The effect of cognitive-based learning on Iranian EFL learners' reading comprehension components

Article info

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Abstract

This study aimed at examining the effect of cognitive-based learning on Iranian EFL learners' reading comprehension components; identifying the main idea, making Inferences, recognizing unfamiliar vocabulary, text organization, and information recall. In doing so, the researchers selected 84 homogeneous intermediate level male and female EFL learners with the age range 18 to 25 out of 110 conveniently nominated sample of students majoring in different fields in a Vocational and Technical college in Dezful. A standard version of Quick Oxford Placement Test (QPT) was used to homogenize the participants and the selected ones whose scores were within one SD above and below the mean, were considered as the experimental (i.e., cognitive-based learning, n=41) and control (n=43) groups in line with the nature of convenience non-random sampling. Then, the learners in both groups experienced the processes of pretesting, 12 sessions of intervention which were presented through synchronous online Interactions using Adobe Connect, and post-testing. A validated researcher-made L2 reading comprehension test tapping different reading components was used to collect the data. The results of Analysis of Covariates (ANCOVA) and Multivariate Analysis of Covariates (MANCOVA) proved the effectiveness of cognitive based learning, using Bloom's Taxonomy levels in developing L2 reading and its components among the participants. The findings can be used to enrich cognitive learning and analytical views in the L2 reading classroom, helping both teachers and learners in this regard.

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1. Introduction

Although learning to read is a skill taught in formal educational settings, a lot of it happens on the learner's own trails and due to their efforts in the informal settings and outside the classroom context (Tong et al., 2024). In an English as a Foreign Language (EFL) setting, reading comprehension (RC) is the most important method of information access (Crystal, 1999). The mastery of reading skill in English, besides other skills, is a priority for many language learners in the EFL context (Amiri & Maftoon, 2010; Ferris & Hedgcock, 2023). Besides, L2 reading proficiency is supposedly the most important aspect of teaching and learning a language, and it has lately become more so in EFL classrooms (Bozan, 2024; Nor & Sihes, 2021). Additionally, RC poses a significant challenge for Iranian EFL learners at the university level (Ahmadian et al., 2024; Akbari et al., 2021; Azmoode et al., 2024; Namaziandost et al., 2022). Moreover, Iranian institutions place a strong emphasis on RC as a primary language competency (Marzban, 2011; Soltani & Taghizadeh, 2023). Even though reading is a major focus of the English language curriculum in Iran's educational system, students face significant hurdles when it comes to comprehension techniques such as identifying the text's key concepts, main idea, and dealing with new terminology (Azmoode et al., 2024; Soltani & Taghizadeh, 2023).

Considering reading as one of the vital and pervasively used language skills in EFL contexts, Crystal (1999) claimed that in EFL environments, RC emerges as a fundamental method for accessing information. According to Habók and Magyar (2019), RC strategies enjoy a developmental feature in L2 classroom. Moreover, RC is a prominent topic within the field of education and fostering learners' development (Chen & Abdullah, 2024; Yusuf et al., 2024). Likewise, Piñero and Cañedo (2024) argued that "reading comprehension abilities are essential for educational growth" (p. 974). In addition, the main aim of reading is collecting information from the reading material. Achieving this, the reader's interaction with the passage is needed in order to get meaning from the passage correctly (Tong et al., 2024).

Reading comprehension is considered necessary for the life success of the EFL learners with regard to the challenges of the world today, demanding a thorough

comprehension of passages in the scientific books or newspapers and the social media (Piñero & Cañedo, 2024). As one of the reading components understanding the text purpose requires extensive cognitive processes encompassing both lower-order thinking and higher-order thinking levels. Such skills represent critical thinking (CT) skills (Bloom, 1956; Huyen & Ngoc 2024; Todorova, 2024). Additionally, CT is vital for answering RC questions, especially those related to the main ideas and inferencing from the text (Huyen & Ngoc, 2024). In addition, comprehension emerges as a result of cognitive processes and skills and it is a process of thought, inference, evaluation, and problem solving and a necessary ability needed for real life success with the emphasis on the three skills of evaluation, inference, and analysis (Facione, 2023). Furthermore, the reading skill allows learners to develop their CT skills which demands an effective method since it is a cognitive process vital for language learning and acquisition, necessarily in the area of EFL (Okasha, 2020; Huyen & Ngoc, 2024).

Second language RC has been considered as a significant skill in different foreign language teaching methods and approaches. However, the cognitive approach, which can be manifested in employing Bloom's taxonomy of learning (Bloom, 1956) and its revised version (Anderson, & Krathwohl, 2001) has been taken into account in teaching reading to the EFL learner just in a few cases (Horváthová & Naďová, 2021), though it has recorded a lot in the testing domain of this skill (Febrina et al., 2019; Pakpahan et al., 2021; Stevani & Tarigan, 2023; Ulum, 2022; Valentiyo, 2024).

