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The Effect of Project-Based vs. Data Driven Language Learning on Reading Comprehension of Iranian Elementary English Learners

Mohsen Sheikhveisi[1], Mehdi Safaie-Qalati[*1], Nahid Yarahmadzehi[1], and Peyman Nasrabadi[1]

[1] Chabahar Maritime University (CMU), Chabahar, Iran

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Abstract

This study investigated the comparative impact of Project-Based Language Learning (PBLL) and Data-Driven Language Learning (DDLL) on the reading comprehension skills of Iranian elementary EFL learners. Thirty-two elementary-level undergraduate students of English translation were selected through a purposive convenience sampling process to participate in the study. Participants, all possessing native proficiency in Standard Farsi, were balanced in terms of gender and randomly assigned to two experimental groups: PBLL and DDLL. The intervention spanned five weeks, comprising four treatment sessions and a final post-test session with a two-week interval, utilizing PBLL through specific project-based activities and DDLL via the Longman Dictionary of Contemporary English (LDOCE). LDOCE, a user-friendly, corpus-based resource, was noted for its intuitive search engine, facilitating ease of use for learners with lower proficiency. Instructions for both groups were provided in Persian by the researchers. Pre- and post-intervention tests assessed reading comprehension, and the results showed that the DDLL group significantly outperformed the PBLL group in post-test scores, highlighting DDLL's effectiveness. Although these results suggest DDLL's potential as an impactful educational strategy in EFL contexts, the study's short duration suggests that these findings should be interpreted cautiously. Future research is recommended to explore these methodologies further by involving longer durations and larger, more diverse populations while also investigating how integrating DDLL with AI technologies can refine and enhance educational practices, effectively combining traditional and modern methodologies for optimal learning outcomes.

Keywords
Project Based, Data Driven, Reading, EFL LDOCE

1. INTRODUCTION

Reading is pivotal to developing proficiency in a foreign language (Hsu, 2004). In countries like Iran, where English is taught as a Foreign Language (EFL), students often have limited opportunities to interact with native English speakers or engage with authentic English texts. This scarcity makes developing strong reading comprehension skills in English particularly important. Proficient reading not only enables learners to access a wealth of information and resources

[*] **Corresponding Author:** Mehdi Safaie-Qalati, English Department, Faculty of Management & Humanities, Chabahar Maritime University (CMU), Chabahar, Iran, **Email**: m.safaieqalati@gmail.com
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independently but also serves as a vital means of acquiring knowledge and engaging in cultural exchange (Gorsuch & Taguchi, 2008). As a result, the need to improve accurate and fluent reading comprehension in EFL contexts has become essential, driving scholarly efforts to assess effective teaching methods for Iranian EFL learners.

Effective teaching methods for reading comprehension in EFL and English as a Second Language (ESL) settings are categorized into bottom-up, top-down, and interactive approaches. Bottom-up approaches stress the significance of decoding individual words to form the foundation for text comprehension (Perfetti et al., 2008; Stahl & Nagy, 2007). Top-down approaches utilize the reader's prior knowledge to make predictions and inferences about text meanings. Interactive approaches blend these methods, acknowledging that reading comprehension is a dynamic balance of decoding and contextual understanding (Kintsch, 2005).

Research has explored numerous effective teaching strategies for reading comprehension, including direct and indirect vocabulary instruction, reciprocal teaching, think-alouds, graphic organizers, and cooperative learning. Direct vocabulary instruction (Bottom-up) provides clear explanations of new words, aiding in comprehension by focusing on the building blocks of language, that is, individual words. Vocabulary notebooks (Bottom-up) support the retention of new words, prioritizing the understanding and memorization of vocabulary to improve comprehension from the ground up. Think-alouds (Top-down) model thought processes during reading, guiding students to access and use their prior knowledge and context to interpret texts, focusing on comprehension as a holistic process. Graphic organizers (Interactive) help visualize and organize text information, bridging the detailed text analysis and broader contextual understanding by creating a visual synthesis of ideas (National Reading Panel, 2000). Reciprocal teaching is an interactive approach where educators and learners engage in shared discussions to understand text together. This method incorporates four key comprehension techniques: making predictions about the text, forming questions, seeking clarification of unclear points, and creating summaries of the content. These strategies are deliberately chosen to help students track and improve their understanding of the material (Mohamed, 2023).

Project-Based Learning (PBLL) and Data-Driven Language Learning (DDLL) have emerged as effective strategies, especially during remote learning prompted by the COVID-19 pandemic. PBLL presents students with real-world tasks to solve, emphasizing student-centered learning and interdisciplinary connections, aligning with an interactive approach (Solomon, 2003 as cited in Sadeghi et al., 2016). DDLL uses linguistic data to help learners identify language patterns, drawing on online corpora and dictionaries, reflecting a bottom-up approach (Barabadi & Khajavi, 2017). These methodologies facilitate both independent and collaborative learning in remote environments. PBLL motivates learners through meaningful projects, while DDLL leverages technology for language learning—approaches that align with post-COVID-19 educational landscapes (Beckett, 2002; Kleinman et al., 2022; Novikov, 2022). The current research aims to compare and contrast the effectiveness of PBLL and DDLL, providing insights into how each methodology supports EFL learners' reading comprehension in an Iranian EFL context.

Statement of the Problem, Purpose, and Significance of the Study

In recent years, particularly in the wake of the COVID-19 pandemic, the integration of technology into educational methodologies has become increasingly prominent. Remote learning has transformed from a temporary solution into a staple of modern education, proving crucial across diverse learning environments, from remote regions to densely populated urban areas. Innovative, student-centered strategies such as DDLL and PBLL have become increasingly popular, especially in technology-enhanced remote learning environments. PBLL, characterized by its project-focused and collaborative learning environment, may offer vital benefits in terms of real-world application. Furthermore, being primarily student-centered, it has the potential to be

implemented effectively in remote learning settings through video calling platforms, as well as by assigning projects via electronic communication tools. While PBLL engages students actively by linking language skills to practical, real-world projects, DDLL emphasizes the learner's interaction with authentic linguistic data. This enables students to uncover language patterns and meanings through extensive investigation of large text corpora, facilitating deeper linguistic insights via pattern recognition and promoting independent learning (Corino & Onesti, 2019).

However, while both PBLL and DDLL methodologies have gained worldwide recognition for their contributions to language learning, particularly in remote education, a significant research gap exists in assessing their relative effectiveness, specifically among Iranian English learners (Sadeghi et al., 2016). More specifically, in the Iranian EFL context, there has been limited exploration into how PBLL and DDLL compare in terms of their impact on reading comprehension skills. Given this backdrop, the principal aim of the current study was to bridge this research gap by examining the impact of these two instructional strategies on the reading comprehension of Iranian elementary EFL learners. Furthermore, the study aimed to incorporate these methodologies in real-life classroom settings, providing insights into their practical application and potential benefits. By integrating project-based tasks and corpus-based language investigation into classroom activities, students can experience diverse learning dynamics, including group interactions and autonomous language exploration.

