Applied Research on English Language

V. 14 N. 3 2025
pp: 53-76
http:// are.ui.ac.ir

DOI: 10.22108/are.2025.144783.2482
Document Type: Research Article

Addressing Challenges of L2 Grammar Learning with a Focus on English Relative Clauses: AI-supported Language Learning

Fatemeh Etaat *

Department of Languages and Culture, UiT Arctic University, Norway

Received: 2025/03/27 **Accepted: 2025/05/31**

Abstract: The present study investigates the challenges of learning English grammar with a focus on the syntactic analysis of relative clauses (RCs) in Persian in contrast to English to identify the most common errors made by Persian learners of English. In addition, it aims to enhance L2 grammar learning and overcome challenges using AI-assisted tools such as Wordtune, Instatext, and ChatGPT in classroom activities. The quantitative data were collected through the RC tests adapted from the models used by Izumi (2003), comprising three test types: sentence combination, interpretation, and grammaticality judgment. These tests were administered before and after the implementation of AI-powered strategies. The result of the tests in intermediate learners revealed that the most recurrent interlingual error was "the use of object pronouns" instead of gaps, while the challenges in "RC reduction" were among the most common intralingual errors. The findings highlight not only the major differences in RC structures between the two languages but also present an innovative approach that uses AI to address these challenges, offering insights for teachers and instructors. Addressing such errors and utilizing technological advances can pave the way for learners and teachers to have more effective learning and teaching strategies.

Keywords: Artificial intelligence, Syntax, Relative clauses, AI-Assisted language learning.

* **Corresponding Author.**

Authors' Email Address:
Fatemeh Etaat (fatemeh.etaat@gmail.com)

2322-5343 © University of Isfahan
This is an open access article under the CC BY-NC-ND/4.0/ License (https://creativecommons.org/licenses/by-nc-nd/4.0/).

Introduction

In recent years, researchers have increasingly focused on accelerating the process of second language (L2) learning and minimizing the learners' errors. Several studies have addressed the challenges faced by multilingual learners of English and emphasized how teaching strategies and tailored instructions can significantly influence their success (Peercy et al., 2024; Foster et al., 2023). According to Yarmohamadi and Rashidi (2009), theoretical contrastive findings serve as the foundation for pedagogical contrastive research by offering a systematic framework for comparing the structures of two languages. Awareness of L2 differences and similarities, especially for adult learners, can facilitate more effective language learning. Theoretical contrastive analysis accounts for similarities and differences between two languages and provides models for their comparison (Fisiak, 1981). By anticipating the common areas of difficulty through contrastive analysis, educators can design more effective and targeted L2 instructional materials (Zitha & Nendauni, 2025; Michel et al., 2025).

Serving multiple aims, the introduction of technological advances like Artificial Intelligence (AI) has become widely used in the language learning process to enhance learning. Applications of AI in education (AIEd) in four domains of teaching, learning, assessment, and administration are new to most teachers, researchers, and practitioners (Chiu et al., 2023). Considering the background studies, the integration of technology into language learning has presented several functions more or less: accelerating the process of learning (Rodinadze & Zarbazoia, 2012); enhancing students' social interactions, motivations, and engagement (Godzicki et al., 2013); increasing cooperation between teachers and learners as a result of higher confidence (Mouza, 2008); increasing exposure to a meaningful authentic language (Zhao, 2013); and raising learners' responsibilities (Drayton et al., 2010). In this regard, the integration of technology, especially AI in the language learning process, can lead to a more effective and vibrant classroom in which learners can meet their needs and overcome the potential challenges more efficiently compared to traditional teacher-centered coursebook-based environments.

Learning relative clauses (RCs) in English causes several challenges for Persian learners. English RCs contain relative pronouns like who, which, what, and why, having two roles: connective and pronoun. However, Persian RCs have the particle "*ke*" that has a connective role. RCs in Persian can be defined as a sentence that modifies an antecedent within another sentence and can either immediately follow its antecedent or be outside of the domain of the main sentence.

Identifying the most recurrent errors and studying the roots of them are essential while attempting to overcome these challenges in innovative and engaging ways is equally important. Although RCs have been the focus of previous studies (Taghavipour, 2005), there is a lack of sufficient classroom-based research focused on learner errors, particularly studies that explore practical strategies for addressing these challenges. Since such RC differences cause challenges for Persian learners in English classes, the present study aims to help reduce the errors of L2 learners by investigating the differences and similarities of RCs between the two languages in detail, along with utilizing AI-assisted language practices to tackle such challenges. It is aimed to first identify the most recurrent errors relating to English RC learning to help the learners improve by raising awareness of the syntactic features of L2 and providing more exposure to it through AI-assisted language learning tools. Therefore, the following two research questions are presented:

1. What are the syntactic similarities and differences between RCs in English and Persian? How do these influence the common errors made by Persian L2 learners?
2. How can AI-assisted tools support Persian L2 learners in addressing the challenges related to English RCs?

Research Background

The implementation of AI in language education represents a significant and innovative shift for both teachers and learners. As AI technologies increasingly permeate educational contexts, their potential to personalize instructions, enhance engagement, and support skill acquisition has drawn growing interest from researchers and practitioners (Mahmoud & Sørensen, 2024; Alam & Mohanty, 2023). Within the domain of AI in education (AIED), three progressive models have been proposed by Ouyang and Jiao (2021): AI-directed (learner as recipient), AI-supported (learner as collaborator), and AI-empowered (learner as leader).

In AI-directed learning, the learner is positioned as a recipient of AI-driven content and guidance. This includes exposure to automated instructions, personalized learning pathways, adaptive feedback, and interactions with intelligent virtual assistants (Sajja et al., 2024). AI-supported learning frameworks shift the learners' role to that of a collaborator, where AI tools act as cognitive partners to assist learners in developing creativity, reasoning, critical thinking, and problem-solving skills. The AI-empowered learning stage emphasizes autonomy, positioning the learner as an active agent who leverages AI tools for self-directed

learning. In this framework, learners take the initiative in setting goals, monitoring progress, and tailoring resources to meet their needs (Beta, 2022).

In a review by Chiu et al. (2023), the role of AI in the educational context has been categorized into four domains of learning, teaching, administration, and assessment, which are depicted as follows in Figure 1.