The present study took support from Cognitive Learning Theory (CLT) (Piaget, 1983) and its more specific extension labeled Social Cognitive Theory (SCT) (Bandura, 2001). The CLT invites students to reflect on their own thought processes and the ways in which both internal and external factors impact their thinking (Fitriani et al., 2021). These factors can encompass an individual's level of focus, the degree of distraction they have experienced, and the community's value of the knowledge they are acquiring. Metacognition, or thinking about thinking, is at the heart of the most basic kind of cognitive learning. Maruf et al. (2024) mentioned that reading materials are excellent sources of input for language learners and the goal of most reading programs is to turn "learning to read" into "reading to learn." Cognitive-based learning, as a method for teaching reading, is used to teach them to read materials and use their thoughts and thinking skills to learn

and comprehend, and employ their learning in their real life.

It is assumed that the six thinking levels of Bloom's taxonomy including *remembering, understanding, applying, analyzing, evaluating,* and *creating*, as cognitive thinking levels, can play a vital role in the development of L2 reading comprehension among EFL learners (Fitri et al., 2024). Therefore, regarding the importance of developing second language reading, especially in the EFL context, the main goal of the current research was to investigate the effect of cognitive-based learning; the Bloom's Taxonomy levels, on RC components of Iranian EFL learners.

2. Review of the Related Literature

2.1 Reading Comprehension Components

A reader's interest in the text, their familiarity with the various text types, and the reader's prior knowledge and strategy use are all factors that interact with one another to form reading comprehension (Brandon, 2021). In addition, EFL learners require specific techniques to help them understand, apply, and retain the information they read (Piñero & Cañedo, 2024). Skilled readers have their own reading methods and are able to adapt those tactics to various text types. Students who have difficulty reading might benefit from instruction in RC methods and the appropriate applications of these strategies to various text types (Allen et al., 2014). Recognizing a student's individual reading issue(s) can lead to the development of an effective program to improve their reading skills (Davidson, 2021).

As a goal component of RC, understanding what one reads should be one's primary objective (Vaughn et al., 2024). Comprehension is the ability to understand written language and it should be highlighted that identifying words is not the same as comprehension. Hence, identifying the text's core concept is the ultimate aim of reading, and just word recognition and semantic meaning fall short of this goal (Brandon, 2021; Meneghetti et al., 2006). Readers employ a multi-step mental process known as comprehension to make sense of what they have read. An individual's ability to understand written language and decode it is what ultimately determines her RC (Ulin,

2020). The solution to achieving genuine reading comprehension is to prioritize teaching both basic reading skills and RC techniques explicitly (Elleman & Oslund, 2019; Piñero & Cañedo, 2024). Thus, it is important for the teacher to ensure that reading training consistently targets phonological awareness, phonics, vocabulary, and reading fluency. Moreover, students need to become proficient in different aspects of RC such as identifying the main idea (paying attention to overall meaning and the text details), drawing conclusions from the text (answering inferential questions), guessing the meaning of unfamiliar words (inferencing from the text analysis), comprehending how the text is structured (recognizing text-organization), and remembering what is read (answering recall questions) (Piñero & Cañedo, 2024).

2.2 Cognitive-based Learning

Cognitive learning, as proposed by Yilmaz (2011), is "an approach to education that emphasizes the importance of students actively engaging with the material and ma king better use of their brainpower" (p. 204). It is not about rote memorization but rather mastering the process of learning. Cognitive learning makes use of mental operations such as paying attention, observing, and retrieving information from long-term memory. Giving learners a better understanding of a topic and how it applies to their job might help them learn it more explicitly (Fitriani et al., 2021). Likewise, Maruf et al. (2024) advocated cognitive learning as an educational strategy that places an emphasis on students' active engagement with the content and improved use of their brainpower. Cognitive learning utilizes mental functions such as attention, observation, and the application of long-term memory (Anderson & Krathwohl, 2001).

The idea of having a well-organized mental picture of the text is crucial to effective understanding and is at the heart of cognitive theories of RC (Duke et al., 2021). The textual information is integral to this cohesive representation, which is both accessible and applicable in many contexts (Abenojar, 2024; Oakhill et al., 2014) and takes into account the reader's prior knowledge (Abenojar, 2024). While reading, a reader makes connections between key elements of the text using a mix of instinctive and purposeful processes. These relationships enhance structure and coherence (Tracey & Morrow, 2024). There is a considerable correlation between cognitive learning, creative thinking,

RC, and CT skills (Almulla & Al-Rahmi, 2023; Siburian et al., 2019). Every academic program should make developing students' CT skills in L2 reading a priority, as it is the most transferable talent a school can offer (Richards et al., 2020). Bloom's Taxonomy (Bloom, 1956) and the Revised Bloom's Taxonomy (Anderson & Krathwohl, 2001) serve as the foundation for cognitive-based learning (CBL). From the most basic to the most complex levels of thought, Bloom's stages are believed to be essential for reading and comprehending a text (Bakhtiari Moghadam et al., 2023; Ennis, 2018; Huang, 2024).

2.3 Bloom's Taxonomy and L2 RC

For the learner to be satisfied, RC requires both cognitive and metacognitive strategies. According to several studies (Aránguiz Améstica, 2021; Bakhtiari Moghadam et al., 2023; Bilki & Irgin, 2022; Chen & Abdullah, 2024; Fitri et al., 2024), effective reading requires the integration of different levels of cognition.

