



Research Article

Digital Learning and Reading Comprehension: LMS-Based Comparison of Collaborative and Scaffolding Strategies

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Abstract

This paper attempts to inspect the possible influence of collaborative learning and scaffolding strategies via LMS on reading comprehension of undergraduate and postgraduate EFL students. For this purpose, using a quantitative, quasi-experimental, pre-posttest control group design, a total of 180 upper-intermediate EFL university students (90 undergraduates and 90 postgraduates) were recruited via convenience sampling. Participants were divided into three intact groups - collaborative, scaffolding, and control - with 30 students in each group. The first group received reading instruction via collaborative learning through the LMS, while the second experimental group was taught using scaffolding strategies on the same platform. The control group received traditional instructor-led instruction. TOEFL reading comprehension test, consisting of 40 items, was used as a pretest and posttest. One-way ANCOVA showed that both collaborative learning and scaffolding strategies via LMS bring good effects to both undergraduate, $F(2, 86) = 24.30, p = 0.000, \eta^2 = 0.36$, and postgraduate, $F(2, 86) = 22.33, p = 0.000, \eta^2 = 0.34$ EFL students' reading comprehension. Furthermore, the results proved that collaborative learning is more effective ($p = 0.013$) than scaffolding strategies to enhance undergraduate EFL students' reading; nonetheless, for the postgraduates, collaborative learning and scaffolding strategies via LMS have almost the same impact ($p = 0.095$) on postgraduate EFL students' reading skill. Findings can be helpful for higher education EFL students, teachers and educators.

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Keywords: Collaborative learning; Digital learning; LMS; Scaffolding strategies; Reading

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1. Introduction

LMSs are web-based platforms that allow documentation, administration, tracking, and delivery of educational courses as well as training programs (Almarzouqi et al., 2022). These systems serve as centralized hubs that enable educators to: (1) distribute instructional materials, (2)

foster learner-instructor interaction, (3) evaluate academic progress, and (4) streamline course administration. Contemporary LMSs integrate advanced functionalities—including discussion forums, automated grading systems, multimedia support, and learning analytics—to optimize instructional delivery and student engagement (Khan & Abdou, 2021). They are widely adopted in academic

institutions, corporate training, and online education due to their scalability, accessibility, and ability to support blended and fully online learning modalities. Emerging educational technologies, particularly artificial intelligence (AI)-enabled adaptive learning systems and cross-platform mobile compatibility, have significantly influenced the development of LMSs (Dias et al., 2023). Recent studies emphasize their role in fostering collaborative learning, self-paced instruction, and data-driven educational decision-making (Hussain et al., 2022). Despite their advantages, significant challenges—including user resistance, technical limitations, and the necessity of pedagogical alignment—must be addressed to ensure effective implementation (Al-Fraihat et al., 2020). As LMSs advance, their integration with emerging technologies, such as virtual reality (VR) and learning analytics, is poised to reshape digital education landscapes. Bradley (2021) highlights that LMSs enable educators to: facilitate digital discourse, design structured virtual learning environments, set clear academic benchmarks, provide differentiated instruction, and promote critical thinking through guided decision-making frameworks. Instructors' pedagogical presence within these digital learning environments substantially improves learner engagement and active participation. Furthermore, well-designed LMS implementations can maintain student agency while supporting sustained academic motivation and fostering self-regulated learning behaviors. To increase the efficiency of these platforms for STEM education and interdisciplinary applications, institutional stakeholders should ground LMS-mediated instructional strategies in evidence-based research, ensuring continuous validation and improvement.

Emerging empirical research illustrates how LMSs are fundamentally restructured reading pedagogy while demonstrably improving text comprehension outcomes in digital learning environments. These platforms provide structured digital learning environments where students interact with texts through multimodal supports—including interactive annotations, embedded vocabulary tools, and multimedia supplements—all of which have been empirically shown to enhance textual analysis skills (Vlachopoulos & Jan, 2023). Research indicates that LMS-mediated instructional strategies—particularly instructor-modeled think-aloud exercises and structured peer discussion forums—effectively develop higher-order comprehension skills by externalizing cognitive processes (Clinton-Lisell, 2022). However, researchers warn that without intentional instructional design, these digital tools risk fostering surface-level skimming behaviors rather than facilitating deep, critical reading (Baron et al., 2023). The personalization capabilities of modern LMS platforms appear particularly transformative for struggling readers. Adaptive algorithms dynamically modify text complexity and prescribe targeted skill-building exercises in response

to identified comprehension gaps—research-supported interventions that correlate with significant improvements on standardized reading measures (Yang et al., 2024). Emerging research reveals these benefits are significantly mediated by socioeconomic and cultural factors, with students lacking reliable home internet access demonstrating markedly reduced gains from LMS-based reading interventions (UNESCO, 2023). As institutions increasingly adopt these systems, ongoing teacher training and equitable resource allocation will prove critical to realizing their full potential for literacy development. To date, few studies have systematically examined usefulness of LMSs in enhancing reading within university context of Iranian. More significantly, no research has specifically investigated and compared LMS impacts between undergraduate and postgraduate EFL student populations. More specifically, the following RQs were primary focus of this study:

1. Does using collaborative learning and scaffolding strategies via LMS significantly affect undergraduate EFL students' reading?
2. Does using collaborative learning and scaffolding strategies via LMS significantly affect postgraduate EFL students the reading?