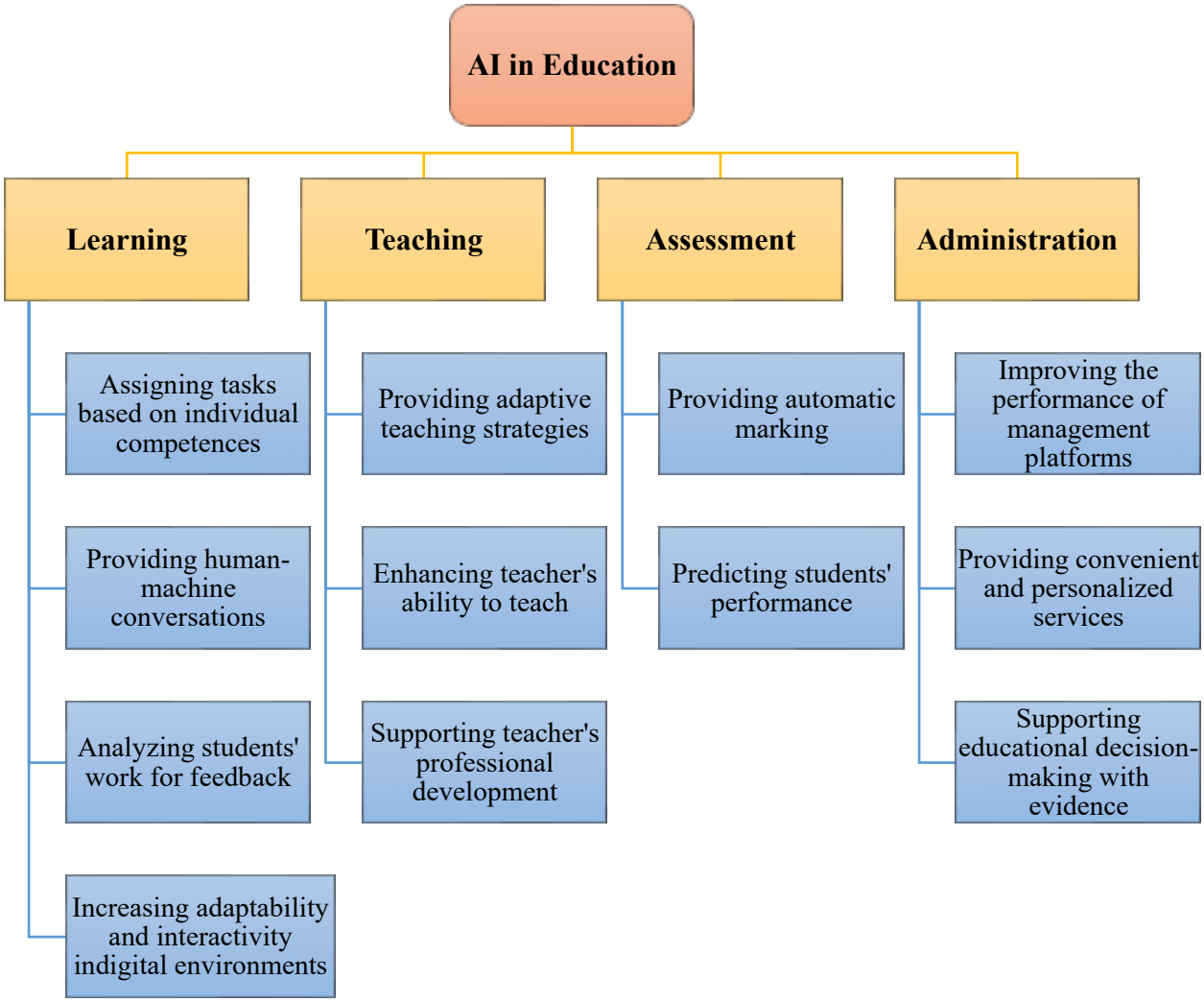

Figure 1. The Roles and Outcomes of AI in Education

Based on the figure, in the learning domain, AI supports personalized task assignment, feedback analysis, and interactive digital environments. In teaching, it aids adaptive strategies, teacher support, and professional development. The ultimate aim of intelligent teaching is to provide learners with instructional materials that best serve learners' needs (Bellod et al., 2021). AI-assisted tools are adapted in educational contexts, particularly in language learning environments, to overcome challenges and enhance the learning of

different language skills (Etaat, 2024). Moreover, based on previous research, the application of AI in classrooms has positively affected classroom management for the teachers (Huang et al., 2021) and new methods of the learners' progress assessments (Etaat, 2025).

Rooted in the principles of behavioristic and structuralist approaches, this perspective maintains that the structural differences between languages, particularly in syntax and phonology, can lead to systematic errors in L2 production and comprehension (McClellan, 2024; Gass et al., 2020; Brown, 2006). In other words, the influence of the first language on the second language is highlighted when it comes to language differences, such as syntactic patterns and phonological rules, which cause errors in language production. Errors made by L2 learners are generally classified into two types: interlingual and intralingual errors (Lightbown & Spada, 2021). Interlingual errors arise from negative transfer when L1 rules interfere with L2 acquisition. In contrast, intralingual errors originate within the L2 itself and reflect the learners' internal developmental processes, such as overgeneralizations (Wood, 2017).

Understanding and analyzing both types of errors is crucial in identifying the learners' needs and improving pedagogical strategies. Recent pedagogical frameworks emphasize data-informed teaching and adaptive instruction to address error patterns and learning difficulties more effectively (Kissova, 2020). In addition, integrating AI into classroom instructions can offer personalized feedback, automatic error correction, and inclusive learning (Umar, 2024).

In sum, identifying the nature and source of learners' errors, specifically in syntactically complex areas such as RCs, remains an essential step in the L2 learning process. It enables educators to design more efficient instructional materials and incorporate modern technological supports to address the specific learners' difficulties. The following sections provide an overview of RCs' syntactic features in English and Persian, laying the groundwork for a deeper understanding of the challenges faced by Persian-speaking English learners.

Syntactic Features of Persian RCs

Persian RCs use the particle "ke", functioning similarly to English "that" but without acting like a pronoun. See the following examples:

1. *a) Sara be madrese**i ke** nazdike khane bood miraft.*

   Sara to school that near home was going [3rd.sg].

   'Sara was going to the school which was near home.'

*b) Sara be **än** madrese **ke** nazdike khane bood miraft*

Sara to that school that near home was going [3rd.sg].

'Sara was going to that school which was near home.'

In (1a), the noun "*madrese*" is changed to "*madresei*", since the indefinite nouns are followed by an indefinite article (i /i:/) which is added to the end of the noun and may be preceded by the morpheme 'yek' (=a, an, one). However, definite nouns are either unmarked or marked with the definite determiner 'än' (=that or the), which precedes a noun, as in (1b). In addition, Persian allows RC extraposition to be influenced by verb class, grammatical weight, and definiteness (Rasekh-Mahand et al., 2016).

In Persian, restrictive and nonrestrictive RCs differ by punctuation and specificity. Restrictive RCs may follow definite or indefinite nouns and affect noun morphology. In addition, in restrictive RCs, the indefinite subject takes the relative particle (i /i:/) at the end of the antecedent. The following examples present both types of restrictive RCs:

2. a) *ketabe jadidi **ke kharidam** geran bood.*

Book new that bought [1st.sg] expensive was.

