Journal of Applied Linguistics Studies, Vol.4, No.1, 2024: 16-23
https://jals.aliabad.iau.ir
ISSN: 2820-9974

Enhancing Iranian EFL Students' Reading Fluency with Real-time Feedback Through Adaptive Online Reading Instruction System

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Received: 02-04-2024, Accepted: 28-08-2024

ABSTRACT
The present mixed-methods research evaluated the effectiveness of an adaptive online reading instruction with real-time feedback on the reading fluency of Iranian EFL students. Sixty out of 147 Iranian EFL students were selected based on a placement test and equally divided into experimental and control groups. The experimental group received instruction using adaptive online reading instruction through the web-based platform Hi-ELINA, providing individualized reading tasks based on needs and reading proficiency. The instruction included timed reading tasks, comprehension quizzes, and pronunciation drills over ten sessions. In contrast, the control group received conventional reading instruction. Posttest results showed a significant improvement in reading fluency for the experimental group, confirming the effectiveness of adaptive online instruction with real-time feedback. Both students and teachers reported positive perceptions of the system. Theoretical and pedagogical implications are discussed.
KEYWORDS: Adaptive Online Reading Instruction System; Computer-Assisted Language Learning; Reading Fluency; Real-time Feedback

INTRODUCTION

The utilization of technology to personalize students' learning experience is referred to as adaptive learning or adaptive instruction (Zhu et al., 2023). The approach of utilizing algorithms and data analysis to customize instruction and assistance to cater to individual student's distinct needs and learning preferences has been extensively discussed in the literature (Graf & Kinshuk, 2022; Lajoie, 2022). Adaptive learning systems have been implemented in various educational contexts, such as language learning, as evidenced by studies conducted by Yang and Chang (2022) and Zhu et al. (2023). Graf and Kinshuk (2022) highlighted the potential of systems that offer real-time feedback to students and personalized learning activities to enhance their academic performance. The effectiveness of online reading instruction in enhancing reading fluency, especially for English as a Foreign Language (EFL) students, has been established by previous studies (Xie & Wang, 2017; Yang & Chang, 2016). The provision of audio recordings of texts, interactive activities for vocabulary and comprehension practice, and progress reports are some of the resources and activities that can be utilized in online reading instruction to enhance the reading skills of students (Xie & Wang, 2017).

In recent years, adaptive online reading instruction systems (AORISs) have gained popularity as a technology-based method. The provision of real-time feedback and personalized learning through adaptation to the student's literacy level are key features of these systems (Blok et al., 2021; Campbell, 2019; Chen et al., 2023; Kamil & Chou, 2009; Lee et al., 2021; Oxman & Wong, 2023). The development of AORISs for language learning has been guided by constructivism, cognitive load theory, and social cognitive theory, as evidenced by the frameworks proposed by Graf and Kinshuk (2022) and Yang and Chang (2016). In AORISs, providing personalized learning activities and real-time feedback based on each student's unique learning styles and requirements is a crucial feature of the system.

The popularity of technology-based approaches such as AORIS to reading instruction has increased in recent years due to their innovative and interactive learning methods that aid students in developing reading fluency, comprehension, and motivation. For instance, Nguyen et al. (2020) conducted a study on the effectiveness of a mobile application for EFL reading instruction. They concluded that implementing the mobile application

improved the students' reading fluency, vocabulary, and motivation to read. Similarly, Lee et al. (2019) explored the effectiveness of an online reading program in improving the reading abilities of EFL students. They found that implementing an online reading program resulted in significant improvements in the student's reading comprehension, vocabulary, and motivation. In another study, Kim et al. (2019) examined the effectiveness of a web-based reading program for EFL students. The study's findings indicated that the implementation of a program had a positive impact on the reading fluency and comprehension skills of the students. In the same vein, Lee and Huang (2018) demonstrated that the integration of real-time feedback in a mobile-assisted language learning program significantly impacted the enhancement of reading fluency among EFL students.
Furthermore, Yamashita and Jiang (2010) found that visual feedback was more effective than auditory feedback in enhancing reading fluency. In addition, enhancing reading fluency through real-time feedback has been an effective method in language acquisition. The study conducted by Kim et al. (2015) pointed out that the incorporation of real-time feedback in a computer-assisted language learning (CALL) program substantially enhanced the reading fluency of EFL students.