2. Literature Review

Laferrière et al. (2003) adopted a collaborative learning perspective that aligns closely with the current study, specifically examining online collaboration in higher education contexts. Data collection spanned multiple educational contexts and temporal scales, ranging from longitudinal three-year studies to intensive one-month observations.

The analytical framework systematically incorporated all three theoretical perspectives identified in the study. The results demonstrate that systematically monitored online collaborative learning, when analyzed through discourse-based approaches, enables instructors to better align pedagogical intentions with actual learning outcomes, thereby enhancing instructional effectiveness. Neo (2003) similarly implemented a collaborative learning environment for first-year undergraduates, investigating its impact on the development of problem-solving and critical thinking competencies. This approach might be linked to a no-scaffolding framework; in other terms, simply assemble individuals and enable them to collaborate. Upon the conclusion of treatment, students' perspectives on collaborative efforts indicated that a vast majority (i.e., 86%) favored group work; however, somewhat paradoxically, 36% felt that teamwork hindered their optimal performance. Maheady et al. (2004) conducted an eight-week intervention study examining the impact of collaborative learning on student academic achievement. The researcher reported that majority of students enjoyed

learning and teaching their partners. The result of this research indicated that elementary school students learn better when they teach one another than they do in completely teacher-directed classrooms.

Also, the influence of the ZPD-based proximal contexts of equal and unequal peer interactions in comparison to teacher-fronted instruction on EFL students' L2 pragmatic development was sought by [Rahimi Domakani and Felfelian \(2012\)](#). Participants were assigned to two experimental conditions: (1) a ZPD-based collaborative context where learners received peer scaffolding through interactive task completion, and (2) a non-ZPD-based individual context requiring autonomous task performance without instructional support. The ZPD-activated class included groups of both equal and unequal proficiency levels that were partnered to collaboratively finish the discourse completion test items. The results showed the usefulness of the ZPD-activated proximal context and the benefits of expert peers' scaffolding compared to that of coequals.

In a related investigation, [Khaliliaqdam \(2014\)](#) explored how scaffolded communicative activities contribute to the development of fundamental speech skills among adult foreign language learners. The results showed that language input from the teacher provided cognitive structure and an organizational model of language for the students and the learners' speech level improved at the end of the term.

[Abbasian et al. \(2015\)](#) examined how off-task scaffold feedback affects the speaking abilities of young learners. The experimental students were supported with teacher off-task recorded feedback from but in the control group, students completed the same tasks but's received immediate feedback. Results reflected that the speaking skills of the learners in the experimental group were noticeably superior to the control group. Investigators attributed this difference to scaffolding type and learner feedback received and the time they spent for reflection.

[Farajee and Arabmofrad \(2015\)](#) investigated the impact of three collaborative strategic vocabulary learning approaches on Iranian students' self-efficacy in the context of third-grade junior high schools. The research employed an experimental approach over ten weeks including eighty students which were divided into four groups and included three treatment groups and one control group. Each treatment group was given one of the following types of instructions for vocabulary acquisition: (a) meta-cognitive, (b) cognitive, and (c) memory strategy. A questionnaire on self-efficacy was utilized as the pre- and posttest for data collection. Finally, the results indicated that cooperative strategic vocabulary learning had no impact on learners' self-efficacy.

[Rezaee et al. \(2014\)](#) examined the influence of both symmetrical and asymmetrical scaffolding on the collocational competence of Iranian intermediate EFL

students within the framework of concordance. The balanced, asymmetrical, and no-scaffolding groups that underwent the treatment tasks within the context of concordance significantly improved their understanding of collocations in both receptive and productive tasks compared to the control group, which lacked access to a concordance and did not receive scaffolding. Moreover, [Khosravi \(2017\)](#) studied the notable impact of symmetrical scaffolding on the reading comprehension of advanced learners. Their research focused on two categories of scaffolding: symmetrical and asymmetrical. They concluded that symmetrical scaffolding influenced reading, nevertheless asymmetrical scaffolding was the most effective method for enhancing reading.

In related research, [Kusumawati \(2018\)](#) examined scaffolding learning for reading and writing abilities in English within mechanical engineering and discovered that scaffolding learning was an effective method for enhancing the participants' English proficiency. In the same vein, [Ghasedi et al. \(2018\)](#) assessed the impact of both symmetrical and asymmetrical scaffolding on enhancing the speaking accuracy, fluency, and complexity of Iranian EFL learners. Thus, this study will investigate the effectiveness of collaborative learning and scaffolding strategies via a LMS that improves writing skills and reading comprehension skills among undergraduate and postgraduate students.

[Sabzevari et al. \(2022\)](#) investigated the efficacy of a reciprocal-scaffolding treatment within a virtual EFL learning context for Iranian learners. A sample of 36 students were determined by a placement test, and was randomly assigned to either an experimental group (n=18) that received the reciprocal-scaffolding intervention or a control group (n=18) instructed through conventional methods. Utilizing homogeneity tests, pretests, and posttests assessing listening and speaking skills, the 16-session study revealed that the experimental group demonstrated significantly greater improvement in both oral proficiencies. Statistical analyses, including independent and paired samples t-tests, confirmed this result. The findings suggest pedagogical implications for integrating reciprocal-scaffolding strategies into EFL instruction.