'The new book that I bought was expensive.'

b) *ketabe jadidi kharidam, **ke geran bood**.*

Book new bought [1st.sg], that expensive was.

'The new book that I bought was expensive.'

Dahlén (2010) mentions that if the head noun is specific and functions as the direct object of the main clause, an object marker (OM), 'rā', can be applied. See example 3.

3. *An filmi **ra ke** kheyli doust dashtam didam.*

That film OM that very like had [1st.sg] saw [1st.sg].

'I saw the film that I liked.'

Nonrestrictive RCs always follow definite nouns, are made by commas, and cannot be extraposed. See example 4.

4. *Madare Elena, **ke** besiar mehraban ast, moaleme zabane englisi ast.*

Mother Elena, that very kind is, teacher language English is.

'Elena's mother, who is very kind, is an English teacher.'

Persian also allows free RCs, often introduced by demonstrative determiner 'har' (=every, any) before a place, time, a person, or a thing, with the optional use of "ke" (Taghvaipour, 2005). See the example below.

5. ***Harjai ke** u raft ziba bood.*

Wherever that he/she went [3rd.sg] beautiful was.

'Wherever he went was beautiful.'

In another type, if the matrix sentence contains a nominal predicate, the relative clause occurs outside of the matrix sentence. For example:

6. *To haman kasi hasti **ke** man mishenasam.*

You same person are that I know [1st.sg].

'You are the same person who I know.'

Persian RCs can include gaps or resumptive pronouns (RPs). Their usage depends on the clause type and grammatical role, with RPs more common in nonrestrictive clauses, especially when the relativized position is a direct object. Table 1 shows the distribution of gaps and RP in Persian RCs (Taghvaipour, 2004):

Table 1. Distribution of Gaps and RP

RCs		Subject	Object of prep.	Genitive	Direct object
Restrictive	Gap is allowed	yes	no	no	yes
	RP is allowed	no	yes	yes	yes
Nonrestrictive	Gap is allowed	yes	no	no	no
	RP is allowed	no	yes	yes	yes

Syntactic Features of English RCs

RCs in English have been the focus of some recent research from a multifunctional perspective to reveal their distinct features (Liao & Chang, 2024). English RCs use pronouns such as who, which, and that, with clear distinctions between restrictive (essential, no commas) and nonrestrictive (additional, comma-separated) clauses. See the examples below.

1. a) The book **which** I borrowed from the library was readable.

b) The book, **which** I borrowed from the library, was readable.

Whom and *which* are used when a preposition is fronted, as presented in the examples below.

2. a) The people **to whom** you were talking were not listening at all.

b) The book **about which** they talked in the meeting was a novel.

When *that* is not the subject of the RC (3), it is optional to use, otherwise, it is mandatory (4). See the following examples.

3. a) The book **that** I bought for my friend was very expensive.

b) The book I bought for my friend was very expensive.

4. The book **that** was bought for my friend was very expensive.

When the antecedent has a possessive role in the RC, *whose* is used. For example:

5. The teacher **whose** class was inspiring for the students was awarded.

Free RCs have no explicit antecedent, but they play the role of an argument in the main clause and are formed with *whatever, wherever,* etc, as follows.

6. **Whatever** you decide, I will follow.
7. **Wherever** he was going, people gathered around him and took photos.

Contrastive Analysis of RCs in Persian Vs. English

While Persian "ke" is multifunctional, English uses distinct wh-words, and that is the case for RCs. The Persian particle "ke" can grammatically function as a complementizer, a relative pronoun, a conjunction meaning when, a conjunction meaning because, and a focus marker. English wh-words that can appear in the RCs appear in question forms and embedded sentences too, which is missed in Persian.

Unlike English, Persian RCs do not contain overt relative pronouns and cannot be omitted through reduction. Additionally, resumption pronouns are more prevalent in Persian, whereas English relies heavily on gaps. Persian RCs also allow unbounded dependencies and more flexible clause positioning.

Understanding these syntactic contrasts is crucial for identifying the learners' common errors and developing effective instructional strategies. Observing the L2 learners' RC production can help address the challenges and enhance language learning outcomes.

Methodology

To address the objectives of this study, a mixed-methods research design was adopted, combining both qualitative and quantitative approaches. The qualitative aspect involved a contrastive syntactic analysis of RCs in Persian and English, supported by the provided examples. The quantitative aspect focused on identifying the learners' errors in English RC production and assessing the impacts of AI-assisted learning tools on their performance. Data were collected through a structured Pre-test and a post-test concerning English RCs, administered in a language academy in Iran. The overall design of the quantitative approach is presented in Figure 2 as follows.