Although the effectiveness of technology-based reading instruction on students' reading fluency has been supported, the scant literature on the use of AORISs in Iranian EFL classrooms warrants further investigation to identify optimal feedback methods and their integration into language acquisition curricula. The novelty of present study lies in its specific focus on real-time feedback within an adaptive online reading instruction system tailored to Iranian EFL students. Unlike previous studies, this research integrates personalized real-time feedback mechanisms that directly respond to students' reading progress, providing immediate and actionable insights to both students and instructors. This approach not only enhances reading fluency but also contributes to the existing literature by demonstrating the practical benefits of advanced technological integration in language education.
Accordingly, the current study aimed to fill such a gap in related literature by proposing the following research questions:
1. Does an adaptive online reading instruction system significantly affect Iranian EFL students' reading fluency with real-time feedback?
2. What are Iranian EFL students' perceptions of utilizing the adaptive online reading instruction system with real-time feedback?

METHODOLOGY

The present study employed a mixed-methods design, incorporating both quantitative and qualitative approaches. In the quantitative phase, a pretest-posttest design was utilized with one control group and one experimental group. The independent variable was the instruction based on AORIS, while the dependent variable was reading fluency. Gender served as a moderator variable in the analysis. In the qualitative phase, semi-structured interviews were conducted.

This study's participants were 147 Iranian EFL students enrolled in three language institutes in Ardabil, Iran. Then, they took a placement test, and 60 homogeneous samples were selected. The sample consisted of 60 individuals between 18 and 50 (M = 26.2, SD = 2.34, M= 28.1), comprising 60 male and 60 female students. The participants were randomly assigned to the experimental and control groups. They were both Persian and Turkish native language speakers. Further, 10 Iranian EFL students from the experimental group were requested to participate in the interview voluntarily. In addition to the student participants, 10 Iranian EFL teachers with nearly the same language teaching experience were selected based on convenience sampling. They ranged from 32 to 41 years old and taught in language institutes in Ardabil, Iran. They were invited to participate in the interview.

Three research instruments were utilized to gather the required data. First, to examine the participants' English language proficiency, the students of the present study took a general training version of the Oxford Placement Test (OPT). The test used in this study was taken from the book Oxford Placement Test (student's book with answers, 2019). One test from this book was selected randomly. The items of all four skills were administered. In addition, for the reading fluency pretest and posttest, the reading section of the Cambridge English Preliminary exam was employed as a standardized measure. This section comprised five subsections with 25 questions, presented as multiple-choice and fill-in-the-blank questions. In order to mitigate the potential influence of practice effects on participant performance, diligent measures must be taken. The sequence of topics was altered between the pretest and posttest administrations while maintaining consistency in test content. In order to maintain the integrity of research outcomes, it is imperative to prioritize both validity and reliability; the test underwent a piloting process.

In the pursuit of understanding the perceptions held by Iranian English as a Foreign Language (EFL) students and teachers regarding the utilization of an adaptive online reading instruction system featuring real-time feedback, an empirical investigation is warranted, two semi-structured interviews were designed and validated by the researcher, EFL students, and teachers, respectively. Each interview consists of 10 open-ended questions. To validate the interview, the items were reviewed by three expert judges. According to Dornyei (2005, p. 136), "In the semi-structured interview, there's a set of pre-prepared guiding questions and prompts, and the interviewer is also keen to follow up interesting developments and let the interviewee elaborate on certain issues." Piloting holds significant importance in research as it allows for the detection of unforeseen minutiae and issues with the instruments used in the main study, thereby averting potential frustration and extra work later on (Dornyei, 2007, p. 75). For the main study, 147 EFL students underwent a proficiency test, from which 60 were selected based on the OPT scoring rubric and evenly divided into two groups. Following the administration of the reading fluency pretest, the treatment phase commenced. In the experimental group, participants were granted access to the web-based platform www.hielina.com, facilitating their engagement with the Highly Efficient Language Learning and Individualized Navigational Application (Hi-ELINA) adaptive online language learning management system. They visited the website, clicked the "Assignment System" icon, and logged in with their username and password. The system provided timed reading tasks, comprehension quizzes, pronunciation drills, and other interactive activities in Hi-ELINA that helped with reading fluency.