Theoretical framework

The current paper situates its inquiry within the theoretical frameworks of both PBLL and DDLL. PBLL is an instructional strategy that requires students to engage in solving real-life problems and creating tangible products through projects that integrate various language skills in authentic contexts. Drawn from the principles of constructivism and sociocultural theories, PBLL places the learner at the center of the educational experience. Learners actively construct knowledge and derive meaning by completing projects that require problem-solving, inquiry, and meaningful communication. This method enhances motivation and student autonomy by providing learners with the opportunity to apply language skills practically, promoting the development of critical language competencies essential for effective reading comprehension (Allen, 2004; Dörnyei, 2005; Egbert, 2003 Grant, 2017).

Within PBLL, an "interactive approach" is employed where language learners build their understanding from concrete experiences in project work, integrating various language skills such as reading, writing, speaking, and listening in a cohesive manner. The interactive element of PBLL encourages collaboration and peer learning as students navigate group projects both inside and outside the classroom to negotiate meaning and apply language in real-world scenarios (Laverick, 2018). By designing a learning environment where the teacher acts as a facilitator, PBLL provides a student-centered space that fosters active engagement and deeper comprehension skills through immersive and practical activities (Cocco, 2006; Cooper & Murphy, 2016).

DDLL immerses students in authentic language data to uncover linguistic rules and patterns independently. This approach relies on tools like corpora and corpus-based dictionaries (such as the Longman Dictionary of Contemporary English (LDCE)), which are vital in providing accurate and contemporary language data (Barabadi & Khajavi, 2017). Corpus-based dictionaries are indispensable in the DDLL approach, offering learners a robust platform to independently discover and internalize language patterns, significantly enriching their language competence and comprehension skills. This aligns with DDLL's aim, as outlined by Johns (1991), to empower learners to extract and generalize linguistic patterns themselves. The dictionary's entries offer not only meanings but also context through extensive example sentences from various genres and registers, facilitating a deeper understanding of syntax and semantics. By using corpus-based dictionaries, learners can explore elements like collocations and sentence structures, enhancing

reading comprehension by observing context-based language use. The inclusion of language frequency and usage notes helps students identify patterns, such as common collocations or verb tenses, fostering their ability to apply these in different contexts. This method encourages active engagement, supporting learners in developing a nuanced and authentic understanding of language.

DDLL's bottom-up approach is inductive, requiring students to analyze linguistic data without prescriptive teaching methods. Learners engage in a data-driven exploration and are encouraged to develop the skills necessary for identifying linguistic patterns across syntax, vocabulary, and grammar. By using tools such as concordances (which are also available in corpus-based dictionaries), students form a comprehensive understanding of language usage patterns, akin to conducting linguistic investigations (Talai & Fotovatnia, 2012). This method promotes learner autonomy and cognitive engagement by fostering skills like predicting, analyzing, reasoning, and making inferences about language phenomena (Bernardili, 2004; Gaskell & Cobb, 2004). As learners engage with authentic texts, they develop a systematic approach to language that builds their reading comprehension through increased linguistic awareness (Boontam, 2022; Boulton, 2008). The teacher's role in DDLL is minimal in content delivery, acting instead as a facilitator for resource access and strategy development, encouraging learners to become autonomous language users (Johns, 2002).

2. LITERATURE REVIEW

This section provides research findings globally and within the Iranian context to identify previous scholarly work's gaps and inform our study's focus on the effect of DDLL and PBLL on Iranian elementary English learners reading comprehension.

Previous Research on PBLL and Reading Comprehension

PBLL has been integral to EFL education for over two decades, offering a dynamic approach that has gained recognition for its effectiveness in teaching English (Fang & Warschauer, 2004). Beckett (2002) describes PBLL as an approach that allows variability in outcomes, as it enables students to apply a range of strategies to complete tasks, thereby fostering learner responsibility and autonomy.

Alan and Stoller (2005) emphasize the collaborative nature of PBLL, which involves group projects that develop students' communication skills by engaging them in real-world scenarios. This pragmatic approach to language learning connects classroom activities with practical, outside-the-classroom applications, enhancing students' social abilities and critical thinking (Lessard-Clouston, 2016; Long & Porter, 1985). By immersing students in authentic, task-based scenarios, PBLL effectively bridges the gap between theoretical knowledge and practical skills.

A substantive body of research supports PBLL's efficacy in enhancing reading comprehension, particularly among ESL and EFL learners. In a case study, Le and Nguyen (2021) demonstrated that students participating in PBLL outperformed those engaged in traditional instruction in reading comprehension assessments. This advantage is attributed to PBLL's emphasis on active engagement and critical thinking, which assists with a deeper understanding and retention of language concepts. Notably, PBLL allows students to construct understanding through contextual and meaningful project-based activities that align with their lived experiences.

Similarly, Imbaquingo and Cárdenas Castillo (2023) explored PBLL's impact on vocabulary and reading skills among EFL learners, in Quito, Ecuador, noting that the engagement with authentic texts in project scenarios resulted in significant improvements in vocabulary retention and reading comprehension. The contextual projects facilitated connections between vocabulary and real-world applications, which enhanced comprehension and language proficiency.

In another study, Kavlu (2024) integrated PBLL into English for Specific Purposes (ESP) courses to examine its impact on EFL learners' ability to acquire discipline-related knowledge and its effect on their academic performance in ESP courses. The research was conducted at Tishk International University in Iraq's Kurdistan Region. Employing a mixed-method approach with both quantitative and qualitative tools, the study assessed PBL's influence on undergraduate Iraqi EFL learners. The results indicated that PBL significantly enhanced students' acquisition of specialized vocabulary and knowledge in English, along with a marked improvement in their academic achievement in ESP courses.

Further, Cao (2024) investigated the effectiveness of project-based language learning PBLL in enhancing self-regulated learning (SRL) among intermediate EFL students in a reading comprehension class. Utilizing a mixed-methods approach, the research employed a questionnaire based on Zimmerman's SRL model and qualitative observations to assess students' motivation, metacognitive strategies, and behaviors throughout three PBLL projects. Findings indicated that PBL significantly improved students' SRL abilities, as evidenced by increased proactive learning behaviors, such as 65% of students engaging in online information searches and 72.5% using visual media for research, while also highlighting that despite the integration of writing tasks, students primarily reported intentions to practice reading, and other skills as well.

Previous Research on DDLL and Reading Comprehension

Data-Driven Language Learning has similarly demonstrated significant potential in improving various language skills, including reading comprehension. Research supports the effectiveness of DDLL in fostering language acquisition by encouraging students to interact directly with authentic language data. Rutherford (1987) highlights DDLL's role in enhancing grammatical awareness through direct engagement and exploration of language data, empowering learners as active participants in discovering linguistic patterns.

Similarly, Boulton (2008) investigates the use of data-driven learning (DDL) through language corpora, particularly focusing on its potential for lower-level language learners, a group often thought unsuitable for this approach. The research involved an experiment with 113 lower-intermediate English learners who were exposed to raw concordance data related to phrasal verbs "pick (up)" and "look (up)." The results were encouraging, showing that even learners at this level can benefit from engaging with corpus data. This suggests that DDLL could be a valuable addition to the techniques available for teaching lower-level learners.