Bloom saw his six stages of cognitive learning as more than just a tool for evaluating the outcomes of comprehension (Bozan, 2024; Krathwohl, 2002). According to Scully (2017), Bloom blurred the boundaries between lower- and higher-order thinking. This prompted a revision to the taxonomy (Anderson & Krathwohl, 2001) that maintained the original six levels for evaluating cognition but divided them into two groups according to the types of thinking abilities they tested. The Lower-Order Thinking Skills (LOTS) consist of the first three levels: remembering-keeping in mind specific details and fundamental ideas; understanding-putting that knowledge into words; and applying-solving issues by using what you have learned in novel contexts. The next three stages, including analyzing, evaluating, and creating are known as Higher-Order Thinking Skills (HOTS). EFL learners need to go all the way to the top of the pyramid to get real mastery and understanding of the text. The ability to draw valid conclusions depends on carrying out exhaustive evaluations (Shabatura, 2018). Different studies have reported that the hierarchical sequence of cognitive proficiencies in Bloom's taxonomy makes it a useful tool for learners to develop their cognitive abilities as well as their RC skills (Fastiggi, 2014; Horváthová & Naďová, 2021; Persaud, 2018). Albeckay (2014) explored how a critical reading program affected the growth of critical RC in undergraduate EFL students from Libya. Other studies conclude that teaching students to think critically in language

classes is an excellent way to boost their RC abilities, regardless of their age (Ramezani et al., 2016; Yousefi & Mohammadi, 2015; Ulum, 2022).

In conclusion, educators can use Bloom's taxonomy as a framework to design well-defined English classes that evaluate students' comprehension at all language thinking levels, from primary to secondary. Additionally, it enables educators to see a cohesive connection between textbook information and the cognitive process of learning outcomes (Boeren & Iniguez-Berrozpe, 2022). By giving English instructors, a framework to create different learning activities and tactics for employing texts in the L2 classroom, the Bloom's taxonomy might assist students to read critically (Djallel, 2022). The current study set out to examine how Iranian EFL learners' RC abilities were affected by cognitive domain of Bloom's Taxonomy. With respect to the purpose of the study, the researchers raised the following questions:

1. Does cognitive-based learning, using Bloom's Taxonomy, improve EFL learners' overall RC ability?

2. Does cognitive-based learning, using Bloom's Taxonomy, improve EFL learners' RC components (i.e., main idea, inferencing, unfamiliar vocabulary knowledge, text organization, and information recall)?

3. Methodology

3.1 Participants

The participants of the study were 84 intermediate level male (n=36) and female (n=48) B.A. students within the age range of 18-25 majoring in different fields taking a three-credit general English course at a Vocational and Technical College of Dezful city. The participants were chosen based on their performance in a standard version of Quick Oxford Placement Test (QPT) administered to 110 EFL learners who had been initially chosen by convenience sampling. The students whose scores were within one standard deviation above and below the mean served as the study's main participants. The students who did not meet the criteria were nonetheless permitted to participate in the study due to the rules and regulations of the university in which the study was carried out,

but their scores were excluded from the data analysis. The selected participants in two different classes were considered as the experimental group (n=41) receiving cognitive-based learning and the control group (n=43) receiving the conventional Grammar Translation Method (GTM) which is the most frequently used method in EFL courses in Iranian universities (Rassouli & Osam, 2019). Then, the participants went through the process of pretesting, intervention, and post-testing for the effect of cognitive-based learning on their reading comprehension skills.

3.2 Instruments

The QPT was used to homogenize the participants prior to the intervention phase. According to Cronbach's alpha, the test is highly reliable (α=.91) (Berthold, 2011, p. 674). Wistner et al. (2009) and Motallebzadeh and Nematizadeh (2011) report that the test has high construct validity based on factor analysis of the data and the credence it receives due to its widespread international use. It should be noted that in the present study, the QPT enjoyed a KR-21 reliability index of .86 which is considered as "appropriate" as noted by Fulcher and Davidson (2007, p. 107).

A 30-item multiple-choice reading test was developed based on eight lessons of the students' course book; e.g., "Read This! Intro Student's Book: Fascinating Stories from the Content Areas" (Mackey et al., 2012), in line with the five significant components of reading comprehension; i.e., finding the main idea (4 items), inferencing (4 items), guessing the unfamiliar vocabulary (10 items), realizing text organization (3 items), and recalling information (9 items) (Piñero & Cañedo, 2024). The six passages appearing in the test were randomly selected out of the texts appearing in the students' course book. To score the test sheets, one correct answer was considered for each item; a zero point was given to choices that were wrong. As a result, the highest score of each participant was 30. The test was put to the scrutiny of three TEFL PhD holders teaching in Islamic Azad University to ensure the test's content validity. Then, the test was piloted in online mode among 30 EFL learners with similar characteristics to those of the study's main participants. The thirty items of the test were authorized following an item analysis, and the defective items were revised and modified. Item facility, item difficulty, and item discrimination were estimated for the reading test. The Cronbach's Alpha reliability index

for the pilot study of RC test was α=0.843. Also, the reliability indices for main idea, inference, unfamiliar vocabulary, text organization, and information recall were .714, .705, .838, .703, and .846, respectively. All of the above-mentioned reliability indices can be considered as "appropriate" (Fulcher & Davidson, 2007, p. 107). The researchers used the piloted test both as the pretest and posttest in the study. In line with Bachman (2005), as the time span between the pre and post-tests was more than eight weeks (i.e., 12 weeks in this study), the test effect was minimized.