As participants did these activities, the system kept track of their growth by keeping track of their reading speed, accuracy, comprehension scores, and how well they pronounced words. The system also gave participants comments and suggestions based on how well they did and how far they had come. It pointed out areas where reading fluency could improve and offered specific strategies or extra activities. The system used an iterative learning process during the treatment to adapt its suggestions and tasks based on participants' engagement and performance. In elucidating the perceptions of Iranian English as a Foreign Language (EFL) students and teachers pertaining to the implementation of an adaptive online reading instruction system integrated with real-time feedback, the application of machine learning and natural language processing methodologies emerges as a promising approach., the system utilized user data and feedback to keep getting better and better. The following steps are followed in a regular AORIS task.

1. *Reading Speed:* Words per minute were used to measure how fast students read the texts or passages they gave.
2. Reading Accuracy: The number of words each participant read correctly wrote.
3. Comprehension Scores: Participants' understanding and comprehension of the reading material are automatically assessed using the Level-up plugin, such as comprehension quizzes or rating scales.
4. Pronunciation Accuracy: The readers' ability to say words correctly while reading was tested.
5. Engagement Level: During the reading tasks, the participant's level of interest and participation was monitored and scored.
6. Reading Strategies: Participants' reading strategies, in examining the perceptions of Iranian English as a Foreign Language (EFL) students and teachers regarding the incorporation of an adaptive online reading instruction system with real-time feedback, it is pertinent to employ machine learning and natural language processing methodologies, which may include techniques such as skimming, scanning, and predictive modeling to extract valuable insights from textual data, were recognized and written down.
7. Self-Correction: The participants fixed their own mistakes while reading.
8. Vocabulary Acquisition: The readings used to test how well the participants could learn new words.
9. Reading Fluency Progress: Participants' progress in reading fluency over time was tracked and measured.
10. System Interaction: The participants used the Hi-ELINA system, including how they navigated and used its features.
11. System Recommendations: Hi-ELINA system gave feedback and suggestions based on students' performance.
12. Time Spent: The amount of time each participant spent on a particular reading task.
13. Task Completion: The participants finished the reading tasks or activities they did.
14. Overall success: The participants' success in reading fluency was rated.

In contrast to the experimental group, the control group did not receive AORISs; instead, they were taught reading using conventional methods in EFL contexts. After ten sessions, the reading posttest was administered. Finally, 10 participants from the experimental group were selected and invited to interview. Each interview lasted 15 minutes.

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https://jals.aliabad.iau.ir
ISSN: 2820-9974

RESULTS

To choose a homogeneous sample of students for this study, the OPT was administered to the 147 students available to the researcher, the results of which are presented in Table 1.

Table 1

Descriptive Statistics of the OPT Test

OPT	N	Min.	Max.	M	SD
	147	45.00	85.00	61.66	11.257
Valid *N* (listwise)	147				

According to Table 1, the mean and standard deviation of the OPT scores were 61.66 and 11.257, respectively. Based on these scores, 60 of 147 Iranian EFL students whose scores fell within one standard deviation above and below the mean were selected and evenly divided into two groups: one experimental group and one control group, each comprising 30 students. Furthermore, verifying the assumptions underlying these tests, such as the normality assumption, was essential before conducting the parametric tests. Therefore, the skewness and kurtosis values for all the tests used in this study were presented and examined in Table 2, which provides descriptive statistics of the employed tests.

Table 2.

Descriptive Statistics of Reading Fluency Pretests and Posttests for Groups

Tests	*N*	Mean	SD	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
EG Pretest	30	18.95	2.65	-.09	.37	-1.39	.73
EG Posttest	30	20.10	2.70	-.30	.37	-1.25	.73
CG Pretest	30	19.80	2.44	-.74	.37	.40	.73
CG Posttest	30	19.97	2.55	-.40	.37	-.97	.73

The skewness and kurtosis values lower than ±2.00 indicate that a given distribution is standard, while values greater than ±2.00 show that the distribution has been skewed and peaked. Because all the skewness and kurtosis values lined up under the skewness statistic and kurtosis statistic columns of Table 2 represent values lower than ±2.00, it concluded that the distributions for all the pretests and posttests of groups met the normality assumption. Besides the assumption of normality, the study also assessed the assumptions of linearity, homogeneity of variances, and homogeneity of regression slopes. A Kolmogorov-Smirnov test was conducted to verify the assumption of normal score distributions."
Please review the revision and let us know if you would like to make any further adjustments or additions.
As indicated in Table 3, the *p*-values obtained for the groups were insignificant ($p > .05$). Thus, the distributions of the scores were normal across groups.