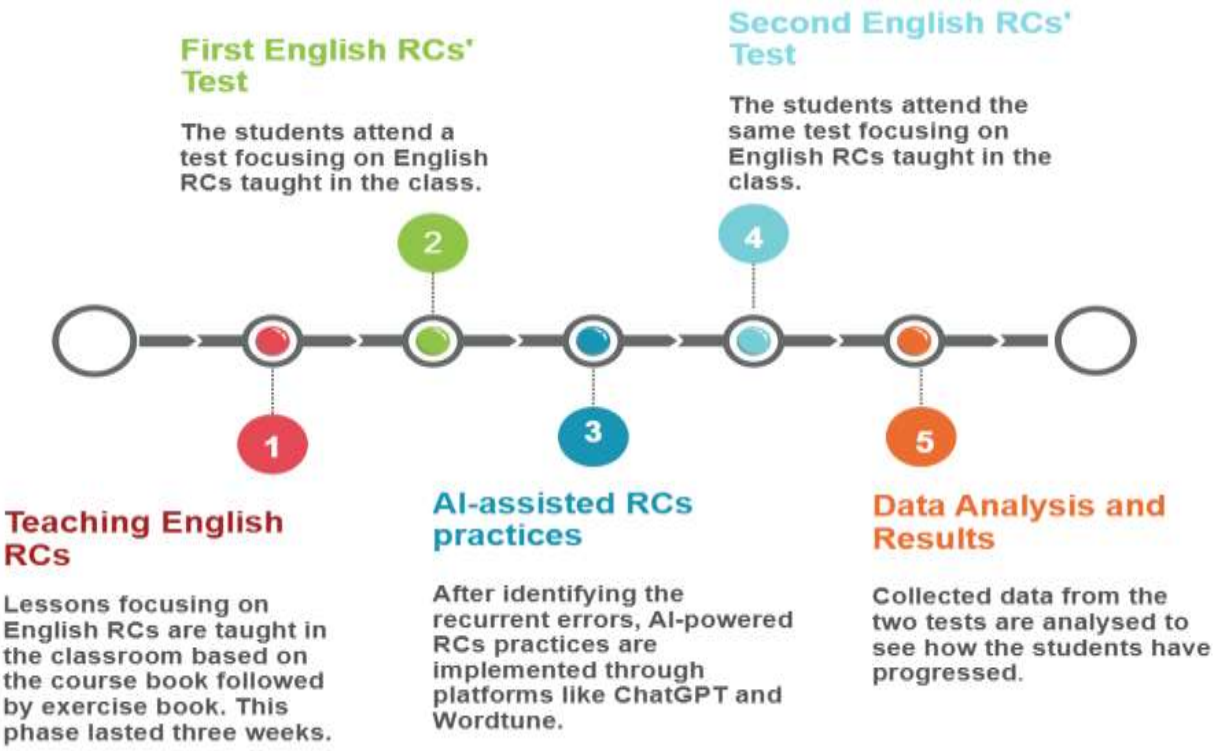

Figure 2. The Overall Design of the Research

After three weeks of instructions on English RCs, the learners completed a Pre-test assessing various aspects of RC production and comprehension. Based on the most frequent errors identified, a three-week AI-assisted intervention followed, incorporating tools such as ChatGPT, Wordtune, and InstaText. The learners engaged in both individual and group activities generated by or in collaboration with AI. A post-test, equivalent in format to the Pre-test, was then administered to measure improvement.

Participants

The participants of this study were 30 intermediate-level Persian learners of English, enrolled in the Safir language academy. All participants had previously completed the institution's internal proficiency assessment and were classified as intermediate level.

Materials and Tests

The primary instructional material used in this study was the English course book "*Touchstone 3"*, Unit 7, which introduces and practices English RCs. After teaching English RCs, to evaluate the learners' comprehension and production of RCs, a Pre-test and a post-test were administered. These tests were adapted from Izumi (2003) and were designed to

comprehensively assess both receptive and productive knowledge of RCs (see appendix). Each test consisted of 70 items and incorporated three distinct task types:

1. Grammaticality Judgment Task: The learners judged whether the given sentences were grammatically correct. The aim of this task was to evaluate the learners' ability to identify both interlingual and intralingual errors.
2. Sentence Completion Task: The learners combined two simple sentences into a complex sentence using appropriate relative clauses. This task assessed the syntactic competence and contextual usage.
3. Interpretation Task: The learners selected paraphrases for sentences containing relative clauses, measuring comprehension of RC structures, including restrictive or nonrestrictive types.

Test items were distributed across seven key RC features (Table 2), each feature contributing a maximum of 10 points, for a total of 70 points per test. The RC features were selected based on instructional relevance and frequency of use. All test items were reviewed and validated by two experienced EFL instructors to ensure clarity, level adaptations, and pedagogical alignments.

Table 2. The Key Features of RCs and Score Distributions

Questions	Scores
1. Use of Relative Pronouns	0-10
2. Use of Commas	0-10
3. Use of Object Pronouns/gaps	0-10
4. RC Reduction	0-10
5. Restrictive RCs	0-10
6. Nonrestrictive RCs	0-10
7. Free RCs	0-10

AI-assisted Tools

Following the Pre-test, the participants engaged in an intervention using AI-assisted learning tools aimed at improving their understanding and use of English RCs. The tools used were *ChatGPT* (a generative AI), *Wordtune* (a collaborative AI), and *Instatext* (an evaluator AI), and their aims are as follows presented in Figure 3.

Figure 3. AI-Powered Platforms and Their Aims

ChatGPT was used for interactive grammar practice, clarification of RC rules, and sentence construction. Wordtune was used for rewriting learner-generated texts, providing contextual suggestions, and collaboration in writing practices. Instatext was used for editing and enhancing grammatical accuracy in the learners' writings.

Data Collection and Analysis

Data were collected using the Pre-test and post-test described in section 3.2. The learners' scores were recorded across the seven RC features, allowing for detailed analysis to identify the most frequent types of RC-related errors and to measure the degree of improvement in RC usage after AI-assisted intervention. Analysis of data was conducted using Mixed Linear Model Regression in Python and RStudio. The results are presented in the following section using tables and figures.

Results

The aims of the present study were to investigate the syntactic features of English and Persian RCs, to identify the recurrent errors of L2 learners when producing English RCs, and to evaluate the effectiveness of AI-assisted language learning to overcome such challenges. Regarding the first research question, a contrastive analysis of RCs in Persian and English in Section 2 revealed significant syntactic differences. A summary of the Pre-test and the post-test data, focusing on 7 factors, is presented in Table 3.

Table 3. Summary of the Data from the RC Pre-test and Post-test

		Pre-test			*Post-test*		
	Questions	*Mean*	*Median*	*SD*	*Mean*	*Median*	*SD*
1	RC Reduction	1.97	2	0.71	8.23	8	0.93
2	Use of Object Pronouns/gaps	2.53	2.5	1.18	8.3	8	1.02
3	Use of Commas	4.67	5	0.69	8.1	8	0.96
4	Use of Relative Pronouns	5.37	6	0.86	8.53	9	0.9
5	Nonrestrictive RCs	7.1	7	1.03	8.93	9	0.74
6	Restrictive RCs	7.17	7	0.91	8.43	8	0.62
7	Free RCs	7.7	8	0.86	8.63	8.5	0.89

The pre-test result revealed that the lowest scores belonged to RC reduction (mean=1.97) and the use of object pronouns or gaps (mean=2.53), indicating major problem areas. Conversely, the learners performed best on the questions related to free RCs (mean=7.70). In addition, the range and distribution of Pre-test scores related to each type of question are illustrated in Figure 4.