Further research by Al-Mahbashi et al. investigated DDLL's effectiveness by considering individual learner differences to identify who benefits most from it. The literature highlighted the need to explore which learners are best suited for DDLL. This study aimed to determine if learners' predominant intelligences could predict DDLL learning outcomes. It involved 30 female Yemeni EFL students from Sana'a University, using a multiple intelligence questionnaire and vocabulary tests. Analysis showed no significant link between intelligence and test outcomes. Findings suggested that addressing learners' needs and preferences in instruction helps create an engaging learning environment.

Lee and Lin (2019) indicated DDLL aids second/foreign language acquisition through its inductive (bottom-up) approach and authentic language samples, promoting deep learning. However, cognitive load posed a challenge, prompting calls for studies on inductive versus deductive methods in DDL-based ESL/EFL instruction. This study compared these approaches regarding vocabulary acquisition and retention using the Corpus of Contemporary American English (COCA), involving 27 EFL learners divided into inductive and deductive groups. A modified Vocabulary Knowledge Scale assessed learning before, immediately after, and two weeks post-instruction. Results showed that both methods were equally effective, with vocabulary knowledge generally improving. Deductive DDLL proved as effective as inductive but with

reduced time, suggesting it might complement DDLL efficiently by mitigating inductive challenges.

Rasikawati (2020) corroborated these findings in an English for Academic Purposes (EAP) context, where DDLL led to superior vocabulary acquisition and reading comprehension compared to traditional methods. Lusta et al. conducted a systematic review highlighting the role of corpora and DDLL in language education. Their extensive search yielded 89 studies from 1997 to 2022, focusing on terms like "DDLL" and "corpus linguistics" to find relevant literature on DDLL classroom interventions. The review considered peer-reviewed English texts with available PDFs. These studies explored DDLL applications in classrooms, identifying common practices, challenges, and limitations. While DDLL shows promise as a teaching tool, its impact is limited by various challenges. Effective strategies for engaging lower-proficiency students include tailored tasks, additional guidance, support materials, and peer/group learning activities.

In another study, Crosthwaite and Baisa (2023) examined the interplay between Generative AI (GenAI) and Corpus-Assisted Data-Driven Learning (CDDL), highlighting the critical role of integrating these methodologies to advance language education. They conducted a comparative analysis that showcased the benefits of DDL, particularly the authenticity and replicability of language data sourced from established corpora compared to AI databases. Conversely, the authors noted that GenAI offered advantages such as immediate feedback and user-friendly interfaces, which could enhance learner engagement. Their findings indicated that while GenAI had the potential to broaden engagement and generate contextualized text rapidly, traditional corpora remained vital for providing reliable language patterns necessary for meaningful learning. Ultimately, the authors advocated for a synergistic approach that combined the strengths of both CDDL and GenAI, emphasizing the importance of innovation in educational practices within the field of language learning.

In a more recent study, Flowerdew (2024) examined the integration of DDLL and large language models (LLMs) in enhancing research writing skills among PhD students in Hong Kong. The research involved conducting 24 workshops with 473 students, where they were introduced to various corpus tools, such as BNCweb and AntConc, which allowed them to analyze language patterns in academic writing. The findings indicated that students demonstrated significant improvements in their ability to identify, comprehend, and effectively use reporting verbs, such as "the data suggest" and "the study indicates," reflecting a deeper understanding of academic discourse. This study highlighted the importance of DDLL in language learning, illustrating how traditional corpus-based approaches can be effectively combined with modern AI technologies to create enriched learning experiences in academic writing.

DDLL and PBLL Research in the Context of Iran

In the Iranian educational context, research into PBLL and DDLL reveals significant insights into their effectiveness. Koosha and Jafarpour (2006) examined three key aspects of teaching and learning English preposition collocations among Iranian adult EFL learners. Firstly, they explored the effectiveness of using DDLL through concordancing materials in teaching these collocations. Secondly, they assessed whether variations in proficiency levels among EFL learners influenced their mastery of preposition collocations. Lastly, they explored how the native language of Iranian EFL learners impacted their understanding of these collocations. The study involved 200 senior English majors at Shahrekord University, divided into two groups: one received traditional instruction, while the other was taught using DDL-based concordancing methods. Pre-tests and post-tests were conducted to measure the impact of these methods. The findings revealed that DDL-based instruction was highly effective, higher proficiency levels positively influenced collocation acquisition, and the learners' native language significantly impacted their patterns of using English prepositional collocations.

Poordaverdi Shiraz and Larestani (2014) investigated PBLL's effect on intermediate Iranian EFL students. They divided participants into three groups: two project-based (magazines and wall newspapers) and one control group using Communicative Language Teaching (CLT). The results showed that PBLL significantly improved reading comprehension compared to the CLT approach, highlighting the diverse effectiveness of PBLL activities regardless of their nature.

Sadeghi et al. (2016) focused on PBLL's impact on writing skills, revealing that PBLL fostered greater improvements in comparison and contrast paragraph writing among Iranian intermediate EFL learners than traditional methods. This study connected PBLL's project-oriented environment with enhanced writing performance.

Barabadi and Khajavi (2017) explored corpus-based DDLL as an innovative method for teaching vocabulary to EFL students, contrasting it with traditional methods like using dictionaries or grammar books. Two intact classes (N = 42) formed the experimental group, while one class (N = 20) served as the control group, all studying for the Certificate for Advanced English (CAE). A standardized vocabulary size test ensured participants had similar vocabulary knowledge. During the semester, the experimental group used teacher-prepared materials from the COCA corpus and conducted similar searches independently. A post-test based on their course book assessed outcomes. Results showed the experimental group outperformed the control group, likely due to their active role in self-discovery and inductive learning processes emphasized in DDL.

While extensive research supports PBLL and DDLL's positive impacts on reading comprehension across different proficiency levels, a noticeable gap remains in the specific comparative study of these methodologies within the context of Iranian EFL learners' reading comprehension skills. Most existing studies focus on higher proficiency levels, different demographic settings, or skills other than reading comprehension, necessitating further exploration into how these approaches affect reading comprehension at the elementary level in an Iranian setting. The present study aimed to address this gap by posing the following questions:

RQ1: Does DDLL significantly enhance the reading comprehension skill of Iranian Elementary EFL learners?

RQ2: Does PBLL significantly improve the reading comprehension skill of Iranian Elementary EFL learners?

RQ3: Is there a significant difference in post-test reading comprehension scores between the DDLL and PBLL groups among Iranian Elementary EFL learners?

The answers to these questions can offer insights into optimizing language instruction strategies for learners in Iran and contribute to existing literature by highlighting the comparative efficacy of PBLL and DDLL in specific context of elementary reading comprehension.

3. METHODOLOGY AND DESIGN

The study utilized a quasi-experimental design with a pre-test, treatment, and post-test structure. This approach was selected because it effectively assesses the initial state of participants before any intervention, providing a baseline for measuring changes after the treatment. The quasi-experimental design was particularly suitable in this context, as random sampling was not feasible due to limited access to qualified participants (Harris et al., 2006), specifically Iranian elementary EFL learners. The treatment involved an instructional program aimed at enhancing reading comprehension skills, with two different treatments (i.e., DDLL vs. PBLL) applied to the two experimental groups. A post-test was administered following four treatment sessions over an 8-day period to evaluate the effects of these interventions.