[Amalia et al. \(2024\)](#) conducted an experimental study using a factorial design to examine how different authoring tools i.e., Hot Potatoes and SoftChalk, within a LMS, along with reader types (Avid, Passive, & Reluctant), influenced the sophomore students' reading. Before the study, participants completed a brief survey to categorize their reading preferences. The researchers then assessed reading comprehension by administering pre- and post-tests to sixty second-year students.

Hot Potatoes tool was found to be more effective in enhancing students' reading comprehension compared to SoftChalk. While both authoring tools contributed to

overall reading achievement across multiple comprehension components, Hot Potatoes showed greater benefits in enhancing specific features. Additionally, although no significant interaction effect was found, the post-test results revealed that Avid and Reluctant readers in both groups performed better than Passive readers. This suggests that student engagement level (Avid, Passive, or Reluctant) played a role in comprehension outcomes, regardless of the tool used.

Wang et al. (2024) employed Classification and Regression Tree (CART) algorithm as machine learning techniques, alongside regression analysis, to evaluate learning outcomes of blended learning via the Rain Classroom LMS. The research investigated the relationship between multidimensional factors in blended learning and their association with English proficiency. By identifying key factors that influence score improvements, the study categorized students according to their learning outcomes through a decision tree model. Furthermore, a multiple linear regression analysis quantified the effectiveness of Rain Classroom in enhancing English language acquisition across different proficiency levels. The findings provided educators with data-driven insights to refine instructional strategies, customize learning materials, and optimize blended learning experiences. By leveraging Rain Classroom's functionalities, instructors can tailor their approaches to individual student needs, fostering deeper engagement and maximizing academic potential.

3. Method

3.1. Design

This study employed a quantitative quasi-experimental design featuring a pre-posttest control group. Students were assigned to three groups: collaborative, scaffolding, and control groups with thirty students in each. The impact of using collaborative learning and scaffolding strategies via the LMS on improving reading skills was sought. The LMS and reading were the independent dependent variables respectively. The participants consisted of three different classes of 30 upper-intermediate EFL learners each. Two of them were the experimental and the other was control one.

3.2. Participants

The sample of this study included 90 undergraduates and 90 postgraduate EFL students, selected out of a larger pool of EFL students ($N = 260$) studying English at four universities of Iran, namely IAU of Najafabad, Falavarjan, and Isfahan, and Feiz-o-Islam Higher Educational Institute in Isfahan based on convenience sampling in the first semester of 2023-2024. From these participants, 90 students were selected as homogeneous, lower-intermediate undergraduates and another 90 ones were

chosen as postgraduate upper-intermediate ones through PET. There were three groups of EG1, EG2, and control with 30 students each in the two academic levels. The participants were of both genders with an average age range of 20 to 38. All of them were Persian native speakers.

3.3. Instruments

A reading comprehension test (RC hereafter) was administered to undergraduate groups as a pretest and posttest to reading control and experimental groups to measure their RC ability before the treatment and to check any significant differences between them. The RC test was a TOEFL sample used as a pretest. This part was designed to assess how well students were able to read and understand the types of academic materials. There were four reading passages of 700 words, with 10 questions per passage. They had 70 minutes for each section.

After completing the treatment - lasting 14 weekly 90-minute sessions - a TOEFL RC test was administered in the final session as a posttest to the three groups to measure their RC ability after the treatment. The test contains both inferential and referential questions entailing skimming, scanning, and detailed reading strategies. Both pre and posttest were similar in terms of content. Again, passages were selected from different TOEFL versions.

It should be mentioned that, to ensure the validity of the Academic RC Pretest and Posttest, they were reviewed by three TOEFL experts, and their comments were utilized in the final draft. Finally, these three experts accepted the content validity of both the pretest and posttest.

Moreover, the Cronbach's alpha for the reading pretest and posttest were computed to be 0.89 and 0.91, respectively. Additionally, expert opinions of three subject matter experts were used to confirm the face and content validity of these tests

3.4. Data Collection Procedure

The researchers selected 180 Iranian EFL students from 260 students who were studying at four universities, namely IAU of Najafabad, IAU of Falavarjan, IAU of Isfahan, and Feiz-o-Islam Higher Educational Institute in Isfahan, based on convenience sampling in the first semester of 2022-2023. They were selected based on their performance on the PET. PET was administered to homogenize them regarding their English proficiency level, especially in RC. They were assigned to 9 groups, including 3 control groups, and 6 experimental groups.

Undergraduate students

- a) EG A ($n = 30$, with collaborative strategies)
- b) EG B ($n = 30$, with scaffolding strategies)
- c) Control group ($n = 30$, traditional method)

Postgraduate students

- a) EG A (with collaborative strategies)

- b) EG B (with scaffolding strategies)
- c) Control group (traditional method)

3.5. Treatment

The conditions of the three groups were the same, including gender, the average age ranged from 20 to 38 years, and the number of sessions, hours, the time of test, the PET questions, and RC passages. The reading courses were held for 12 sessions (one semester) once a week, and each session lasted for 90 minutes. This part consisted of two main parts of collaborative learning treatment and scaffolding strategies treatment, with their sub parts of undergraduate and postgraduate for experimental and control groups.