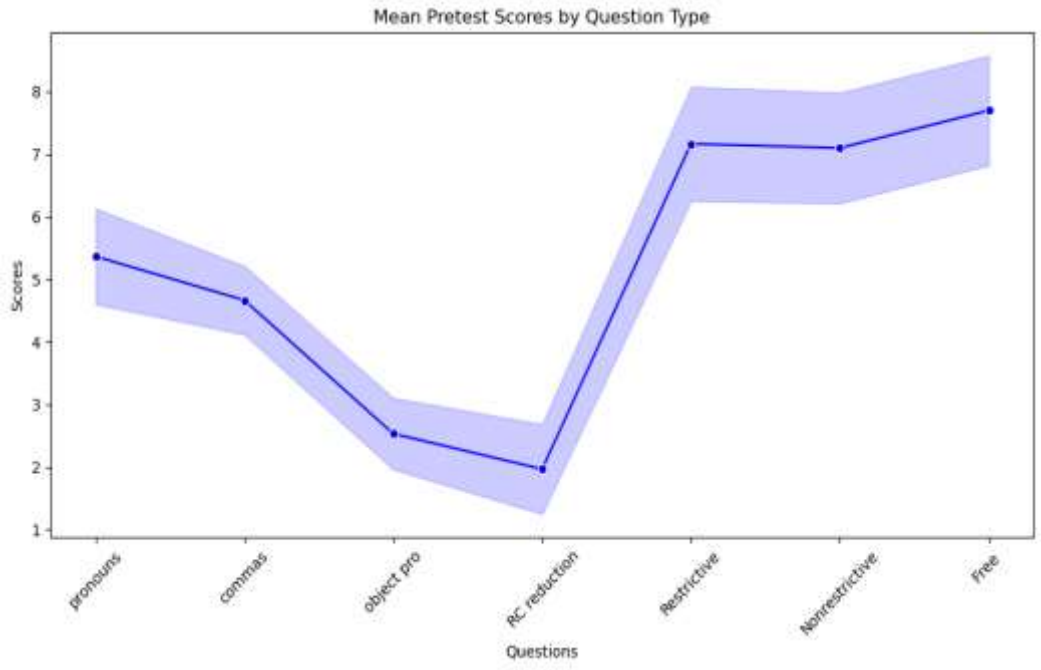

Figure 4. Scores Distribution Based on the Question Types in the Pre-test

To know whether the Pre-test scores were significantly different from each other and how each type of question influenced the scores compared to the reference category, here "RC reduction", a mixed linear model regression was run in Pre-test scores ("scores ~ questions", groups=df ["participants"], data=df), the result of which is presented in Table 4.

Table 4. Mixed Linear Model Regression Results of the Pre-test Scores

Model:	MixedLM	Dependent Variable	scores			
No. Observations	210	Method:	REML			
No. Groups:	30	Scale:	0.5039			
Min. group size:	7	Log-Likelihood:	-243.2616			
Max. group size:	7	Converged:	Yes			
Mean group size	7.0					
	Coef.	Std. Err.	z	P>|z|	[0.025	0.975]
Intercept	1.967	0.142	13.827	0.000	1.688	2.245
questions [T.Free]	5.733	0.183	31.282	0.000	5.374	6.093
questions [T.Nonrestrictive]	5.133	0.183	28.009	0.000	4.774	5.493
questions [T.Restrictive]	5.200	0.183	28.372	0.000	4.841	5.559
questions[T.commas]	2.700	0.183	14.732	0.000	2.341	3.059
questions [T.object pro]	0.576	0.183	3.092	0.002	0.207	0.926
questions [T.pronouns]	3.400	0.183	18.551	0.000	3.041	3.759
Group Var	0.103	0.089				

Based on the results of the mixed linear model regression, question types related to the use of object pronouns/gaps have the lowest coefficient (0.56) compared to the intercept, with a p-value of 0.02. All the other question types have a low p-value (<0.05), indicating that they are statistically significant. Figure 5 shows the estimated coefficients by question types.

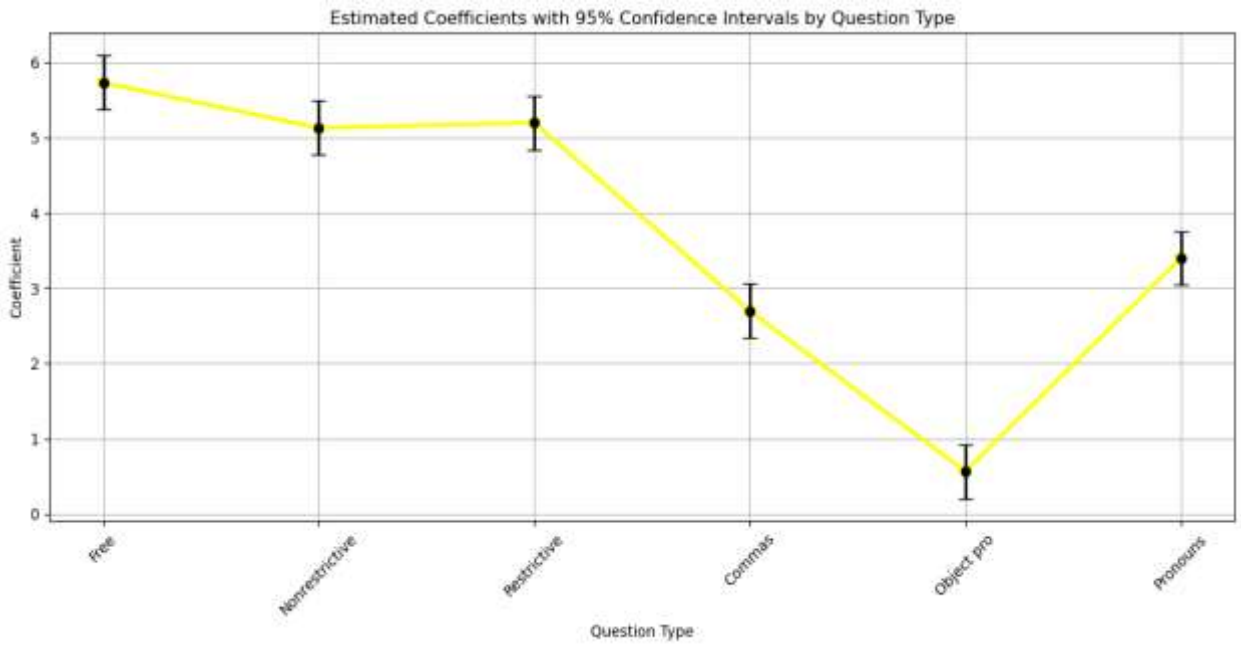

Figure 5. Estimated Coefficients with 95% Confidence Intervals by Question Type

Based on the result, regarding the first research question, the learners faced challenges in RCs, particularly in two types of questions: “use of object pronouns/gaps” and “RC reduction”, to which the lowest scores belong. The most recurrent errors refer to these features in English RCs, indicating that the learners faced the most challenges producing them.

Regarding the post-test, which was applied after the AI-assisted learning methodologies, concerning practices of RCs, Figure 6 illustrates the results.