Participants

Initially, the study aimed to include 'pre-intermediate' EFL learners. Undergraduate students of English translation at Chabahar Maritime University (CMU) in Chabahar, Iran, were invited to

participate through convenience sampling. A total of 56 participants took the placement test, comprising 35 females and 21 males. Based on the results of the placement test, the proficiency levels of the participants were distributed as follows: 1 participant at the upper-intermediate level, 8 at the intermediate level, 8 at the pre-intermediate level, 35 at the elementary level, and 4 at the beginner level. Due to the insufficient number of pre-intermediate participants to form two experimental groups, the study shifted its focus to the elementary level, which had a sufficient number of participants. The target group for the study thus became the elementary level, consisting of 35 participants (19 females and 16 males). To ensure an equal number of male and female participants, 3 female elementary learners were randomly selected using random numbers generated by the Google search engine, resulting in 16 males and 16 females being included in the study. These 32 participants were then randomly assigned to two experimental groups, each containing 8 males and 8 females. The random assignment was achieved by alphabetically listing the participants and alternating their placement into the groups. Despite the participants' diverse linguistic backgrounds and dialects, the demographic information gathered through a questionnaire included at the beginning of the placement test indicated that they all had a native mastery of Standard Farsi, either as their first or second language.

Instruments

Tests

A series of tests were utilized to assess participants' proficiency and reading comprehension skills. The Macmillan General English Proficiency Test (Macmillan, 2019), was administered electronically to determine participants' proficiency levels and ensure homogeneity. An elementary (A1) reading comprehension test from The British Council website served as the pre-test (Appendix A), while a different A1 reading comprehension test from the same source was used as the post-test (Appendix B). Both tests were transformed into electronic formats and administered via laboratory software.

Instruction Materials

Due to the limited time, the participants could allocate to the experiment, and their very low level of English proficiency, introducing an authentic large English corpus and teaching participants how to use standard corpus search engines to explore it themselves was a significant challenge in the DDLL group. Instead, the researchers utilized the corpus-based Longman Dictionary of Contemporary English, 6th edition (LDOCE). This dictionary was available as software already installed on the computers of all participants in the lab. LDOCE offers an extensive set of definitions, synonyms, antonyms, usage notes, register, part of speech, etc., for each of the 230,000 contemporary English words. It also contains over 165,000 relevant examples extracted from a vast collection of corpora to provide accurate and up-to-date information (Chi, 2016). The incorporation of various corpora ensures that this dictionary reflects authentic and current language usage, making it an invaluable data-driven resource for learners and users of English. Additionally, as a searchable dictionary, it provided a user-friendly search engine for the participants.

For the PBLL instructional instrument, based on relevant suggestions in the literature, one of the following four projects was assigned to the participants of the PBLL experimental group during each of the four treatment sessions: group discussions (session 1), translation (session 2), summarizing through T-chart concept maps (session 3), and summarizing through timeline and graphic concept maps (session 4).

Procedure

The study was conducted between October and November 2023. Participants were invited to participate through a convenience sampling method, which included an announcement call and personal invitations. These students were then randomly assigned to one of the two experimental groups: DDLL or PBLL. They actively participated in four treatment sessions. At the start of the first treatment session, a pre-test was administered to both groups to establish a baseline for their reading comprehension skills. Each group then participated in three additional treatment sessions, engaging in activities specific to their instructional approach. The DDLL group focused on using the LDOCE to explore linguistic data, while the PBLL group engaged in project-based activities to tackle reading comprehension tasks. After the intervention, a post-test was administered with a 2-day interval to assess the impact of the instructional treatments on the participants' reading comprehension abilities. Two of the present study researchers gave the instructions to the two groups, and they were delivered in Farsi to ensure comprehension. Both the DDLL and PBLL groups received identical reading materials and immediate post-tests in each treatment session.

DDLL Instructional Sessions

The primary aim of the instructional approach in the DDLL group was to enhance the reading comprehension skills of participants by utilizing the LDOCE as a data source. Each session was structured into three 20-minute segments. Initially, participants received instructions on how to effectively use the LDOCE to explore reading comprehension texts. The first session introduced participants to the dictionary's functionalities, focusing on using it to understand unfamiliar words from a poster depicting an airport information board. The second session emphasized understanding English modal verbs, with participants exploring definitions and examples in the LDOCE. The third session focused on parts of speech, teaching participants to use advanced search options in the dictionary to identify specific grammatical categories. The final session directed attention to prepositions related to time and place, as well as their usage in collocations and phrasal verbs. Throughout the sessions, participants were encouraged to rely solely on the LDOCE for data exploration without using a Farsi dictionary. Each session concluded with an electronic reading comprehension test to assess the participants' understanding and retention of the material. The DDLL approach aimed to familiarize participants with practical applications of data-driven learning, enhancing their ability to independently explore linguistic data and improve their reading comprehension skills.

PBLL Instructional Sessions

The PBLL instructional approach was also conducted over four sessions, with the goal of improving participants' reading comprehension skills through project-based activities. Each session was divided into three 20-minute segments, starting with instructions. The first session involved a group discussion project, where participants discussed a reading comprehension text about a flight information board, posing WH questions and negotiating answers. The second session introduced T-chart concept maps, where participants summarized a text about school library rules, visually organizing information into categories such as allowed and not allowed activities (Appendix C). The third session focused on translation, with participants translating dictionary entries and bold-faced words from a monolingual English dictionary excerpt into Persian. The final session involved creating timeline and graphic concept maps to summarize a narrative about a Hollywood actress's life and career (Appendix D). Participants were guided in using these visual tools to organize chronological events and daily activities. Each session concluded with an electronic test to measure the impact of the project-based activities on reading comprehension. The PBLL approach aimed to provide participants with collaborative learning experiences, encouraging them to engage with reading materials creatively and critically.

Data Collection and Data Analysis

Data were collected through pre- and post-tests administered electronically. Immediate post-tests ensured active participation but were not included in the main data analysis. Data analysis involved parametric (Paired Samples t-Test) and non-parametric (Kolmogorov-Smirnov, Mann-Whitney U, and Wilcoxon Related Samples) statistical tests using IBM SPSS Statistics 27.0.1 IF026.

4. RESULTS

Pre-test's Results and Analyses

The pre-test results were crucial for comparing the effectiveness of DDLL vs. PBLL methods. First, descriptive statistics and normality tests, specifically Kolmogorov-Smirnov, were utilized to analyze the pre-test data, ensuring the validity of comparisons. The results of these analyses are detailed in tables 1 and 2.

Table 1: Pre-Test Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Pre-Test DDLL	16	8	10	18	14.50	2.033	4.133
Pre-Test PBLL	16	7	11	18	15.31	1.852	3.429
Valid N (listwise)	16						

Table 1 presents descriptive statistics for pre-test scores of the two groups DDLL and PBLL, each with 16 participants. The DDLL group scores range from 10 to 18, with a mean of 14.50, a standard deviation of 2.033, and a variance of 4.133. The PBLL group scores range from 11 to 18, with a slightly higher mean of 15.31, a standard deviation of 1.852, and a variance of 3.429. These statistics indicate that the PBLL group had a slightly higher average score and less variability in scores compared to the DDLL group.