Table 3.

Normality Tests by Groups

		Kolmogorov-Smirnov		
	Group	Statistic	df	Sig.
Pretest	Experimental	.10	28	.20
	Control	.23	28	.06
Posttest	Experimental	.16	28	.20
	Control	.18	28	.20

Table 4 shows the result of Levene's test of homogeneity of variances. As represented, the *p*-values obtained were not statistically significant ($p > .05$), which indicated that the homogeneity assumption was met.

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Table 4.
The result of Levene's Test

	Levene Statistic	df1	df2	Sig.
Pretest	.15	1	58	.69
Posttest	.11	1	58	.73

Subsequently, no violations of these assumptions were identified for the independent sample tests. To address the initial inquiry posed in the research study, the performance of the two groups was analyzed using an independent samples t-test. The results of the pretest and posttest are presented in Table 5.

Table 5.
Results of the Independent Samples t-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pretest	Equal variances assumed	.15	.69	-.03	58	.93	-.05	.73	-1.50	1.38
	Equal variances are not assumed.			-.04	52.64	.96	-.05	.68	-1.44	1.39
Posttest	Equal variances assumed	.11	.733	3.05	58	.00	2.37	.80	.81	4.23
	Equal variances are not assumed.			3.12	19.71	.00	2.37	.78	.81	4.07

As shown in Table 5, no statistically significant difference was found between the two study groups in the pretest, t (58) = -.05, p = .93 (two-tailed). The mean difference was -.05, with a 95% confidence interval ranging from -1.50 to 1.38. However, for the posttest, the mean difference was 2.37, with a 95% confidence interval ranging from .81 to 4.23. These results suggest that AORIS significantly impacted the students' reading fluency.
This section's qualitative analysis was conducted on data obtained from interviews with students and teachers. The participants identified several criteria for evaluating the Adaptive Online Reading Instruction System (AORIS), including (a) accessibility anytime and anywhere, (b) facilitating comprehension of abstract concepts, (c) promoting open communication, and (d) offering appropriate tasks and assignments. Below are some examples of responses illustrating each criterion:

Theme	Example Quotes
Improved Reading Skills	"AORIS made reading easier and improved my comprehension and vocabulary."
Engagement and Motivation	"The interactive activities kept me engaged and prevented boredom."
Technical Challenges	"Sometimes I had issues with navigation but overall it was manageable."
Recommendations	"More detailed grammar explanations would be helpful."

"Regarding participants' perceptions, the majority expressed favorable views towards AORIS, considering it a valuable self-learning tool for several reasons. They found the reading content of online learning to be practical, relevant to their daily lives, and well-suited to their current level. Moreover, during discussions, many participants noted the appropriateness of the online learning content. While most interviewees reported a smooth experience with AORIS, some did encounter challenges, particularly related to technical issues. Several participants highlighted browser compatibility issues, adversely affecting students' and teachers' performance. According to interviewees, such technical hurdles could impede self-learning success. Furthermore, they observed that adhering to the weekly schedule posed another challenge for participants, potentially disrupting their self-learning process."

In addition, participants expressed encountering the challenge of time constraints inherent in online learning. However, they noted that with consistent practice over time, individuals adapt and learn to manage this aspect effectively. Regarding access to training facilities for online technology, students highlighted that only a limited number of educational institutions offer such resources. Nevertheless, they emphasized the availability of assistance through remote support, indicating that help is readily accessible for addressing any issues that may arise during online instruction. Iranian EFL students and teachers held differing personal perspectives on AORIS's advantageous aspects, reflecting on various components. Interview results revealed that the majority favored AORIS's effectiveness in enhancing vocabulary, reading, speaking, and listening skills while expressing reservations regarding its impact on writing and grammar. Participants noted that expanding vocabulary facilitated improved reading comprehension and highlighted the usefulness of the pronunciation feature. This perceived effectiveness may be attributed to the authenticity of the materials offered by AORIS.The comprehensive analysis of the interviews revealed predominantly positive perceptions regarding the use of AORIS in EFL contexts. Furthermore, the results underscored the students' high regard for the platform's effectiveness in practicing and enhancing their language skills, particularly in reading. AORIS allowed students to simulate words and phrases that they might otherwise feel hesitant or lacking in confidence to express in typical situations.