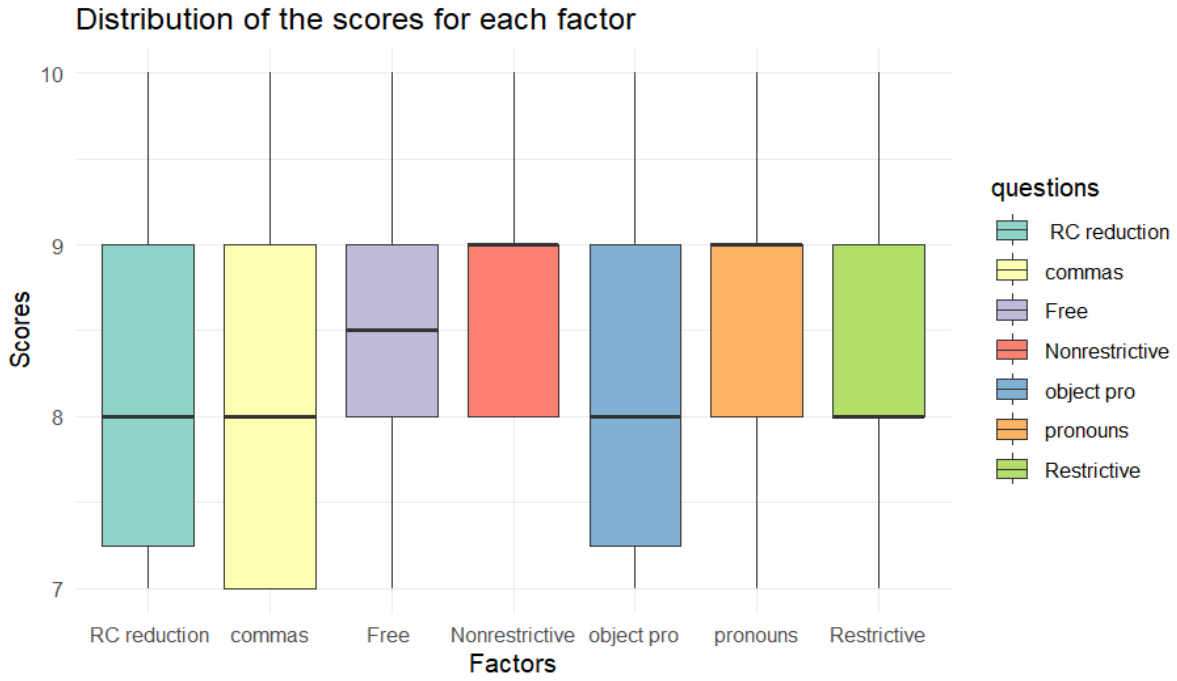

Figure 6. Distribution of the Scores in the Post-test

As shown, the scores have improved compared to the Pre-test, especially in the challenging areas. To know whether the scores have improved significantly in comparison to the Pre-test, a mixed-effect linear model was run in Python, the result of which is presented in Table 5.

Table 5. Mixed Linear Model Regression Results between the Pre-test and Post-test

Model	MixedLM	Dependent Variable	scores			
No. Observations	420	Method:	REML			
No. Groups:	30	Scale:	1.7726			
Min. group size:	14	Log-Likelihood:	-719.1795			
Max. group size:	14	Converged:	Yes			
Mean group size	14.0					
	Coef.	Std. Err.	z	P>|z|	[0.025	0.975]
Intercept	6.776	0.184	36.878	0.000	6.416	7.136
tests[T.Pre-test]	-3.352	0.130	-25.802	0.000	-3.607	-3.098
questions [T.Free]	3.067	0.243	12.616	0.000	2.590	3.543
questions[T.Nonrestrictive]	2.917	0.243	11.999	0.000	2.440	3.393
questions[T.Restrictive]	2.700	0.243	11.108	0.000	2.224	3.176
questions[T.commas]	1.283	0.243	5.280	0.000	0.807	1.760
questions[T.object pro]	0.717	0.243	2.948	0.003	0.240	1.193
questions[T.pronouns]	1.850	0.243	7.611	0.000	1.374	2.326
Group Var	0.000					

As seen, the negative coefficient of the test (-3.35) represents the difference in scores between the Pre-test and post-test, which indicates that the intervention was successful and made an improvement in the scores from the Pre-test to the post-test. In addition, as the p-value indicates, there is a significant improvement in the post-test scores in all question types, including the challenging parts (0.0<0.05). To be more specific, Figure 7 illustrates the learners' performance in the two tests, before and after AI applications.

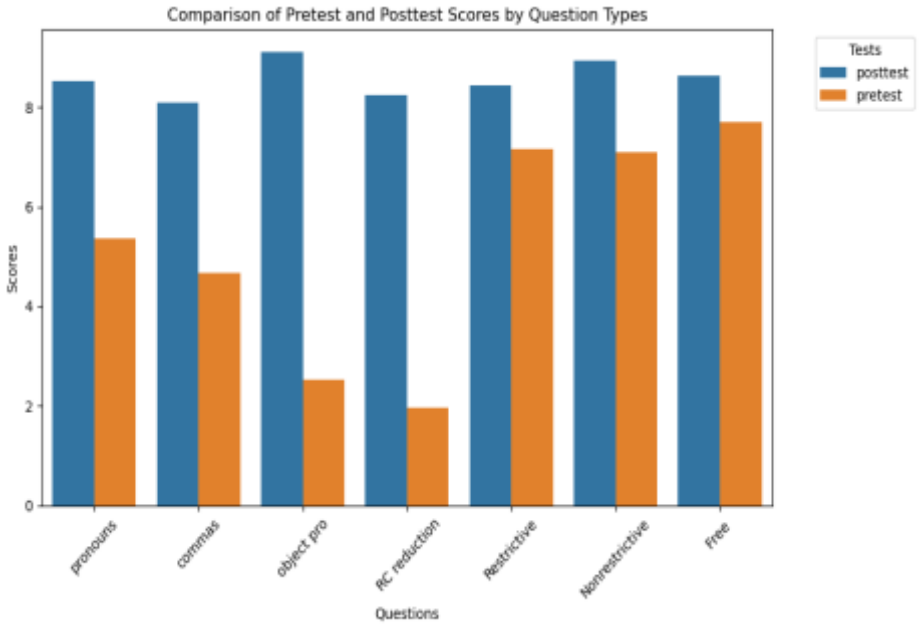

Figure 7. Comparison of the Pre-test and the Post-test

As the figure presents, post-intervention results showed a general increase across all areas, with notable improvements in previously challenging features. The findings are further discussed in the next section.

Discussion

The findings highlight several key insights related to RC learning by Persian EFL learners and the effectiveness of AI-assisted language learning tools.

Learners' Challenges in English RCs

Based on the results of the Pre-test, the most significant difficulties occurred primarily with RC reduction, which is likely due to the absence of this syntactic feature in Persian. In addition, the use of object pronouns instead of gaps was among the common errors for the Persian learners, likely as a result of L1 transfer. These findings align with Ellis (1996), who distinguishes between interlingual and intralingual errors. The poor performance on RC reduction suggests persistent intralingual issues, as English often omits relative pronouns and auxiliary verbs in reduced RCs, which are absent in Persian. Similarly, the overuse of object pronouns in English RCs may stem from Persian syntax, which typically retains the equivalent of the pronoun, resulting in redundancy in English. This kind of interlingual transfer has been identified in several studies, including Jarvis and Pavlenko (2008).

About other types of questions, due to what was mentioned before about the use of the Persian particle "ke" in RCs, it seems challenging for the learners to choose the correct relative pronoun based on the antecedent and its role in the clause. Moreover, distinguishing between restrictive and nonrestrictive RCs may also be challenging, which resulted in punctuation errors too, although less than other features. Finally, despite the challenges, learners performed relatively well on free RCs, likely due to similarities in Persian usage. This supports the notion that positive transfer can also play a role in L2 learning (Bardovi-Harlig & Sprouse, 2018).