Table 2: Results of the One-Sample Kolmogorov-Smirnov Test for Normality in Pre-Test DDLL and PBL Groups

			Pre-Test DDLL	Pre-Test PBLL
N			16	16
Normal Parameters[a,b]	Mean		14.50	15.31
	Std. Deviation		2.033	1.852
Most Extreme Differences	Absolute		.278	.207
	Positive		.168	.168
	Negative		-.278	-.207
Test Statistic			.278	.207
Asymp. Sig. (2-tailed)[c]			.002	.065
Monte Carlo Sig. (2-tailed)[d]	Sig.		.002	.065
	99% Confidence Interval	Lower Bound	.001	.059
		Upper Bound	.003	.072

As illustrated in Table 2, the Pre-Test DDLL group showed a test statistic of 0.278 with a p-value of 0.002, indicating a non-normal distribution. In contrast, the Pre-Test PBLL group had a test statistic of 0.207 and a p-value of 0.065, suggesting a normal distribution. These results indicate that only the Pre-Test PBLL group meets the normality assumption. The simple histograms in Figure 1 also confirm the non-normal distribution of the pre-test scores in the DDLL group.

Given the non-normal distribution of the pre-test data (in the DDLL group), a non-parametric test was conducted to ensure the homogeneity of the pre-test results between the two experimental groups. Specifically, the Mann-Whitney test was used to compare the results of Group 1 (DDLL) and Group 2 (PBLL). The outcomes of this test are detailed in Tables 3 and 4.

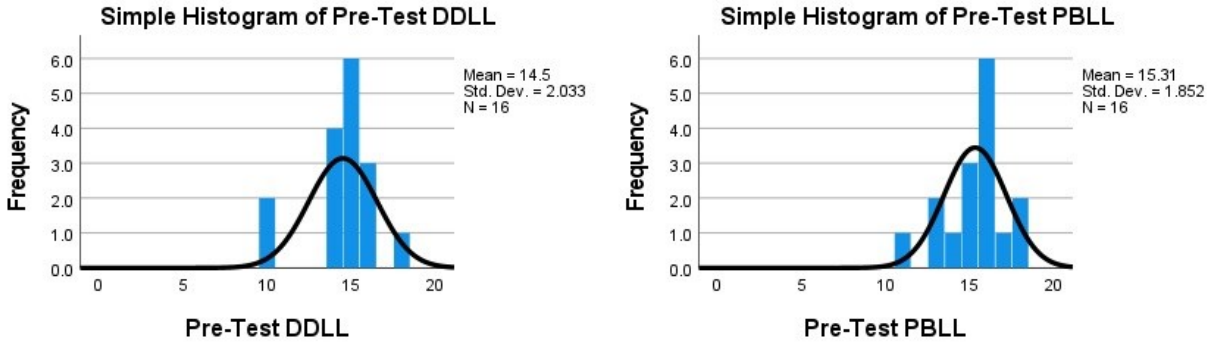

Figure 1: Simple Histograms of the DDLL & PBLL Pre-Test Scores

Table 3: Ranks of Pre-Test Scores for DDLL and PBLL Groups

		Ranks		
	DDLL vs. PBLL	**N**	**Mean Rank**	**Sum of Ranks**
Pre-Test	DDLL	16	14.25	228.00
	PBLL	16	18.75	300.00
	Total	32		

Table 1: Mann-Whitney U Test Statistics for Pre-Test Comparison Between DDLL and PBLL Groups

Test Statistics	
	Pre-Test
Mann-Whitney U	92.000
Wilcoxon W	228.000
Z	-1.391
Asymp. Sig. (2-tailed)	.164
Exact Sig. [2*(1-tailed Sig.)]	.184b
a. Grouping Variable: DDLL vs. PBLL	
b. Not corrected for ties.	

The Mann-Whitney U test results in Tables 3 and 4 indicate that there is no statistically significant difference between the pre-test scores of the DDLL and PBLL groups. Table 3 shows that the mean rank for the PBLL group (18.75) is higher than that of the DDLL group (14.25), suggesting a slight difference in central tendency. However, Table 4 reveals that the Mann-Whitney U value is 92.000, with a Z score of -1.391 and an asymptotic significance (2-tailed) of 0.164, which is above the conventional threshold of 0.05 for statistical significance. This suggests that any observed differences in ranks are not statistically significant, implying that the pre-test results are homogeneous between the two groups.

Post-test's Results and Analyses

To address the first two research questions, "RQ1: Does DDLL significantly enhance the reading comprehension skills of Iranian Elementary EFL learners?" and "RQ2: Does PBLL significantly improve the reading comprehension skills of Iranian Elementary EFL learners?", null hypotheses were formulated for each. The first null hypothesis posited that DDLL does not significantly enhance reading comprehension skills, while the second suggested that PBLL does not significantly improve these skills. To test these hypotheses, post-tests were administered following the respective treatment sessions for each group. The pre-test and post-test results for Group 1 (DDLL) and Group 2 (PBLL) were compared to evaluate the hypotheses. Before conducting these comparisons, normality tests were performed on the post-test data to ensure the validity of the statistical analyses, with the results detailed in Tables 5 and 6.

Table 5: Descriptive Statistics of Post-Test Scores for DDLL and PBLL Groups

Descriptive Statistics	N	Mean	Std. Deviation	Minimum	Maximum
Post-Test DDLL	16	18.56	1.263	15	20
Post-Test PBLL	16	16.13	2.680	10	20

Table 6: Normality Assessment Using One-Sample Kolmogorov-Smirnov Test for DDLL and PBLL Groups

One-Sample Kolmogorov-Smirnov Test			Post-Test DDLL	Post-Test PBLL
N			16	16
Normal Parameters[a,b]	Mean		18.56	16.13
	Std. Deviation		1.263	2.680
Most Extreme Differences	Absolute		.260	.190
	Positive		.177	.100
	Negative		-.260	-.190
Test Statistic			.260	.190
Asymp. Sig. (2-tailed)[c]			.005	.124
Monte Carlo Sig. (2-tailed)[d]	Sig.		.006	.122
	99% Confidence Interval	Lower Bound	.004	.114
		Upper Bound	.008	.131

Table 5 presents descriptive statistics for the post-test scores of two groups: DDLL and PBLL. The DDLL group achieved a higher mean score of 18.56 with a standard deviation of 1.263, indicating relatively consistent performance among participants, with scores ranging from 15 to 20. In contrast, the PBLL group had a lower mean score of 16.13 and a higher standard deviation of 2.680, suggesting more variability in performance, with scores spanning from 10 to 20. This data suggests that the DDLL group generally performed better and more consistently on the post-test compared to the PBLL group.

Table 6 presents the results of a One-Sample Kolmogorov-Smirnov Test conducted to evaluate the normality of the post-test scores for the DDLL and PBLL groups. For the DDLL group, the test statistic is 0.260, and the asymptotic significance (2-tailed) is 0.005, indicating a significant deviation from normality. The Monte Carlo significance corroborates this with a value of 0.006, within a 99% confidence interval of 0.004 to 0.008. Conversely, the PBLL group has a test statistic of 0.190 and an asymptotic significance of 0.124, suggesting the data does not significantly deviate from normality. The Monte Carlo significance of 0.122, with a 99% confidence interval from 0.114

to 0.131, supports this finding. Overall, similar to the results obtained for the pre-test scores, the DDLL group's scores deviate significantly from a normal distribution, while the PBLL group's scores do not. Histograms in Figure 2 also confirm these results.