3.5.1. Collaborative Learning Treatment

The RC experimental groups were the students who took Academic reading Courses in the first semester of 2023-2024 and were divided into different groups. The method was an experimental method by applying a pretest-posttest TOEFL. The study design was as follows:

(1) Dividing or selecting the experiment class and the control class;

(2) Giving a RC pretest to both groups to see the equality of their RC ability. Their passages and questions were selected from different versions of TOEFL.

(3) In the treatment phase, the experimental group received web-based CL treatment while the control group underwent traditional treatment. The teacher also instructed Select Reading by [Linda Lee and Erik Gundersen \(2011\)](#) using the LMS. WBC consists of five elements: learning, peer interaction, group activities, tutoring, web-based learning platforms, and communication. There is no in-person connection present. Peers are more individual as each peer is situated at a single computer station, even though they can be categorized into different groups by the online collaborative learning system via a web server. They are able to view one another solely through webcams. They are located in various geographic areas. In this context, communication tools play a crucial role, including real-time chat rooms, electronic bulletin boards, BBS, audio and video systems, email, virtual seminars, virtual forums, bookmarks, notebooks, search engines, and others ([McConnel, 2000](#)), which can be used to receive, send, browse, discuss, publish, and look up learning messages. The tutor organized classmates into various groups and provided guidance or assistance to individuals or groups

First, the teacher introduced and explained some RC techniques to students, such as inferring, activating, questioning, monitoring-clarifying, summarizing, searching-selecting, and visualizing-organizing, etc. Furthermore, the teacher applied some pre-reading

activities, such as questioning about the text's title as well as making some comments about it to activate their prior knowledge and form new experiences. The teacher also introduced and described some scaffolding strategies and their positive effects on RC via the LMS. Afterward, the students utilized these activities in the web-based environment in wikis.

(4) Conducting a posttest to measure the RC ability of two classes after the treatment.

(5) Conducting a posttest and interview for EFL RC to measure the RC ability and students' attitudes toward RC strategies of the two classes after the treatment.

(6) Calculating and comparing the difference between pre- and the posttest mean of the two groups and analyze the interview for EFL RC.

3.5.2. Scaffolding Strategies Treatment

Similarly, the research was performed in an L2 RC class with no changes to the course syllabus besides the embedment of collective peer scaffolding strategies in the class activities. At the beginning of the semester, students were evaluated to assess the equality of their RC ability. They were assessed by using TOEFL sample papers on RC

First of all, the teacher introduced and explained some RC techniques to students, such as inferring, activating, monitoring-clarifying, searching-selecting, summarizing, questioning, and visualizing-organizing etc. Furthermore, the teacher applied some pre-reading activities, such as asking questions about the text's title and making some comments about it to activate their prior knowledge and form new experiences. The teacher also introduced and described some scaffolding strategies and their positive effects on RC.

Afterward, the teacher taught students how to scaffold their partners effectively, such as asking for guidance from their peers or in case of problems. The teacher then gave them a short time to read the text to find the main idea of each paragraph or summarize paragraphs by employing some of the RC techniques. They were given time to do these activities with their peers in groups and with their teacher through the LMS (peer and teacher scaffolding). They were requested to answer the comprehension questions alongside their classmates. While they were scaffolding one another to complete the task, the teacher supported each group until the peers grasped the text by offering suggestions, helping them, demonstrating some questions related to the reading, asking questions, using gestures, pausing, praising, repeating reading techniques, summarizing or clarifying the text, and enabling students to pose any relevant questions that helped them answer the comprehension questions. The teacher varied levels of support from participant to participant and from teacher to participant based on their knowledge levels. At the same time, the teacher considered practical factors across groups

to decrease their anxiety. Little by little, the teacher reduced the scaffolding applied after some sessions. In the last sessions, the teacher intervened and guided students if it was necessary. During 14 weeks, the teacher took advantage of peer and teacher scaffolding strategies, including reasoning, generalizing, co-participating, predicting, reducing choices, and eliciting. These strategies were classified into two categories: low-support techniques and high-support strategies (Table 1). Here, the aim was to determine whether these strategies affected students' RC over time via the LMS. The students were pretested on RC skills before the treatment, and all of them were post-tested after it. Then, an interview was administered to assess students' attitudes after proposing reading techniques. Differences between the measurements were examined for statistical significance.

3.6. Control Group

In undergraduate and postgraduate control groups, the settings were completely traditional, and all of the students worked individually. The settings were fully teacher-led. The teacher came to the class and taught points while students just listened silently and were asked to write individually in class or at home. There was no active interaction between the teacher and students. Before the treatment phase, the pretest was administered, and after the

treatment phase, posttest was administered to all groups. Data were then compared and analyzed.

4. Results

4.1. Addressing Research Question (RQ) One

The first RQ of the current study addressed the effects of incorporating collaborative learning and scaffolding strategies via LMS on Iranian undergraduate EFL students' RC. Analysis of Covariance was applied to examine this RQ. The scores on the pretest are dealt as a covariate to control for pre-existing differences between the groups. The results of checking the assumption of a linear relationship between the dependent variable (posttest of RC) and the covariates (pretest of RC) are depicted in Figure 1. As indicated in the scatter plot, there are three straight lines between the pretest (covariate) and posttest scores representing the three groups of the study. These straight lines show that the linearity assumption was not violated.