3.3 Procedure

The research was carried out at the COVID-19 pandemic period when all the university classes were held online. Hence, Adobe Connect was used for both experimental and control groups emphasizing synchronous online interactions among the teacher and learners. The first and second sessions were devoted to administering the pretests and briefing the students about the classroom activities and research purposes. The third through fourteenth sessions (i.e.,12 sessions) were allocated to the intervention, and the last two sessions were saved for the administration of the posttests and announcing learners' scores. The class met once a week for a total of 16 weeks during the semester, with each session lasting 120 minutes, for both groups; including a 20-minute break at the middle of the class. The researchers had to consider the university's curriculum which was to be covered during the semester, in addition to breaks and midterm exams. Accordingly, one of the researchers who was teaching the course during the experiment, taught eight lessons of the learners' coursebook and followed the university schedule. However, for the whole class time, the methods used in the experimental and control groups differed with respect to the study purposes. The classes in the control and experimental groups therefore received an equal amount of training and practice time.

The experimental group learners were exposed to cognitive-based learning which relied on reading the texts and applying Bloom's taxonomy in posing questions and eliciting answers with regard to the texts. Accordingly, the learners in the experimental group worked with the texts using question and answer technique to cover all six levels of the taxonomy. Bloom's Taxonomy of cognitive learning levels, RC components and CT

sub-skills are coordinated as shown in Table 1, below. This table shows the framework of the syllabus designed based on Bloom's taxonomy for the experimental group.

Table 1.

Framework of the Syllabus Designed based on Bloom's Taxonomy, RC, and CT Skills

Cognitive Level	Reading Skills	Critical Thinking Skills
1.Remembering	*Literal Comprehension (**Information Recall**):* Measuring the ability to remember and recount specific details from the text, which is a fundamental aspect of reading comprehension (Albeckay, 2014; Piñero & Cañedo, 2024).	***Deductive & Inductive Reasoning:*** Whereas inductive reasoning uses proven experience and observations to infer a conclusion, deductive reasoning uses theories and ideas to rationalize and prove a particular conclusion (Adnan et al., 2021; Bag & Grsoy, 2021).
2.Understanding	*Reorganization Comprehension (**Text Organization** and sequencing events):* Sequencing events involves understanding the structure and order of information within a text, which directly relates to how text is organized (Piñero & Cañedo, 2024).	*Deductive & Inductive Reasoning +**Inferencing**:* drawing a conclusion from evidence by combining observation and reasoning. Using one's knowledge and expertise to solve a problem is a sophisticated talent (Yan, 2021).
3.Applying	*Identifying **unfamiliar vocabulary**:* Recognizing and understanding new or challenging words within the text is very significant, as vocabulary knowledge is essential for comprehension (Aránguiz Améstica, 2021; Piñero & Cañedo, 2024).	*Deductive & Inductive Reasoning* as well as *activating* both *world knowledge* and the *learned knowledge*. These sub-skills help learners focus on make sue of their prior knowledge to solve problems in the new situations (Almulla & Al-Rahmi, 2023).
4.Analyzing	*Inference Comprehension (**Making inferences**):* Drawing logical conclusions based on information provided in the text combined with prior knowledge, identifying parts of a given text and analyzing the relationships between its different sections (Albeckay, 2014; Piñero & Cañedo, 2024).	*Deductive Reasoning & **Analyzing:*** *F*ocusing on component parts of information given or a phenomenon. In order to better comprehend, evaluate, and draw conclusions from a text, it is necessary to analyze it by dissecting its concepts and structure (Almulla & Al-Rahmi, 2023; Bag & Grsoy, 2021).
5.Evaluating	*Evaluative Comprehension (**Identifying the main idea** or noting details):* Focusing on the ability to identify the central theme or primary concept of a text, which is crucial for understanding overall content (Albeckay, 2014; Piñero & Cañedo, 2024).	*Deductive & Inductive Reasoning +**Evaluating:*** Relying on logical reasons and evaluating the content presented in the text and checking its values and intentions (Van Le & Chong, 2024; Yan, 2021).
	Appreciative Comprehension (main idea, inferencing, unfamiliar vocabulary knowledge, text organization, & information recall): Appreciative comprehension means recognizing something that matters,	*Analyzing, Evaluating, Inferencing, Deductive, & Inductive reasoning:* Reading the given text thinking critically relying on evaluating the given information and arguments with an open mind and a healthy dose of skepticism.