Effectiveness of AI-Assisted Learning

Following AI-integrated instruction, scores improved significantly across all RC types, especially in the most problematic areas. These results affirm the value of AI in second-language instruction. AI-based interventions likely contributed to this improvement by offering immediate feedback, which aligns with Ghufron and Rosyida (2018) and Etaat (2024), who emphasized the importance of timely error corrections. Based on these studies,

after several uses of AI-assisted applications, the learners could not only select the correct word but also the correct grammar and writing mechanics.

In addition, providing adaptive scaffolding aligns with Sajja et al. (2024), who argued for the benefits of intelligent computer-assisted language learning systems in personalized instruction. Furthermore, the findings are consistent with research by O'Neill and Russell (2020), who found that increasing self-correction, developing self-regulation, receiving personalized feedback, and categorizing the errors provided by AI-mediated tools were significant.

Conclusion

The present study aimed to identify the Persian L2 learners' challenges while producing English RCs; to discover the differences and similarities between the structures of Persian and English relative clauses; and to implement innovative approaches, such as using AI-assisted learning mediums to tackle the challenges. The research highlights the main differences in relative pronouns and clause positioning in the two languages, and it offers insights for identifying common errors and more efficient language teaching methods. In other words, it is not only aimed at finding out the most challenging parts of learning RCs in English, but also innovative methods are applied to overcome such challenges more effectively.

English and Persian RCs are mainly of two major kinds: restrictive and nonrestrictive, along with a kind of Free RCs. Among the many differences between the two languages, RC reduction and the use of gaps in English, and the use of RP and the particle "ke" in Persian can be mentioned. Based on the results gained from the Pre-test focusing on 7 features (restrictive, nonrestrictive, free, comma, gap, reduction), it was revealed that the participants face the most challenges in RC reduction and the use of gaps in English RCs. In other words, the learners had intralingual errors like errors in RC reduction, which can be the result of ignorance of the rules, and also interlingual errors like the use of object pronouns in RCs instead of gaps, which can be the result of transfer from Persian RC structures. AI-assisted language learning mediums such as ChatGPT, Wordtune, and Instatext were implemented to practice more and tackle the challenges in a variety of activities, both individually and in groups, like chats, exercises, quizzes, anecdotes, and writing practices. The result of the post-test revealed that learners improved significantly in terms of English RCs and could largely reduce errors.

The findings of this study have practical implications for L2 educators, curriculum designers, and language learners. By identifying specific problem areas, teachers can design targeted grammar instruction and practice activities more efficiently. Moreover, the study demonstrates the effectiveness of integrating AI-assisted tools in grammar learning, particularly RCs. Language programs may consider incorporating such technology as a supplement to traditional instruction, especially for syntactic challenges that stem from cross-linguistic interference. This research is limited to Persian intermediate learners of English with a special focus on RC production errors. Future research could further explore other aspects of the syntactic features of the two languages to identify the challenges and common errors of the learners to enhance the process of learning and teaching.

Declaration of Conflicting Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this study.

References

Alam, A., & Mohanty, A. (2023). Educational technology: Exploring the convergence of technology and pedagogy through mobility, interactivity, AI, and learning tools. *Cogent Engineering*, *10*(2), 2283282. https://doi.org/10.1080/23311916.2023.2283282

Bardovi-Harlig, K., & Sprouse, R. A. (2018). Negative versus positive transfer. *The TESOL encyclopedia of English language teaching*, 1-6. https://doi.org/10.1002/9781118784235.eelt0084

Bellod, H. C., Ramon, V. B., Fernandez, E. C., & Lujan, J. F. G. (2021). Analysis of stress and academic-sports commitment through self-organizing artificial neural networks. *Retos: nuevas tendencias en educación física, deporte y recreación*, (42), 136-144. https://doi.org/10.47197/RETOS.V42I0.86983

Beta, K. (2022). *The impact of artificial intelligence on students' learning in higher education institutions in the UK* [Doctoral Dissertation, Coventry University]. https://B2n.ir/qp7858

Brown, H. D. (2006). *Teaching by principles: Interactive language teaching methodology*. Prentice Hall Regents.

Chiu T. K. F., Xia, Q., Zhou, X., Chai, C. S., & Cheng, M. (2023). Systematic literature review on opportunities, challenges, and future research recommendations of artificial

intelligence in education. *Computers and Education: Artificial Intelligence*, *4*, 100118. https://doi.org/10.1016/j.caeai.2022.100118.

Dahlén, A. (2010). *Modern Persisk Grammatik*. Ferdosi Publication.

Drayton, B., Falk, J. K., Stroud, R., Hobbs, K., & Hammerman, J. (2010). After installation: Ubiquitous computing and high school science in three experienced, high-technology schools. *Journal of Technology, Learning, and Assessment*, *9*(3), 1-57. https://eric.ed.gov/?id=EJ873677

Ellis, R. (1996). *The study of second acquisition*. Oxford University Press.

Etaat, F. (2024). *The effect of AI-based applications on EFL writing skill development: An inquiry into integration of AI into language learning* [Master's Thesis, UiT Norges arktiske universitet]. https://hdl.handle.net/10037/33935

Etaat, F. (2025). AI-based assessment of students' writing skill progress: Implementing "Artificial neural network modeling" vs. "Time series prediction". *International Journal of Educational Research*, *131*, 102575. https://doi.org/10.1016/j.ijer.2025.102575

Fisiak, J. (1981). Some introductory notes concerning contrastive linguistics. *Contrastive linguistics and the language teacher*, 1-9.

Foster, N., Van Avermaet, P., & Auger, N. (2023). Hierarchies of home language proficiency in the linguistically diverse primary school classroom: Personal, social and contextual positioning. *Linguistics and Education*, *76*, 101187. https://doi.org/10.1016/j.linged.2023.101187

Gass, S. M., Behney, J., & Plonsky, L. (2020). *Second language acquisition: An introductory course*. Routledge.

Ghufron, M. A., & Rosyida, F. (2018). The role of Grammarly in assessing English as a Foreign Language (EFL) writing. *Lingua Cultura*, *12*(4), 395-403. https://doi.org/10.21512/lc.v12i4.4582

Godzicki, L., Godzicki, N., Krofel, M., & Michaels, R. (2013). *Increasing Motivation and Engagement in Elementary and Middle School Students through Technology-Supported Learning Environments* [M.A Thesis, Saint Xavier University]. http://www.eric.ed.gov.ezproxy.cu

Huang, J., Shen, G., & Ren, X. P. (2021). Connotation analysis and paradigm shift of teaching design under artificial intelligence technology. *International Journal of Emerging Technologies in Learning*, *16*(5), 73–86. https://doi.org/10.3991/ijet

Izumi, S. (2003). Processing difficulty in comprehension and production of relative clauses by learners of English as a second language. *Language Learning*, *53*(2), 285-323. https://doi.org/10.1111/1467-9922.00218

Jarvis, S., & Pavlenko, A. (2008). *Crosslinguistic influence in language and cognition*. Routledge.