The results showed that the sig. of Levene's test (0.08) was above .05, proving that the homogeneity of variance assumption was not violated for the undergraduate's RC scores in the three groups.

Table 1. Six Scaffolding Strategies Examined in the RC Class

Strategies	Description
Low- support strategies	Ask students to expand the lesson content beyond the lesson itself—to past or future personal experiences
Generalizing	Ask students to describe Why something happened or happen or explain why something is the way it is
Reasoning	Ask students to explain what might happen next or to hypothesize the outcome of an event/activity
Predicting	Ask students to produce a correct answer to a task by completing the job with another person—the teacher or a peer.
High-support strategies	Ask students to complete a task by reducing the number of choices of correct answers.
Co-participating	Ask students to produce a correct answer to a task by providing an exact model of the ideal response.
Reducing choices	
Eliciting	

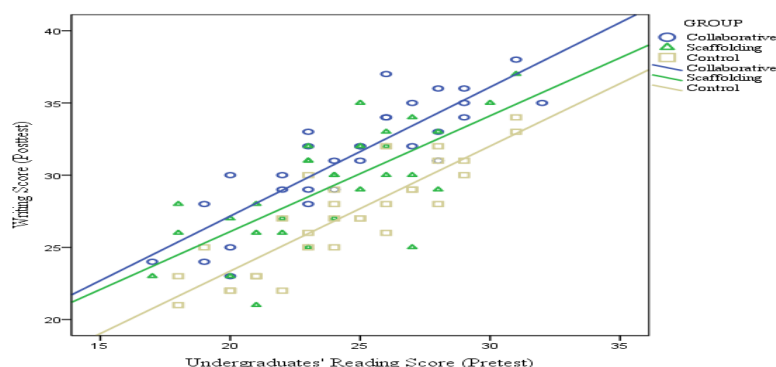


Figure 1. Scatter Plot for the Undergraduates' RC Scores in the Three Groups (Pretest & Posttest)

Also, it was shown that interaction effect (Group*Pretest) was not significant, $F(2, 84) = .16, p = 0.85$, revealing that the pretest and posttest of the undergraduate's RC scores in the three groups enjoyed the assumption of homogeneity of regression slopes.

The mean, SD, and SEM for the scores in the collaborative, scaffolding, and control group were calculated (Table 2) before presenting the results of ANCOVA. In fact, Table 2 indicates that the mean of the undergraduate's RC in the collaborative group ($M = 24.67, SD = 3.78$), scaffolding group ($M = 23.83, SD = 3.47$), and control ($M = 24.40, SD = 3.63$) are near to each other on the pretest; though, the mean of the undergraduate's RC in the collaborative group ($M = 32.33, SD = 3.93$) is the highest, followed by the mean in

the scaffolding group ($M = 30.17, SD = 3.89$), and then control group ($M = 28.17, SD = 3.58$) on posttest. As it is obvious from the Line Chart, the mean of RC has risen from pre to posttest for the three groups; still, mean rise for the collaborative group is severer than scaffolding group, and mean growth for both experimental groups is considerably greater than the control group. After adjusting for undergraduate's RC pretest scores, there a significant difference, $F(2, 86) = 24.30, p = 0.000, \eta^2 = 0.36$, was detected between the three groups' RC scores on the posttest. Also, as set forth in Table 3 there was seen a strong relationship, $F(1, 86) = 171.60, p < 0.05, \eta^2 = 0.67$, between the pre- and post-intervention scores on undergraduate's RC showing that the RC pretest scores affected the RC posttest scores.

Table 2. Descriptive Statistics of the Undergraduate's RC Scores on Pretest and Posttest by Group

Test	Group	N	Mean	SD	SEM
Pretest	Collaborative	30	24.67	3.78	0.690
	Scaffolding	30	23.83	3.47	0.634
	Control	30	24.40	3.63	0.662
Posttest	Collaborative	30	32.33	3.93	0.718
	Scaffolding	30	30.17	3.89	0.711
	Control	30	28.17	3.58	0.654