6.Creating	becoming emotionally engaged with the content, feeling the characters' plights, the author's wit, and compelling arguments as all have the potential to evoke strong emotions in the reader (Todorova, 2024). In some advanced cases reading a piece of written document and developing a critical view based on that is expected, representing both comprehension and evaluation (Yan, 2021).	Analyzing, interpreting, judging, and challenging what is read, watched, or seen in the multimedia as well as the environment around. The goal is to rely on trustworthy information in order to make reliable decisions (Sudarmin et al., 2018; Van Le & Chong, 2024). What is significant at this level is developing a critical look which does not follow sensations, but logics and relies on evidence, not feelings (Adnan et al., 2021)

To translate theories into practice, the cognitive-based syllabus used in the present study, needed to focus on operationalizing the sophisticated views of educational philosophers. Hence, a practical syllabus was designed to employ Bloom's Taxonomy in the reading classroom, assuming that this syllabus would pave the ground for the development of EFL learners' analytical look on reading skills. Moreover, it was assumed that this syllabus would enhance critical thinking of the target learners. Table 2 presents the classroom activities and the interactions aimed at presenting cognitive-based learning for critical reading comprehension based on Blooms' taxonomy in the present study.

Table 2.

Cognitive-based Learning for Critical RC based on Blooms' Taxonomy

Cognitive Level	Definitions	Interactions	Sample Questions
1.Remembering	Focused on remembering and reciting learned information based on the text.	The students read the text silently and underline the new terms observed in the text. Then the teacher asks questions aiming at recalling facts and information to test learners' knowledge level.	How old was the man? / When did the accident happen? How many birds were in the cage? Where…...? / When….? / Who opened the gate? How many….? / How much…? / Whose…?
2.Understanding	Focused on comprehension; explaining the meaning of information and deriving meaning out of the text	To help shape their sensory experience of the text and to help learners establish connections between their senses and language, the teacher urges students to look for new terms and cultural or conceptual mismatches between Iran and England or other countries in the text.	How can you categorize the information given? / What is the best title for the passage? / What is the main idea of the text? / Which one can be supported by the text and why? / Which of the of following points can be less likely deciphered from the text? /

3. Applying	Concentrated on employing the previously learned knowledge to new situations relying on rule, principles, and regulations.	The teacher asks learners rely on their world knowledge and solve problems. When questions are posed in this stage, they may have solutions in the text or may require further thought or investigation. Questions that appear may entice the reader to continue reading for more information.	Which one is the best solution to the problem based on the text intention? / What is your idea about the suggestions made in the text about establishing a lucrative business? / How is the author rejecting the police accountability in the text? / How is it possible to control the situation without force?
4.Analyzing	Concentrated on component elements of information, such as identifying the parts and studying the connections between parts.	Students are asked to read the text paragraph by paragraph and decide upon the main ideas for each section. They are asked to discuss the concepts in their groups and finally come to a decision about each section's main idea.	What is the relationship between A & B? / What are the characteristic features of her personality? / How can you relate the process of escaping the accident to his intelligence? / What evidence does the author mention for the illegal act of the director? / How can the man defend himself in the court? /
5.Evaluating	Concentrated on evaluating and selecting information according to its usefulness for a certain objective.	The teacher asks students to make judgments about the information described in the text based on the criteria set in their mind. They are asked to evaluate the content presented in the text and check its values and intentions. Students are asked to re-evaluate their own understanding of the texts and its use in real context.	What would you do in case you were the man in the room? What do you think about…...? / What is your idea about….? / What is your opinion about changing the program? / On what grounds do you think this will happen? What do you think should be recommended in such a situation? / Which choices can the man have regarding what happened…...? /
6.Creating	Focused on assembling parts of a formula, new models, structures, or compositions	Students are asked to extract the key ideas from texts, summarize the data, and add any additional interpretations. Students are supposed to read texts and think about their main ideas, writers' purposes, text organizations and the message of the text. Then, they share their understanding of the text to all students of the class.	How could the woman change the results? / How would you……to develop a new idea…solving the problem? / How is it possible to invent a machine which……? / How could the polices be changed in your opinion? / What ways can be suggested for controlling inflation? / Which alternatives can be proposed for…...? / How can we minimize / maximize the effect of…. on …...?

The control group was exposed to the Grammar Translation Method (GTM) in which leaners read the text and translated it. Students were encouraged to work out the

translations, focus on cultural facts and terminologies and develop their own list of words, and finally individual learners were asked to read the questions which followed the text and answer them, complete the vocabulary exercises, fill in the blanks to complete some sentences, and translate a similar text of smaller size, which was provided to the class by their instructor, from English to Persian as their homework which was supposed to be done at home. The teacher received the translations of the learners through the classroom online platform which was Adobe Connect and provided them with oral corrective feedback in the next session.

After the treatment sessions were completed, all the learners in the two groups sat for the RC posttest which was the same validated reading pretest whose items and the choices in each item were rearranged in order to minimize the test effect. The collected quantitative data were fed into SPSS version 28 and the results were reported.