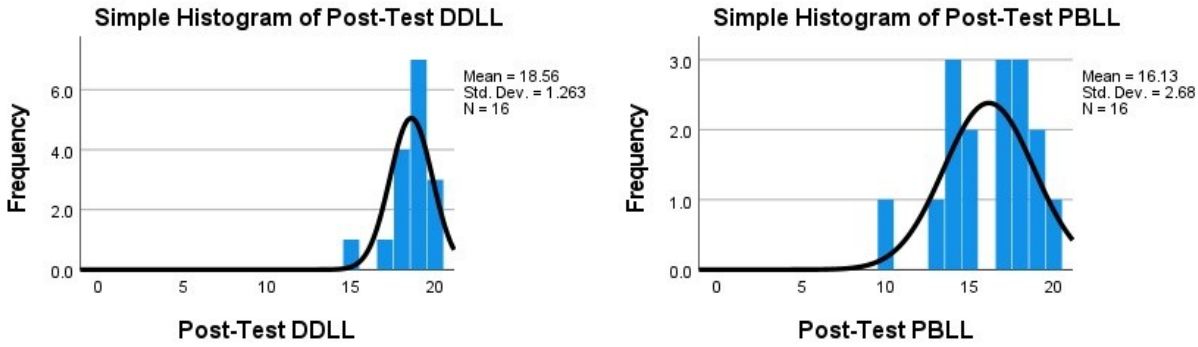

Figure 2: Simple Histograms of the DDLL & PBLL Post-Test Scores

Testing the First and Second Hypotheses

Since both the pre-test and post-test scores of the DDLL group deviated from a normal distribution, a non-parametric paired samples test, specifically the Wilcoxon Signed-Rank Test, was conducted to assess the first null hypothesis regarding the effectiveness of DDLL on the reading comprehension of Iranian elementary learners. On the other hand, since the data obtained from the PBLL group were normally distributed for both the pre-test and post-test, a parametric test, specifically the Paired Samples t-Test, was conducted.

Table 7: Wilcoxon Related Samples Test Results Comparing Pre-Test and Post-Test Scores in DDLL

Total N	16
Test Statistic	136.000
Standard Error	19.258
Standardized Test Statistic	3.531
Asymptotic Sig. (2-sided test)	.000

Table 8: Descriptive Statistics for PBLL Pre-Test and Post-Test Scores

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Post-Test PBLL	16.13	16	2.680	.670
	Pre-Test PBLL	15.31	16	1.852	.463

Table 9: Paired Samples Test Results for PBLL Group (Pre-test and Post-test)

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Post-Test PBLL - Pre-Test PBLL	.813	1.559	.390	-.018	1.643	2.085	15	.055

The results of the Related-Samples Wilcoxon Signed-Rank Test (Table 7) indicate a significant enhancement in the reading comprehension skills of Iranian Elementary EFL learners following the DDLL intervention. With a total sample size of 16, the test statistic is 136.000, and the standardized test statistic is 3.531. The asymptotic significance (2-sided) is .000, which is below the conventional alpha level of 0.05, suggesting that the improvement in reading comprehension skills is statistically significant. Therefore, the null hypothesis is rejected to conclude that DDLL significantly enhances the reading comprehension skills of the learners in this study.

The results of the Paired Samples Test for the PBLL group (Tables 8 and 9) indicate a mean increase of 0.813 in reading comprehension scores from the pre-test to the post-test, with a standard deviation of 1.559 and a standard error mean of 0.390. The 95% confidence interval for the difference ranges from -0.018 to 1.643, and the t-value is 2.085 with 15 degrees of freedom. The significance level (2-tailed) is 0.055, which is slightly above the conventional alpha level of 0.05. Therefore, the null hypothesis is confirmed, and the answer to Research Question 2 (RQ2) is negative, as there is insufficient statistical evidence to conclude that PBLL significantly improves the reading comprehension skills of Iranian Elementary EFL learners. However, the proximity of the p-value to the threshold suggests a potential trend towards significance, warranting further research with a larger sample size or different conditions.

Testing the Third Hypothesis

To address the third research question, "RQ3: Is there a significant difference in post-test reading comprehension scores between the DDLL and PBLL groups among Iranian Elementary EFL learners?" a relevant null hypothesis was formulated. In this case, the null hypothesis posited that there is no significant difference in post-test reading comprehension scores between the two groups. A non-parametric inferential statistical test, specifically the Mann-Whitney U Test, was employed to assess this hypothesis. This test was chosen because it is well-suited for comparing two independent groups when their data does not adhere to the assumptions of normality, as observed in the post-test scores for the DDLL group. Thus, the Mann-Whitney U Test provided an appropriate method for evaluating the potential differences between groups under these conditions.

Table 10: Ranks of Post-Test Scores for DDLL and PBLL Groups

Ranks				
	DDLL vs. PBLL	**N**	**Mean Rank**	**Sum of Ranks**
Post-Test	DDLL	16	21.31	341.00
	PBLL	16	11.69	187.00
	Total	32		

Table 11: Mann-Whitney U Test Statistics for Post-Test Scores Comparison Between DDLL and PBLL Groups

Test statistics	
	Post-Test
Mann-Whitney U	51.000
Wilcoxon W	187.000
Z	-2.958
Asymp. Sig. (2-tailed)	.003
Exact Sig. [2*(1-tailed Sig.)]	.003b

a. Grouping Variable: DDLL vs. PBLL
b. Not corrected for ties.

The analysis of the post-test scores for the DDLL and PBLL groups, as detailed in Tables 10 and 11, provides a definitive answer to the third research question. The results of the Mann-Whitney U Test demonstrate a significant difference between the two groups. Specifically, the DDLL group achieved a higher mean rank of 21.31 compared to the 11.69 mean rank of the PBLL group. The test yielded a Mann-Whitney U value of 51.000 and a Z-score of -2.958. The asymptotic significance (2-tailed) was calculated to be 0.003, which is notably below the conventional alpha threshold of 0.05, indicating a statistically significant difference in reading comprehension scores favoring the DDLL group. Consequently, the null hypothesis, which posited no significant difference in post-test reading comprehension scores between the groups, is rejected. This outcome suggests that the DDLL approach significantly outperformed the PBLL approach, effectively enhancing the reading comprehension skills of Iranian Elementary EFL learners.

5. DISCUSSION AND CONCLUSION

The findings of this study reveal a significant impact of the DDLL method on enhancing reading comprehension skills among Iranian elementary EFL learners, while the PBLL method did not show a statistically significant effect. This outcome suggests that DDLL may be more effective in this context, but the unexpected lack of significant results for PBLL warrants further exploration.