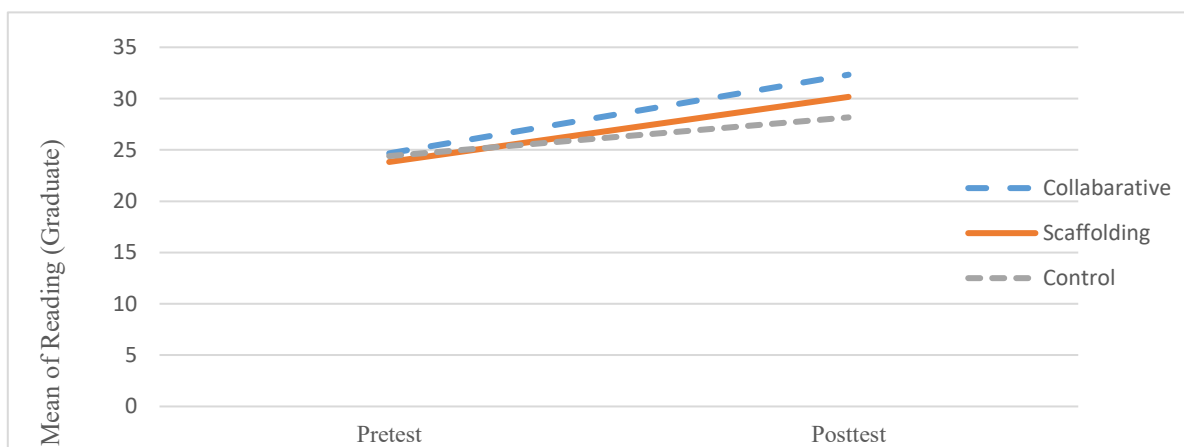


Figure 2. Line Chart for Three Undergraduate Groups' Means of RC (Pretest & Posttest)

Table 3. ANCOVA for the Undergraduate's RC

Source	Type III Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1100.573	3	366.858	74.943	0.000	0.723
Intercept	134.628	1	134.628	27.502	0.000	0.242
Pretest	840.017	1	840.017	171.602	0.000	0.666
Group	237.922	2	118.961	24.302	0.000	0.361
Error	420.983	86	4.895	-	-	-
Total	78376.000	90	-	-	-	-
Corrected Total	1521.556	89	-	-	-	-

Post-hoc comparisons results (Table 4) yielded a significant difference, $p = 0.000$, in the undergraduate's RC means between the collaborative and control groups, with the mean difference of 3.94 in support of the collaborative group; thus, it can be declared that employing collaborative learning via LMS leads to the progress of undergraduate EFL students' RC. In the same way, the results found a significant difference, $p = 0.000$, in the undergraduate's RC means between the scaffolding and control groups, with the mean difference of 2.48 on the side of the scaffolding group; consequently, it can be claimed that undergraduate EFL students' RC can be enhanced using scaffolding strategies via LMS can enhance.

Similarly, a significant difference, $p = 0.01$, $p < 0.05$, was found in undergraduate's RC means between the collaborative and scaffolding group groups, with the mean difference of 1.45 in favor of the collaborative group; hence, it was shown that collaborative learning via LMS is more effective than scaffolding strategies via LMS to advance undergraduate EFL students' RC.

4.2. Addressing RQ Two

Figure 3 illustrates the results of checking the assumption of linear relationship between posttest of RC as dependent variable and pretest of RC as covariates. As manifested in scatter plot, there are three straight lines between the

pretest (covariate) and posttest scores representing the three groups of the study. These straight lines reflect that the linearity assumption was not violated. The results indicated that Levene's test (0.008) was significant revealing that the homogeneity of variance was violated for the postgraduates' RC scores. In order to compensate for this shortcoming, the alpha level was reduced from 0.05 to 0.01.

In addition, the results revealed that the interaction (Group*Pretest) was not significant, $F(2, 84) = 1.44$, $p = 0.24$, $p > 0.05$. Therefore, the pretest and posttest of the postgraduates' RC scores did not violate the assumption of homogeneity of regression slopes.

As two out of three assumptions were met, the current researcher conducted ANCOVA to compare effect of using collaborative learning via LMS and scaffolding strategies via LMS on the postgraduates' RC. To compensate for violating the homogeneity of variance, the researcher reduced the alpha level to .01 instead of .05 (Tabachnick & Fidell, 2014). As it's observable in Table 5, the pretest means of the postgraduates' RC in the collaborative group ($M = 28.70$, $SD = 3.15$), scaffolding group ($M = 27.93$, $SD = 2.72$), and control group ($M = 28.30$, $SD = 3.23$) seem to be close to each other; however, the mean of RC in the collaborative group ($M = 36.20$, $SD = 3.38$) is the highest, followed by the mean in the scaffolding group ($M = 34.60$, $SD = 3.17$), and then control ($M = 32.10$, $SD = 3.35$) on the posttest.

Table 4. Post-Hoc Comparisons for Undergraduates' RC Means among the Three Groups

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Collaborative	Control	3.94	0.572	0.000
Scaffolding	Control	2.48	0.572	0.000
Collaborative	Scaffolding	1.45	0.574	0.013

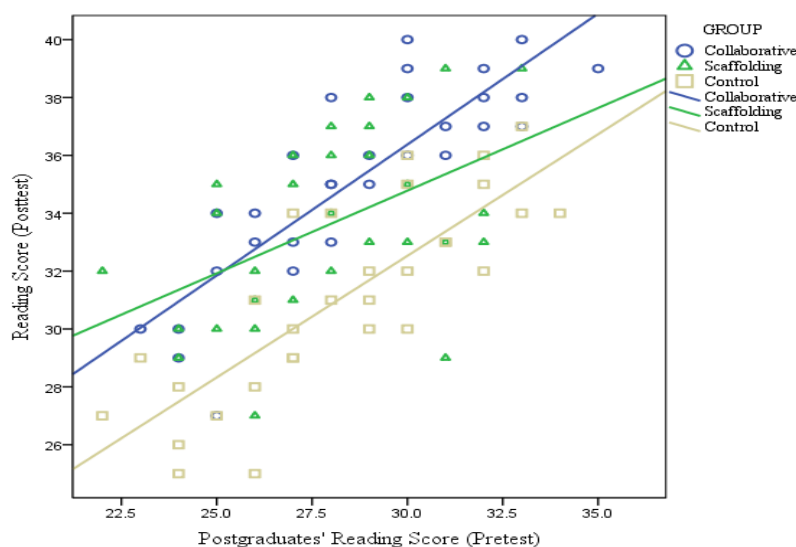


Figure 3. Scatter Plot for the Postgraduates' RC Scores in the Three Groups (Pretest & Posttest)