4. Results

One-Way ANCOVA was run to compare the experimental and control groups' means in the posttest of RC after controlling for the effect of pretest in order to answer the first research question. First, assumption of normality, reliability along with the three specific assumptions One-Way ANCOVA; linearity, homogeneity of regression slopes, and homogeneity of variances (Field, 2024; Pallant, 2016) were taken into account and approved. Then, One-Way ANCOVA was run. As Table 3 shows, the experimental group (M = 23.07, SE = .886) had a higher mean than the control group (M = 17.95, SE = .865) in the posttest of RC after controlling for the effect of pretest.

Table 3.

Descriptive Statistics for Posttest of Reading Comprehension by Group with Pretest

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experimental	23.078a	.886	21.315	24.841
Control	17.955a	.865	16.233	19.676

a. Covariates appearing in the model are evaluated at the following values: Pretest = 15.50.

Table 4 shows the main results of One-Way ANCOVA. The results (F (1, 81) =

17.03, p < .01, partial η2 = .174 representing a large effect size) indicated that the experimental group significantly outperformed the control group in the posttest of RC after controlling for the effect of pretest. Thus, the first null-hypothesis as "cognitive-based learning presented through synchronous online interactions does not improve EFL learners' overall RC ability", was rejected.

Table 4.

Tests of between-Subjects Effects for Posttest of RC by Groups with Pretest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Pretest	310.598	1	310.598	9.697	.003	.107
Group	545.508	1	545.508	17.031	.000	.174
Error	2594.416	81	32.030			
Total	38689.205	84				

The second research question was an attempt to find if cognitive-based learning presented through synchronous online interactions could improve EFL learners' RC components. Multivariate Analysis of Covariance (MANCOVA) was run to compare the experimental and control groups' means on posttests of main idea, inference, unfamiliar vocabulary, text organization and information recall after controlling for the effect of their pretests in order to probe the second research question. Assumptions of linearity, homogeneity of regression slopes, and homogeneity of variances were taken into account and approved and then MANCOVA was run.

Table 5 shows the experimental and control groups' means on posttests of components of RC after controlling for the effect of pretests. The results indicated that the experimental group had higher means than the control group on all five tests. The results are discussed with respect to the results of the Between-Subject Tests as presented in Table 7 below.

Table 5.

Descriptive Statistics for Posttests of Components of RC by Group with Pretests

Dependent Variable	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
PostMainIdea	Experimental	2.774a	.085	2.604	2.944
	Control	2.331a	.083	2.166	2.497
PostInference	Experimental	2.693a	.069	2.554	2.831
	Control	1.991a	.068	1.856	2.126

PostUnfamilar	Experimental	3.032a	.101	2.832	3.232
	Control	2.458a	.098	2.263	2.653
PostTextOrganization	Experimental	2.771a	.078	2.616	2.926
	Control	2.474a	.076	2.323	2.626
PostInformation	Experimental	3.990a	.085	3.820	4.159
	Control	3.708a	.083	3.543	3.873

a. Covariates appearing in the model are evaluated at the following values: PreMainIdea = 2.01, PreInferenceRC = 4.08, PreUnfamilar = 4.89, PreTextOrganization = 2.08, PreInformation = 2.17.

Table 6 shows the main results of MANCOVA. The results ($F_{(5, 73)}$ = 23.37, $p <$ .05, partial η^2 = .616 representing a large effect size) indicated that there was a significant difference between the experimental and control groups' overall means on five components of RC. Thus, the second null-hypothesis as "cognitive-based learning presented through synchronous online interactions does not improve EFL learners' RC components", was rejected. The two groups' means on each of the five components of reading comprehension will be discussed below.

Table 6.

Multivariate ANCOVA for Reading Comprehension by Group with Pretest

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.157	2.729	5	73	.000	.157
	Wilks' Lambda	.843	2.729	5	73	.000	.157
	Hotelling's Trace	.187	2.729	5	73	.000	.157
	Roy's Largest Root	.187	2.729	5	73	.000	.157
Group	Pillai's Trace	.602	22.086	5	73	.000	.602
	Wilks' Lambda	.398	22.086	5	73	.000	.602
	Hotelling's Trace	1.513	22.086	5	73	.000	.602
	Roy's Largest Root	1.513	22.086	5	73	.000	.602

Table 7 shows the results of the Between-Subject Effects which compares the groups on each of the components of RC. Based on these results, and the mean scores shown in Table 5, it can be concluded that;

A: The experimental group (M = 2.77) had a significantly higher mean than the control group (M = 2.33) in the posttest of main idea after controlling for the effect of the pretest ($F_{(5, 73)}$ = 13.54, $p <$ .05, partial η^2 = .150 representing a large effect size).

B: The experimental group (M = 2.26) had a significantly higher mean than the control group (M = 1.99) in the posttest of inference after controlling for the effect of the pretest

(F (5, 73) = 51.33, p < .05, partial η2 = .400 representing a large effect size).

Table 7.