Kissova, O. (2020). Contrastive analysis in teaching English pronunciation. *SWS Journal of Social Sciences and Art*, *2*(1), 39-65. https://B2n.ir/px6513

Liao, Q., & Chang, C. (2024). Unraveling the logical status of sentential relative clauses in English: Constructing a multifunctional framework. *Lingua*, *308*, 103775. https://doi.org/10.1016/j.lingua.2024.103775

Lightbown, P. M., & Spada, N. (2021). *How languages are learned* (5th ed). Oxford University Press.

Mahmoud, C. F., & Sørensen, J. T. (2024). Artificial intelligence in personalized learning with a focus on current developments and future prospects. *Research and Advances in Education*, *3*(8), 25-31. https://www.paradigmpress.org/rae/article/view/1262

McClellan, K. (2024). *English prosody in first and second language speakers*. John Benjamins Publishing Company. https://doi.org/10.1075/scl.120

Michel, M., Atkinson, D., Ribeiro, A. C., Alexopoulou, T., Cappellini, M., Eskildsen, S. W., ... & Zheng, Y. (2025). Forging common ground in second language acquisition and teaching: A combined synergy statement. *The Modern Language Journal*, *109*(S1), 90-103. https://doi.org/10.1111/modl.12983

Mouza, C. (2008). Learning with laptops: Implementation and outcomes in an urban, underprivileged school. *Journal of Research on Technology in Education*, *40*(4), 447-472. https://eric.ed.gov/?id=EJ826086

O'Neill, R., & Russell, A. M.T. (2020). Grammarly: help or hindrance? Academic learning advisors' perceptions of an online grammar checker. *Journal of Academic Language and Learning*, *13*(1), A88–A107. https://journal.aall.org.au/index.php/jall/article/ view/591

Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers & Education: Artificial Intelligence*, *2*, 100020. https://doi.org/ 10.1016/j.caeai.2021.100020

Peercy, M. M., Hardy-Skeberdis, M., & Crawford, J. (2024). "Because we bilingual": Examining an early career ESOL teacher's humanizing approach to language use. *Linguistics and Education*, *83*, 101337. https://doi.org/10.1016/j.linged. 2024.101337

Rasekh-Mahand, M. Alizadeh-Sahraie, M., & Izadifar, R. (2016). A corpus-based analysis of relative clause extraposition in Persian. *Ampersand*, *3*, 21–31. http://doi.org/10.1016/j.amper.2016.02.001

Rodinadze, S., & Zarbazoia, K. (2012). The advantages of information technology in teaching English language. *Frontiers of Language and Teaching*, *3*(5), 271-275. https://B2n.ir/jk7192

Sajja, R., Sermet, Y., Cikmaz, M., Cwiertny, D., & Demir, I. (2024). Artificial intelligence-enabled intelligent assistant for personalized and adaptive learning in higher education. *Information*, *15*(10), 596. https://doi.org/10.3390/info15100596

Taghvaipour, M. A. (2004). *Resumption in Persian relative clauses: An HPSG analysis*. CSLI Publications.

Taghavaipour, M. A. (2005). *Persian relative clauses in head–driven phrase structure grammar* [Unpublished Doctoral Dissertation]. University of Essex.

Umar, U. (2024). Advancements in English language teaching: Harnessing the power of artificial intelligence. *Foreign Language Instruction Probe*, *3*(1), 29-42. https://doi.org/10.54213/flip.v3i1.402

Wood, J. F. (2017). Errors in second/foreign language learning and their interpretations. *Education and Linguistics Research*, *3*(1), 1-14. http://dx.doi.org/10.5296/elr.v3i1.10251

Yarmohamadi, L., & Rashidi, N. (2009). *Practical contrastive analysis of English And Persian with special emphasis on grammar*. Rahnama Press.

Zhao, Y. (2013). Recent developments in technology and language learning: Literature review and meta-analysis. *CALICO Journal*, *21*(1), 7-27. https://eric.ed.gov/?id=EJ674877

Zitha, I., & Nendauni, L. (2025). Linguistic misconceptions of tautology in the English second language context among student educators. *Southern African Linguistics and Applied Language Studies*, 1-13. https://doi.org/10.2989/16073614.2024.2372357

Appendix

Examples of test items categorized by the 7 RC features across three tasks. There are some items for each feature given as examples below.

1. **The use of relative pronouns**:

A. Sentence Combination Task

- Example: *The woman is an experienced professor. She wrote an autobiography.*

B. Grammaticality Judgment Task

- Example: *The boy which won the race was wearing a blue cap and a striped T-shirt.*

2. The use of commas (Restrictive or nonrestrictive RCs)

A. Interpretation Task

- Example: *The committee members, who all voted against the manager, received a notice letter.*

What does this imply? *a) The manager received a notice letter.*

b) The committee members received a notice letter.

B. Grammaticality Judgment Task

- Example: *The applicants who had related experience, were given an opportunity.*

3. The use of Object Pronouns / Gaps

A. Grammaticality Judgment Task

- Example: *The documentary that they watched it in class was so interesting.*
- Example: *The woman who I talked to her was a university instructor.*

B. Sentence Combination Task

- Example: *She recommended a romantic novel. I later purchased it online.*
- Example: *My grandma bought me a purse. I lost it on my way home.*

4. Relative clause reduction

A. Sentence Combination Task

- Example: *The students who are participating in the exchange program must have high grades.*

B. Grammaticality Judgment Task

- Example: *The articles were published last year received an international award.*

5. Restrictive Relative Clauses

A. Interpretation Task

• Example: *The books that were translated into French sold the most copies.*

What does this mean? a) *All books sold well.*

b) *Only translated books sold well.*

B. Sentence Combination Task

• Example: *I attended the course. It was organized by the National Geographic Society.*

6. Nonrestrictive Relative Clauses

A. Sentence Combination Task

• Example: *Dr. Jackie is giving a lecture today. She is a specialist in sociolinguistics.*

B. Interpretation Task

• Example: *This monument, which dates back 2000 years, attracts millions of tourists every year.*

What does this sentence imply? a) *The monument is an ancient place.*

b) *Tourists are not attracted to it.*

7. Free Relative Clauses

A. Grammaticality Judgment Task

• Example: *The manager confirmed whatever was proposed in the final report.*

B. Interpretation Task

• Example: *Whoever finishes the task on time will receive a bonus for the next month.*

What does this mean? a) *A specific person will receive a bonus.*

b) *The bonus depends on who finishes the task on time.*