-treatment and post-treatment reading scores were significantly different in the collaborative strategic reading group. Table 5 reports the paired-samples statistics. Table 5 indicates the mean and standard deviation for the collaborative strategic reading group on the pretest (M = 20.80, SD = 2.96) and posttest (M = 25.70, SD = 3.19).

Table 5

Descriptive Statistics of Paired Samples T-Test for Collaborative Strategic Reading Group

Time	N	M	SD	SEM
Pretest	30	20.800	2.964	0.541
Posttest	30	25.700	3.196	0.583

Table 6 presents the results of the paired-samples t-test. As reported in Table 6, there was a statistically significant increase, $t(29) = 10.75$, $p = 0.000$, in reading scores from pretest to posttest in the collaborative strategic reading group with the mean increase in aviation reading scores of 4.9. In addition, the eta squared statistic (0.799) indicated a large effect size eta squared = 0.799).

Table 6

Paired Samples T-Test for Comparing Pretest and Posttest Reading Means in the Collaborative Strategic Reading Group

Gain Score	SD	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Lower	Upper			
4.900	2.496	3.967	5.832	10.752	29	0.000

Also, another paired-samples t-test was run to find out whether the pre-treatment and post-treatment reading scores were significantly different in the concept mapping group. The mean and

standard deviation for the concept mapping group on the pretest (M = 20.46, SD = 2.55) and posttest (M = 23.13, SD = 2.69) are manifested in Table 7.

Table 7

Descriptive Statistics of Paired Samples T-Test for Collaborative Strategic Reading Group

Time	N	M	SD	SEM
Pretest	30	20.465	2.554	0.466
Posttest	30	23.133	2.687	0.490

According to the results represented in Table 8, paired-samples t-test detected a statistically significant increase, $t(29) = 7.48$, $p = 0.000$, in aviation reading scores from pretest to posttest in the concept mapping group with the mean increase in reading scores of 4.9. Moreover, the eta squared statistic (.65) indicated a large effect size eta squared = 0.65).

Table 8

Paired Samples T-Test for Comparing Pretest and Posttest Aviation Reading Means in the Concept Mapping Group

Gain Score	SD	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Lower	Upper			
2.666	1.953	1.937	3.396	7.477	29	0.000

Furthermore, to systematically investigate whether collaborative strategic reading and concept mapping treatments affect aviation students' reading comprehension differently, independent samples t-test was run. The related descriptive statistics were computed (Table 9) before explaining the results of t-test. The table displays the mean, standard deviation, and number of students for the collaborative strategic reading (M = 25.70, SD = 3.19, n = 30) and concept mapping (M = 23.13, SD = 2.69, n = 30) groups on posttest of reading comprehension.

Table 9

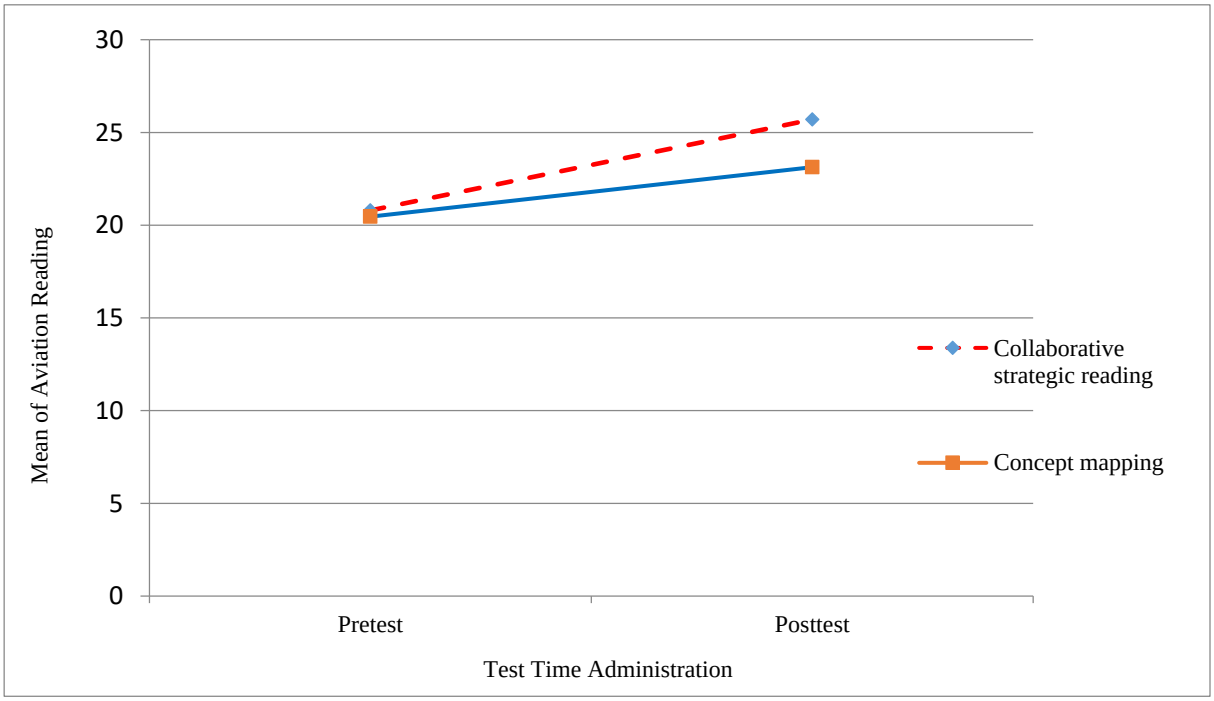
Descriptive Statistics for Aviation Reading Posttest Scores in Collaborative Strategic Reading and Concept Mapping Groups