Table 5. Descriptive Statistics of the Postgraduates’ RC Scores on Pretest and Posttest by Group

Test	Group	N	Mean	SD	SEM
Pretest	Collaborative	30	28.70	3.15	0.576
	Scaffolding	30	27.93	2.72	0.496
	Control	30	28.30	3.23	0.589
Posttest	Collaborative	30	36.20	3.38	0.617
	Scaffolding	30	34.60	3.17	0.579
	Control	30	32.10	3.35	0.613

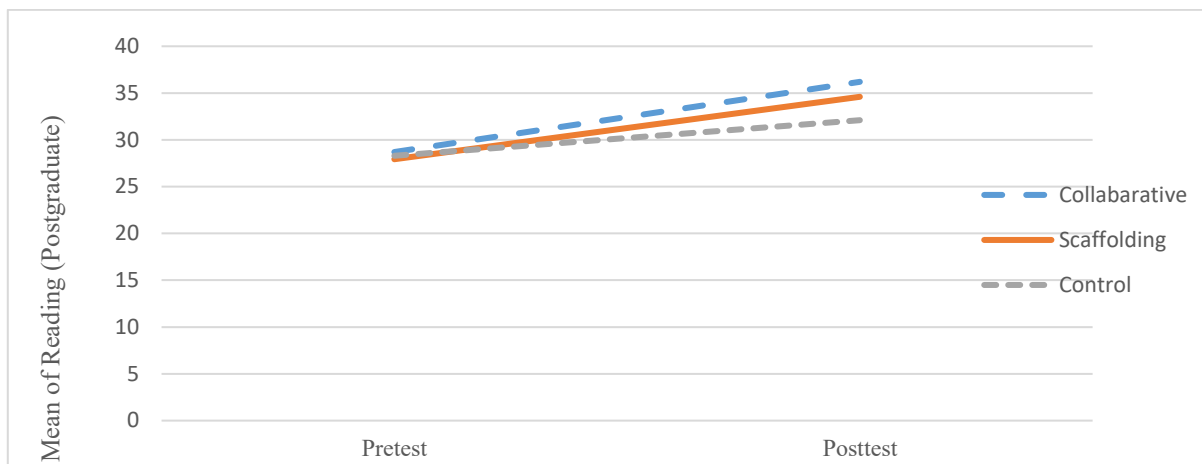


Figure 4. Line Chart for Three Groups’ Means of RC (Pretest & Posttest)

Table 6. ANCOVA for the Postgraduates’ RC

Source	Type III Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	760.753	3	253.584	49.102	0.000	0.631
Intercept	117.476	1	117.476	22.747	0.000	0.209
Pretest	504.553	1	504.553	97.697	0.000	0.532
Group	230.655	2	115.327	22.331	0.000	0.342
Error	444.147	86	5.164	-	-	-
Total	10100.000	90	-	-	-	-
Corrected Total	1204.900	89	-	-	-	-

Line Chart in Figure 4 indicates that the postgraduates’ RC mean has improved from pre to posttest for three groups, but mean rise for the collaborative group is greater than the scaffolding group, and the mean growth for these both experimental groups is intensely harsher than the control group. Table 6 gives ANCOVA results. After controlling for the postgraduates’ RC scores on the pretest, a significant difference, $F(2, 86) = 22.33, p = 0.000, p < .05, \eta^2 = 0.34$, was observed between the three groups’ RC scores on the posttest. Moreover, there was seen a strong relationship, $F(1, 86) = 504.55, p < 0.05, \eta^2 = 0.53$, between the pre- and post-intervention measures on the postgraduates’ RC implying that the RC pretest scores influenced the RC posttest scores.

Table 7 shows that pairwise comparisons results found a significant difference, $p = 0.000, p < 0.05$, in postgraduates’ RC means between collaborative and control groups, with the mean difference of 3.78 in favor

of the collaborative group. That’s why it can be claimed that utilizing collaborative learning via LMS contributes to the development of postgraduate EFL students’ RC.

Correspondingly, the results detected a significant difference, $p = 0.000, p < 0.05$ in the postgraduates’ RC means between the scaffolding group and control group, with the mean difference of 2.79 on the side of the scaffolding group. Therefore, it can be concluded that postgraduate EFL students’ RC can be improved through scaffolding strategies via LMS can enhance).

Likewise, post-hoc comparisons results could not find any significant difference, $p = 0.09, p > 0.05$, in postgraduates’ RC means between the collaborative and scaffolding group groups, with the mean difference of 0.99 on the side of the collaborative; thus, it can be declared that collaborative learning via LMS and scaffolding strategies via LMS affect postgraduate EFL students’ RC almost equally.