The literature review highlighted the effectiveness of both PBLL and DDLL in enhancing reading comprehension among EFL learners. Studies such as those by Alan and Stoller (2005) and Beckett (2002) have demonstrated the efficacy of PBLL in promoting active engagement and improving language skills through real-world tasks. Similarly, research by Lenko-Szymanska and Boulton (2015) and Corino and Onesti (2019) has shown that DDLL can significantly enhance language acquisition by allowing learners to interact with authentic linguistic data. However, the current study's findings diverge from these established results, particularly concerning PBLL. The neutral effect observed with the PBLL approach, despite using the same materials and time span as the DDLL group, is counterintuitive. This discrepancy challenges the findings of previous studies that have demonstrated the effectiveness of PBLL in language learning (Alan & Stoller, 2005; Beckett, 2002; Fang & Warschauer, 2004; Laverick, 2018; Lessard-Clouston, 2016).

Several factors could explain this anomaly, including the small sample size, which may have limited the statistical power of the study, and more specifically, the short duration of the intervention, which might not have been sufficient for participants to fully develop the skills targeted by PBLL. Additionally, the quality of instruction and the instructors' professionality in PBLL could have influenced the outcomes, suggesting a need for further investigation into these variables. Moreover, this result aligns with Cao (2024), who emphasized that PBLL might significantly enhance self-regulated learning rather than immediate reading comprehension, indicating the possibility that the benefits of PBLL manifest through longer-term skills development rather than immediate performance.

The significant improvement in reading comprehension skills observed in the DDLL group not only aligns with previous studies (Barabadi & Khajavi, 2017; Corino & Onesti, 2019; Crosthwaite & Baisa, 2023; Johns, 1991; Lenko-Szymanska & Boulton, 2015) but also resonates with the findings of Boulton . Boulton's investigation demonstrated that lower-intermediate English learners could benefit from DDLL. In agreement with Boulton's (2008) findings, this study supports the notion that DDLL's emphasis on linguistic data and pattern recognition can lead to significant gains in language proficiency, even among learners with lower levels of proficiency. However, acknowledging the limitations of this study, such as the small sample size and the brief duration of the intervention, these promising results should be considered preliminary. Future research should aim to replicate these findings using larger sample sizes and extended intervention periods to further substantiate the efficacy of DDLL in enhancing reading comprehension.

While the literature broadly supports both PBLL and DDLL as effective methodologies, this study highlights a nuanced perspective on their impacts. The lack of significant improvement in the PBLL group might suggest, in line with aligns with Cao's (2024) findings, that the method's success largely depends on specific contextual factors, including the duration of the intervention, the nature of tasks, and learners' previous exposure to project-based learning. Moreover, the participants' low proficiency level, being elementary learners, might have affected their engagement and performance in PBLL activities, leading to divergent outcomes from DDLL. These speculations warrant further investigation in future studies to deepen our understanding of the complex interplay between these factors.

Conversely, the success of DDLL observed in this study underscores its adaptability and immediate applicability. As supported by Flowerdew (2024), integrating DDLL with contemporary language analysis tools can enhance educational benefits by equipping learners with the ability to effectively dissect and apply language patterns. This study contributes to the broader discourse on language learning methodologies by showcasing DDLL's potential in EFL contexts and prompting an examination of the conditions that optimize PBLL's effectiveness. Continued research is essential to explore these dynamics and establish the ideal parameters for the successful implementation of each approach, ensuring that both DDLL and PBLL can be leveraged effectively to support EFL learners.

Conclusive Implications and Suggestions for Further Studies

The study encountered several limitations, such as a small sample size and time constraints, which limited the study's duration and prevented random sampling. Many participants were students with part-time jobs, reducing their availability and necessitating a shorter intervention period, potentially affecting the outcomes. Despite these challenges, the study highlights the practical utility of the LDOCE as a user-friendly, data-driven tool in EFL settings. The findings indicate that even lower-level EFL learners can benefit from DDLL approaches.

However, to draw more robust conclusions, future research should replicate this study with larger sample sizes and extended intervention periods to enhance the reliability of the findings. Additionally, exploring the effects of DDLL and PBLL on learners with higher proficiency levels could provide valuable insights. Investigating the immediate impacts of individual projects or data-driven exploration strategies could also be a fruitful area for future research. Moreover, incorporating findings from Crosthwaite and Baisa (2023) and Flowerdew (2024), future explorations into integrating DDLL with AI technologies could offer a pathway to further refine and enhance educational practices within EFL programs, effectively blending traditional and modern methodologies for optimal learning outcomes.

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In sweet memory of Mohsen Sheikhveisi, the first author of this paper, who unfortunately passed away at a very young age before this paper was published.

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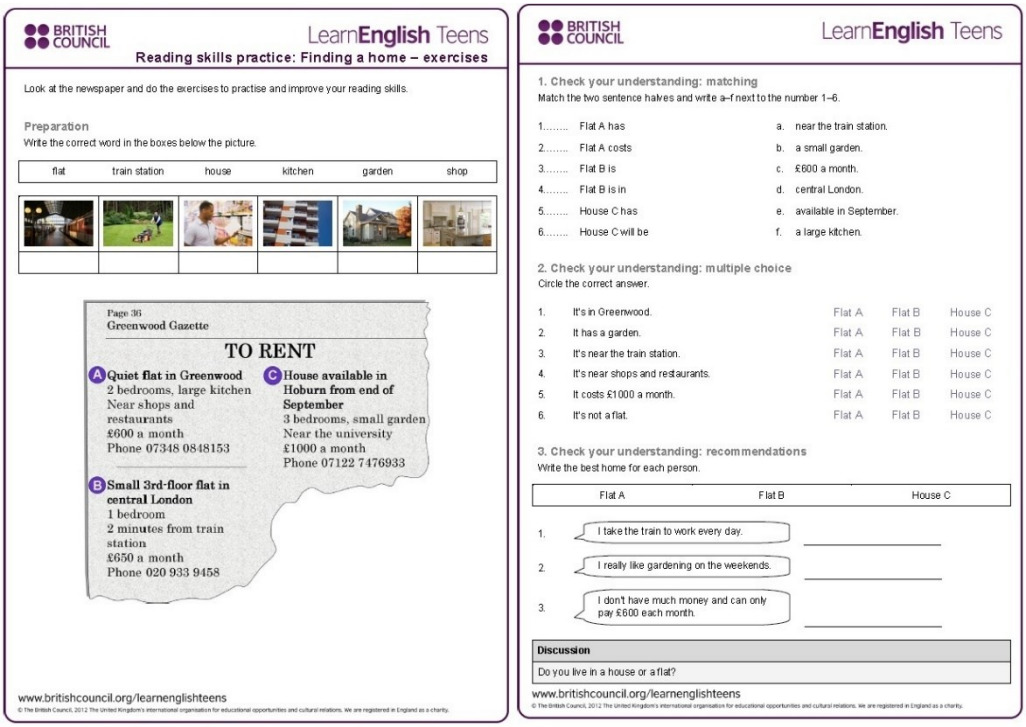
Appendices

Appendix A: Pre-test



BRITISH COUNCIL LearnEnglish Teens

Reading skills practice: Finding a home – exercises

Look at the newspaper and do the exercises to practise and improve your reading skills.