Group	N	M	SD	SEM
Collaborative strategic reading	30	25.700	3.195	0.583
Concept mapping	30	23.133	2.687	0.490

In order to demonstrate the results more obviously, a line Chart (Figure 1) was drawn. As seen clearly in the Line Chart, the two groups have had almost the same level of reading performance at the outset of the study. After experiencing different interventions, the two groups have grown noticeably, though the collaborative strategic reading has surpassed the concept mapping regarding reading performance.

Figure 1

Line Chart for Means of Aviation Reading in Collaborative Strategic Reading and Concept Mapping Groups (Pretest & Posttest)



Initially, it was needed to check the assumption of homogeneity of variances. As reported in Table 10, this assumption was met, Levene's $F = 0.86$, $p = 0.36$. Therefore, the values presented in the first line of the table were used. As set forth in Table 10, there was a significant difference, $t(58) = 3.37$, $p = 0.001$, in aviation reading comprehension scores for concept mapping and collaborative strategic reading groups for the benefit of the collaborative strategic reading group. The magnitude of the differences in the means (mean difference = 2.57) was large (eta squared = 0.18).

Table 10

Independent Samples T-Test of Aviation Reading Posttest of Two Groups

	Levene's Test for Variances		T-test for Means			
Factor	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.
Equal variances assumed	.856	.359	3.366	58	.001	2.566
Equal variances not assumed			3.366	56.339	.001	2.566

6. Discussion

The research question of the study was an attempt to compare the effect of CSR and concept mapping on aviation students' reading comprehension. Addressing the research question of this study through running an independent samples t-test indicated that the collaborative strategic reading group had significantly outperformed the concept mapping group. One possible explanation of this result could be that learners by answering questions, monitoring their understanding and peer discussion, which were

included in the procedure of collaborative strategic reading, could reach to deeper comprehension than using concept mapping strategy.

These findings were supported by the findings of Klingner and Vaughn (1996) and Kinger et al. (2001) who concluded that the CSR treatment had a positive and significant effect on ESP students' academic gains such as comprehension and fluency in reading comprehension.

Additionally, the results of this study comply with the findings of Hitchcock et al. (2011) and Katims and Harmen (2000), who observed that the employment of collaborative strategic reading strategy led to increased engagement among learners in extracting meaning from texts when working collaboratively. Similarly, Fan (2010) reported improved reading comprehension among Taiwanese university learners, mainly regarding comprehension questions related to signifying the main idea and finding supporting details, as a result of employing collaborative strategic reading.

A similar pattern of results was obtained in Kalhor and Shakibaei's (2012) study in which they found that teaching concept mapping as a learning strategy in reading had positive effect on the English learners' reading comprehension. This finding was also in line with Beydarani (2015), who concluded that the learners in concept mapping experimental group outperformed the learners in control group in reading comprehension. This finding is also aligned with Dias (2010) and Ardakani and Lashkarian (2014), who concluded that using the concept mapping strategy is beneficial in the process of reading comprehension among ESP students.

A similar conclusion was reached by Nosratinia, et al. (2013) who found a noticeable increase in ESP students' performance in ESP reading comprehension due to the effect of collaborative strategic reading approach. This finding was also in line with Riani (2015), who showed that implementing collaborative strategic reading strategy had positive effect on students' reading comprehension as well as its aspects included grasping the main idea, identifying the supporting ideas and text structure, comprehending words and making inferences.