Table 7. Post-Hoc Comparisons for Postgraduates' RC Means among the Three Groups

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Collaborative	Control	3.78	0.588	0.000
Scaffolding	Control	2.79	0.588	0.000
Collaborative	Scaffolding	0.99	0.590	0.095

5. Discussion and Conclusion

The first RQ of the current study inquired about the effect of using collaborative learning via LMS and scaffolding strategies via LMS on Iranian undergraduate EFL students' RC. The results of one-way ANCOVA revealed that the implementation of both collaborative and scaffolding learning via LMS can improve undergraduate EFL students' RC skills. Additionally, the results proved that collaborative learning via LMS is more influential than scaffolding strategies via LMS in improving undergraduate EFL students' RC skills

Our findings align with [Doo et al.'s study \(2020\)](#). They arrived at a meta-analysis regarding the effects of scaffolding on educational outcomes in online learning settings in higher education, utilizing data from 18 published journal articles. Eventually, they determined that computers serve as a scaffolding resource in online learning settings more frequently than human teachers, indicating that while initial scaffolding research focused on human skill, computer technology is becoming an increasingly favored alternative tool

Corresponding with the outcomes of this study, a study conducted by [Liseno and Kelly \(2020\)](#) revealed that scaffolding in online learning causes significant changes in learning results. However, the critical challenge in scaffolding online collaboration relates to access to the LMS, resulting in the formation of informal groups that may not be easy to monitor ([Lazareva, 2016](#)). As such, the requirement for flexibility must be cautiously balanced with appropriate participation to permit decentralized participation in hyperlinked environments ([Widrow et al., 2015](#)). According to [Liseno and Kelly \(2020\)](#), even though learners have more learning opportunities through the LMS, its low-quality instruction and poor engagement can be lessened through instructional scaffolds so as to aid learners in constructing their own meaning.

Additionally, these results are consistent with those of [Khosravi \(2017\)](#), who probed the significant effect of symmetrical scaffolding on advanced students' RC. Their study concerned two types of scaffolding: symmetrical and asymmetrical. They found that symmetrical scaffolding influenced RC, but asymmetrical scaffolding was the most effective strategy in fostering RC.

[Kusumawati \(2018\)](#) conducted a related study investigating the role of scaffolding in enhancing reading as well as writing skills in English for mechanical

engineering students. Findings demonstrated that scaffolded learning serves as an effective pedagogical strategy for improving language proficiency among learners in this discipline

Our results correlate with [Wang et al.'s \(2024\)](#), which revealed that EFL students utilize LMS platforms as resources for blended learning. For instance, they enroll in online courses, finish learning assignments, and engage in forum discussions, quizzes, and tests

Likewise, these results associate with those of [Amalia et al. \(2024\)](#), who concluded that the Hot Potatoes tool was more useful than SoftChalk in boosting students' RC. Despite the fact that both authoring tools brought positive effects on overall reading achievement across multiple comprehension components, Hot Potatoes revealed greater benefits in developing specific features. Furthermore, although they found no significant interaction effect, the post-test results indicated that avid and reluctant readers in both groups performed better than passive readers. This suggests that, regardless of the tool used, student engagement level (i.e., avid, passive, or reluctant) was an important factor in comprehension achievements.

This study demonstrates that LMSs (LMS), when integrated with collaborative learning and scaffolding strategies, significantly enhance RC among both undergraduate and postgraduate EFL students in Iran. The experimental results revealed that while both approaches improved reading outcomes, collaborative learning via LMS yielded more substantial gains for undergraduates, whereas postgraduates benefited nearly equally from both methods. These align with those of [Amalia et al. \(2024\)](#) and [Wang et al. \(2024\)](#), confirming that structured digital interaction and adaptive support mechanisms in LMS environments foster deeper engagement with texts. Notably, the study advances existing scholarship by highlighting how learner characteristics (e.g., academic level) mediate the effectiveness of LMS-based interventions, addressing a critical gap in the literature regarding context-specific implementation ([Khan & Abdou, 2021](#)). However, the study's outcomes must be interpreted within its limitations. The non-random sampling from Iranian universities and the focus on upper-intermediate learners may constrain generalizability to other proficiency levels or cultural contexts. Additionally, while the 14-week intervention provided robust data, longer-term studies are needed to assess sustained

comprehension gains (Dias et al., 2023). These limitations underscore the necessity for further research exploring how socioeconomic factors (UNESCO, 2023) and institutional support systems influence LMS efficacy, particularly in under-resourced educational settings

Pedagogically, this research underscores the transformative potential of LMS platforms when combined with evidence-based strategies. For practitioners, the findings advocate: (1) prioritizing collaborative tasks for undergraduate cohorts, (2) integrating scaffolded supports for complex texts, and (3) providing instructor training to optimize LMS functionalities (Al-Fraihat et al., 2020). Future studies should investigate hybrid models that balance these approaches while addressing equity concerns—a vital step toward realizing the full promise of digital learning ecosystems in global EFL education.

Authors Contribution

All the authors have participated sufficiently in the intellectual content, conception, and design of this work or the analysis and interpretation of the data (when applicable), as well as the writing of the manuscript.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of interest

The author states that there is no conflict of interest.

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