Tests of Between-Subjects Effects for Posttests of Components of RC by Group with Pretests

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
	Post Main Idea	3.965	1	3.965	13.546	.000	.150
	Post Inference RC	9.957	1	9.957	51.335	.000	.400
Group	Post Unfamiliar	6.657	1	6.657	16.386	.000	.175
	Post Text Organization	1.776	1	1.776	7.277	.009	.086
	Post Information	1.607	1	1.607	5.540	.021	.067
	Post Main Idea	22.537	77	.293			
	Post Inference RC	14.935	77	.194			
Error	Post Unfamiliar	31.280	77	.406			
	Post Text Organization	18.793	77	.244			
	Post Information	22.338	77	.290			
	Post Main Idea	582.000	84				
	Post Inference RC	492.000	84				
Total	Post Unfamiliar	674.000	84				
	Post Text Organization	604.000	84				
	Post Information	1273.000	84				

C: The experimental group (M = 3.01) had a significantly higher mean than the control group (M = 2.47) in the posttest of unfamiliar vocabulary after controlling for the effect of the pretest (F (5, 73) = 16.38, p < .05, partial η2 = .175 representing a large effect size).

D: The experimental group (M = 2.77) had a significantly higher mean than the control group (M = 2.47) in the posttest of text organization after controlling for the effect of the pretest (F (5, 73) = 7.27, p < .05, partial η2 = .086 representing a moderate effect size).

E: And finally, the experimental group (M = 3.55) had a significantly higher mean than the control group (M = 2.41) in the posttest of information recall after controlling for the effect of the pretest (F (5, 73) = 5.54, p < .05, partial η2 = .067 representing a moderate effect size).

5. Discussion

Based on the results of data analysis, cognitive-based learning was found effective as the EFL learners in the experimental group outperformed their counterparts in the control group in the posttest of RC components. This is in line with the findings of of

previous studies on the same ground which have proved effective in helping EFL and ESL learners improve their RC ability (Smith et al., 2021; Soltani & Taghizadeh, 2023). As different studies (Assaly & Smadi, 2015; Bikowski & Casal, 2018; Djallel, 2022; Stevani & Tarigan, 2023; Fitri et al., 2024; Stevani & Tarigan, 2023) have argued, in case the development of reading questions in the textbooks follows that of Bloom's Taxonomy, it could indirectly help learners develop critical reading and develop analytical views among them.

Moreover, the study findings highlighted the role of background knowledge and its activation in different phases of critical reading, which is in line with Smith et al.'s (2021) study highlighting the role of background knowledge in reading comprehension. The present findings, under the effect of Boom's Taxonomy, can also take support from Gershon's (2018) study on the efficacy of Bloom's taxonomy in the L2 classroom and on the reading comprehension of EFL learners reporting that familiarizing learners with techniques such as activating or building background knowledge and analyzing the text can make them aware of the main features of reading L2 texts. Moreover, like the present study, Horváthová and Naďová (2021) asserted that a cognitive learning-oriented teaching of L2 reading could help learners understand the message conveyed by the text and they would be able to find out about the intended message of the writer which, in some cases, would be vague to understand due to the technicality and complexity if the texts.

The present study showed the priority of critical and cognitive teaching of L2 reading over the conventional method of translating texts in the Iranian EFL context. Numerous research (Alfaki, 2014; Koksal & Ulum, 2018; Nasir et al., 2022; Pakpahan et al., 2021; Ulum, 2022) have supported the effectiveness of cognitive-based teaching and learning strategic of L2 reading. The present study found that strategies such as a) activating or building background knowledge, b) analyzing the texts, c) making predictions and inferences, d) determining main ideas, and e) synthesizing could facilitate reading comprehension of EFL texts among university students at the B.A level. Likewise, the present study findings are in line with findings of Koksal and Ulum (2018) who focused on assessing L2 reading based on Bloom's taxonomy, and found that reading comprehension questions developed based on this taxonomy can measure both higher

and lower order of critical thinking abilities in the examinees. The study can also take support from Piñero and & Cañedo's (2024) study on learners' reading comprehension skills confirming that the five reading components of main idea, inferencing, unfamiliar vocabulary knowledge, text organization, and information recall are supported by Bloom's taxonomy levels.

As one of the most important linguistic abilities, RC requires students to improve their reasoning abilities and use analytical reading strategies to uncover not just the words' literal meaning but also the passage's underlying meanings; both explicit and implicit. In other words, according to Abenojar (2024) and Todorova (2024), in order to fully understand a text, one must progressively build meaning by recognizing and analyzing the main points, assessing the reliability of the sources, drawing connections to prior knowledge, and finally, synthesizing and reflecting on the final data. Consequently, once reading commences, several levels of cognition are engaged concurrently.

The present study showed that applying Bloom's Taxonomy to L2 reading classroom can enhance EFL learners' ability in answering different reading questions; from recalling the information to deciphering complicated ideas from the text. This can take support from the ideas presented in cognitive-based learning research: Cognitive-based second language reading instruction uses Bloom's taxonomy to stress the usefulness of different questioning strategies, which can be different depending on how the question is written (Alfaki, 2014; Assaly & Smadi, 2015; Ekalia et al., 2022). Cognitive models of reading comprehension provide guidance on the types of inquiries that could aid in better understanding the writer's aim, inferential reasoning, analytical perspectives, and coherence. According to Elias (2014), it is important to focus on the higher levels of Bloom's Taxonomy while asking questions in order to foster higher-order capabilities. In addition, readers need to recognize the logical and causal relationships among events in the text in order to draw meaningful conclusions from it (Febrina et al., 2019).