Similarly, Hamedi et al. (2020) discovered that concept mapping had a statistically significant impact on learners' reading comprehension, while anticipation guides also significantly affected reading comprehension. However, the study found no significant difference between the effects of concept mapping and anticipation guides on learners' reading comprehension.

Furthermore, these results are consistent with the findings presented by Ta and Razali (2023), who determined that utilizing the Kit-Build concept mapping method, whether in a technology-enhanced learning setting or with a source linking feature, enhances students' reading comprehension skills.

The results of this study tie well with Mudihang et al.'s (2023) investigation wherein they found that Collaborative Strategy Reading (CSR) influences how well the students understand the texts. Additionally, they concluded that the participants' reading performance on the pretest is more diverse than on the test after treatment through CSR calculations and the standard deviation.

7. Conclusions and Implications

It can be concluded that both collaborative strategic reading and concept mapping techniques can increase participants' understanding and lead to improved reading outcomes. This can clearly mean that aviation students can become better readers if they use collaborative strategic reading or concept

mapping strategies in reading comprehension. These two strategies could help them to think before, during and after reading that helped them to read more and comprehend better.

Based on statistical analyses of the data which was mentioned previously, it was concluded that the difference between the means of the pretest and posttest in both groups shows the significant effect of the treatments on the level of reading comprehension. This means that, both concept mapping and collaborative strategic reading have significant effect on aviation students' reading comprehension. Also, based on the results, it was revealed that the collaborative strategic reading group had significantly outperformed the concept mapping group. Accordingly, the teachers can use both concept mapping and collaborative strategic reading strategies to make learners have better level of reading comprehension.

Reading involves strategic thinking, as readers continually build understanding through various methods. Applying strategies encouraged learners to think about text, solve problems, and monitor understanding of texts already read (Harvey & Goudvis, 2000). Since collaborative strategic reading and concept mapping have significant effect on reading comprehension, it seems that teachers have to provide learners with instructions regarding these two strategies to cultivate learners' strategy knowledge in ELT reading classes.

Absolutely, teachers' familiarity with strategies and their adept utilization can greatly benefit teaching across all domains. Oxford (1990) advocated that strategies are fundamental to the effective teaching of any subject and should form the core of any professional program. This highlights the significance of integrating strategy instruction into teacher training programs to boost pedagogical effectiveness across various disciplines. Thus, teachers should emphasize the role of using strategies in their classrooms. Therefore, teacher trainers should make the ESP teachers aware of these two strategies and provide the teachers with enough information regarding collaborative strategic reading and concept mapping and methods of teaching them. Meanwhile, English teachers should practice these strategies as a part of teaching and practicing reading.

Indeed, the findings of the current study hold potential benefits for ESP students as well. Learners who engage in strategic thinking and learning are often more motivated and exhibit a greater sense of self-efficacy and autonomy in their learning process. By understanding and using effective reading comprehension strategies, ESP students can boost their overall language proficiency and academic success. These strategies not only facilitate comprehension but also empower students to take ownership of their learning journey, leading to greater confidence and independence (Adair-Hauck, 1996). Conscious awareness of collaborative strategic reading and concept mapping strategies can help them to take more responsibility in their learning process and consequently be more independent in their reading process. Actually, using collaborative strategic reading could help learners to learn how to read, ask questions and understand the text in a cooperative and critical thinking way leading to deeper understanding and comprehension in reading.

Moreover, syllabus designers can take advantage of the findings of this study and employ the methods of teaching both collaborative strategic reading and concept mapping, especially collaborative strategic reading in their curriculum. It also seems that ESP material developers do not include a sufficient amount of information regarding strategies into their materials (Nosratinia & Mohammadi, 2017). Therefore, a need for inclusion of strategies such as collaborative strategic reading and concept mapping, especially collaborative strategic ESP reading because of its powerful effect on learners' reading comprehension, is obvious. Providing reading texts and materials accompanied by graphs,

charts, pictures, and other supplements can help learners use proper strategies which in turn lead them to be better strategic readers.

Finally, this research was a mere quantitative one aiming at comparing the effect of teaching concept mapping versus collaborative strategic reading on ESP students' reading comprehension of aviation texts. Other interested researchers in this field can conduct a qualitative or mixed methods study to deeply delve into the inner layers of the students' brain in order to understand the issue more profoundly. Meanwhile, this study was done on the students of aviation. Other related studies could be launched to compare the impact of teaching concept mapping versus collaborative strategic reading on general text and other technical texts such as computer engineering, psychology, law, management, medicine, etc.

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Authors' Contributions

All authors have conducted the study, collected data, analyzed and interpreted the data, and written up the manuscript.

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Competing Interests

The authors declare that there is no conflict of interest.

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