Preparation

Write the correct word in the boxes below the picture.

flat	train station	house	kitchen	garden	shop

Page 36
Greenwood Gazette

TO RENT

A Quiet flat in Greenwood
2 bedrooms, large kitchen
Near shops and restaurants
£600 a month
Phone 07348 0848153

B Small 3rd-floor flat in central London
1 bedroom
2 minutes from train station
£650 a month
Phone 020 933 9458

C House available in Hoburn from end of September
3 bedrooms, small garden
Near the university
£1000 a month
Phone 07122 7476933

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BRITISH COUNCIL LearnEnglish Teens

1. Check your understanding: matching

Match the two sentence halves and write a–f next to the number 1–6.

1.....	Flat A has	a.	near the train station.
2.....	Flat A costs	b.	a small garden.
3.....	Flat B is	c.	£600 a month.
4.....	Flat B is in	d.	central London.
5.....	House C has	e.	available in September.
6.....	House C will be	f.	a large kitchen.

2. Check your understanding: multiple choice

Circle the correct answer.

1.	It's in Greenwood.	Flat A	Flat B	House C
2.	It has a garden.	Flat A	Flat B	House C
3.	It's near the train station.	Flat A	Flat B	House C
4.	It's near shops and restaurants.	Flat A	Flat B	House C
5.	It costs £1000 a month.	Flat A	Flat B	House C
6.	It's not a flat.	Flat A	Flat B	House C

3. Check your understanding: recommendations

Write the best home for each person.

	Flat A	Flat B	House C
1.	I take the train to work every day.		
2.	I really like gardening on the weekends.		
3.	I don't have much money and can only pay £600 each month.		

Discussion

Do you live in a house or a flat?

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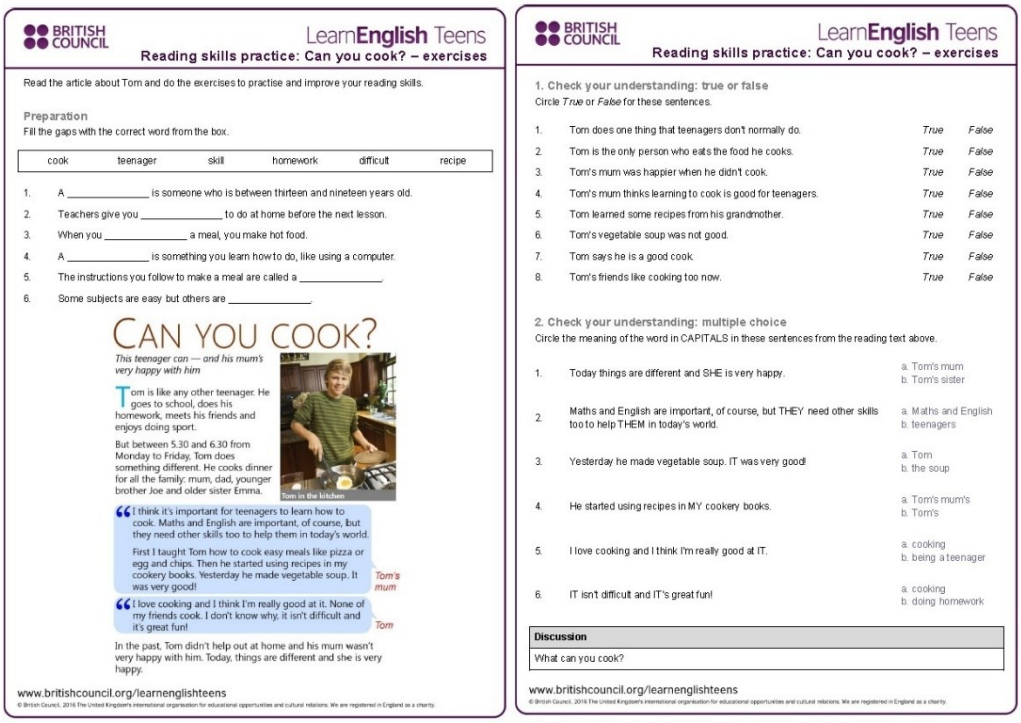
Appendix B: Post-test



BRITISH COUNCIL LearnEnglish Teens
Reading skills practice: Can you cook? – exercises

Read the article about Tom and do the exercises to practise and improve your reading skills.

Preparation
Fill the gaps with the correct word from the box.

cook	teenager	skill	homework	difficult	recipe

1. A _____ is someone who is between thirteen and nineteen years old.
2. Teachers give you _____ to do at home before the next lesson.
3. When you _____ a meal, you make hot food.
4. A _____ is something you learn how to do, like using a computer.
5. The instructions you follow to make a meal are called a _____.
6. Some subjects are easy but others are _____.

CAN YOU COOK?

This teenager can — and his mum's very happy with him

Tom is like any other teenager. He goes to school, does his homework, meets his friends and enjoys doing sport.

But between 5.30 and 6.30 from Monday to Friday, Tom does something different. He cooks dinner for all the family: mum, dad, younger brother Joe and older sister Emma.

Tom in the kitchen

"I think it's important for teenagers to learn how to cook. Maths and English are important, of course, but they need other skills too to help them in today's world.

First I taught Tom how to cook easy meals like pizza or egg and chips. Then he started using recipes in my cookery books. Yesterday he made vegetable soup. It was very good!" *Tom's mum*

"I love cooking and I think I'm really good at it. None of my friends cook. I don't know why, it isn't difficult and it's great fun!" *Tom*

In the past, Tom didn't help out at home and his mum wasn't very happy with him. Today, things are different and she is very happy.

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BRITISH COUNCIL LearnEnglish Teens
Reading skills practice: Can you cook? – exercises

1. Check your understanding: true or false
Circle *True* or *False* for these sentences.

1.	Tom does one thing that teenagers don't normally do.	*True*	*False*
2.	Tom is the only person who eats the food he cooks.	*True*	*False*
3.	Tom's mum was happier when he didn't cook.	*True*	*False*
4.	Tom's mum thinks learning to cook is good for teenagers.	*True*	*False*
5.	Tom learned some recipes from his grandmother.	*True*	*False*
6.	Tom's vegetable soup was not good.	*True*	*False*
7.	Tom says he is a good cook.	*True*	*False*
8.	Tom's friends like cooking too now.	*True*	*False*

2. Check your understanding: multiple choice
Circle the meaning of the word in CAPITALS in these sentences from the reading text above.

1.	Today things are different and SHE is very happy.	a. Tom's mum b. Tom's sister
2.	Maths and English are important, of course, but THEY need other skills too to help THEM in today's world.	a. Maths and English b. teenagers
3.	Yesterday he made vegetable soup. IT was very good!	a. Tom b. the soup
4.	He started using recipes in MY cookery books.	a. Tom's mum's b. Tom's
5.	I love cooking and I think I'm really good at IT.	a. cooking b. being a teenager
6.	IT isn't difficult and IT's great fun!	a. cooking b. doing homework

Discussion
What can you cook?

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Appendix C: Examples of the T-Chart concept map

T-chart 1

Days with the same opening and closing time	Day with different opening and closing time
Example: Monday 9:00 to 17:00 Tuesday 9:00 to 17:00	Sunday: CLOSED

T-Chart 2

Allowed (✓)	Not Allowed (X)
Example: Borrowing 3 books	Talking on the phone

Appendix D: Examples of timeline and graphic concept map

Timeline

2006	She moved to Los Angeles.
2007	……?……..
……?….	……?……..

Graphic concept maps