Surveying the literature thoroughly, the researchers also found that cognitive based instruction benefitting from Bloom's Taxonomy (1956) can help EFL learners enhance their learning ability. According to different studies (Smith et al., 2021; Soltani &

Taghizadeh, 2023), EFL learners can benefit from the cognitive learning levels proposed by Bloom in terms of both language proficiency and various L2 language skills and components. Additionally, critical thinkers are becoming more analytical, reasonable, and logical as they face life's obstacles, which influence their perceptions of themselves, events, and the world around (Bakhtiari Moghadam et al., 2021). However, it is well-established that CT is positively correlated with L2 language proficiency, reading comprehension, and other language skills (Abenojar, 2024; Horváthová & Naďová, 2021; Huyen & Ngoc, 2024).

6. Conclusion

The findings of the present study indicated the positive effect of cognitive-based learning approach on L2 reading development components of EFL learners. By using Bloom's Taxonomy in L2 classroom, this opportunity is provided for learners to be able to express their opinions, do critical reading, and think deeply about what they read. Moreover, collaboration and question-answer sessions provide EFL learners with the opportunity of expressing their opinions and receiving feedback from their classmates and instructors. Based on the conducted research, providing an effective teaching method for the learners of English as a foreign language is considered very valuable because it improves the RC skills of EFL learners, their problem-solving ability, and analytical reading skills. In other words, choosing appropriate teaching/learning techniques, provides the necessary interaction between the reader and the text and can have stable learning outcomes (Almulla & Al-Rahmi, 2023). On the other hand, reading should be used not only as a source of information, but also as a tool for developing language knowledge, thoughts, and critical thinking extension (Bozan, 2024; Chen & Abdullah, 2024). The success in developing L2 reading through Bloom's taxonomy levels can be considered due to the creation of a supportive learning environment among the class members, which can provide more opportunities to explain and refer to, and as a result, the students' understanding of the presented materials would be enhanced (Huang, 2024; Huyen & Ngoc, 2024; Vaughn et al., 2024).

Bloom's Taxonomy levels could be employed by EFL teachers to make learners more

aware of the intentions and ideas in what they are reading. The assumption is that participation in a cognitive-based learning program of an EFL course could facilitate learning (Childs & Taylor, 2022), and learners must pay attention to the features of input they are exposed to and concentrate on the strategies they employ and focus on the way they learn better. This could be done through a kind of cognitive comparison which has been seen as one of the crucial processes in language acquisition. Paige et al. (2024), within the framework of cognitive learning, pay special attention to the role of critical thinking and its correlation with reading comprehension among L2 learners. In the same vein, Huyen and Ngoc (2024) emphasize the importance of providing EFL teachers with teaching strategies and methods relying on cognitive learning approach. They underscore the presence of cognitive based learning in prompting EFL learners' textual and contextual awareness. Bloom's taxonomy, according to Abenojar (2024), serves as a valuable framework for testing learners at all levels of competence, from basic to advanced, during their study. Fastiggi (2014) asserts that teachers can use Bloom's Taxonomy as a framework to teach any cognitive content. Teachers can use it to plan lessons that push their students to their limits and help them achieve their full potential, no matter what subject they teach (Ahmadi, 2020; Akbari et al., 2021).

In addition, EFL learners could employ cognitive based learning using Bloom's Taxonomy to meaningfully solve their L2 reading problems, be focused on analytical and critical reading of materials and this way develop both their critical reading skills and reading comprehension ability in an atmosphere filled with awareness of a mismatch between the input they receive and their current learning. This way the classroom interactions could be enriched and would help subsequent L2 development of the learners.

The present study focused on the effect of cognitive-based learning on Iranian EFL learners' reading comprehension components. Future studies might consider examining the residual effects of cognitive learning methods related tasks and activities to explore whether and how long-term these effects actually could be. A semi-longitudinal study of the concept cognitive learning on a specific group of EFL learners majoring in different fields at the B.A. level can reveal if this technique energizes "retention of EFL reading ability and CT skills in the learners' mentality or not. In addition, the present study

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employed Bloom's taxonomy focusing on the EFL reading and CT skills development. Future studies may be needed to replicate the findings with other language skills or components. Moreover, the present study was carried out in the virtual world due to the Covid-19 pandemic. A new study might delve into the issue through comparing the face-to-face interactions and virtual training of the EFL reading courses to the Iranian EFL students in different majors and different higher education levels. Further research is recommended to explore the role of cognitive based learning in developing second language cultural familiarity, cooperative learning, instructed noticing, attention, and awareness in developing grammar, vocabulary, or any other skill and component of the second language and their relationship together or the probable effect they leave on learner autonomy, self-regulatory factors of learning, and learner motivation.

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