However, the participants believed that their writing skills had a below-lowest improvement via AORIS. What could account for this may be students' inability to apply the writing knowledge to form appropriate essays in such a context. They also perceived that the grammar explanation needed to be more transparent and more straightforward in the Adaptive Online Reading Instruction System (AORIS). One of them believed:
The interviewees also discussed the problems they had during AORIS. One of them pointed out that the interviews conveyed the perception that navigating AORIS was relatively easy. It could be attributed to the participants' overall technological proficiency, enabling them to engage with the platform easily. As articulated by one interviewee. Another issue observed with AORIS activities is that many students tended to access the answer keys before attempting the tasks. The research findings also unveiled that students frequently resorted to the answer key for solutions when encountering difficulties or errors in completing an activity. This tendency underscores students' inconsistency, potentially stemming from variations in task difficulty or individual proficiency levels in the English language. Moreover, most interviewees asserted that their English reading comprehension, vocabulary, phrases, slang, and idioms improved due to using AORIS. They found that AORIS made reading articles and paragraphs easier than their previous experiences.

DISCUSSION AND CONCLUSION

The study aimed to examine the impact of AORIS on Iranian EFL students' reading fluency and explore perceptions of its use. The findings confirmed the efficacy of AORIS with real-time feedback in enhancing reading fluency. Positive reception among students and teachers highlights the potential for broader application of such technology in language education. These findings align with a growing body of research supporting the benefits of integrating technology into language education. Studies such as Alamri et al. (2020), Blok et al. (2021), Campbell et al. (2019), Jung et al. (2019), and Zulfiani et al. (2018) provide additional evidence of the positive impact of technology on language learning outcomes. Overall, the current study's results contribute to the existing literature by highlighting the effectiveness of AORIS in improving reading fluency among Iranian EFL students and emphasizing the importance of technology integration in language education.

The results underscore the impact of AORISs on reading fluency, demonstrating significant success in addressing the research questions concerning their influence on reading skills. These findings align with previous studies by Bhatti (2013), Liu (2015), and Bhatti (2020). Additionally, this research evaluates the methods and practices for improving reading fluency by integrating AORISs. Bhatti (2020) examines explicitly the importance of AORISs in English language classrooms for enhancing reading fluency among teachers. Research indicates that integrating AORIS instruction in learning environments can elevate proficiency levels in reading skills, offering constructive and productive approaches with academic benefits for EFL students (Navarro & Mourgues-Codern, 2018). The study by Sung et al. (2022) emphasizes the significant impact of technology on the teaching and learning environment, a sentiment corroborated by the present study's findings. These findings align with previous research, including Vernadakis et al. (2021), Naraghizadeh and Barimani (2020), Wang et al. (2015), Ahmadian et al. (2015), and Mousavi and Nemati (2019), which all demonstrate the positive effects of technology-assisted programs on various aspects of language learning.

Specifically, the present study's use of AORISs for reading fluency has proven to be highly motivating and engaging for EFL students. The variety of animated stories, sounds, and captivating visuals within AORISs kept students interested and prevented boredom during treatment sessions. AORISs boosted motivation levels among ESL students and outperformed teachers in fostering motivation. Thus, AORISs emerged as a competent mode for teaching reading skills and promoting a positive attitude towards learning. However, it is noteworthy that these findings contrast with those of Ostovar-Namaghi and Malekpur (2018), who found digital games ineffective in vocabulary learning and suggested that AORISs may act as a distractive factor.

The implications of this study extend to ELT curriculum developers, encouraging them to integrate appropriate AORISs into curricula to accommodate EFL/ESL students' individual learning preferences and paces, thereby promoting reading fluency. Language teachers should also recognize that AORISs have the potential not only to improve reading fluency but also to create motivating learning contexts for students.
Further research can address unresolved issues left by this study, including the need to consider different variables such as gender, motivation, and proficiency levels of EFL students in discussions of the relationship between AORISs and reading fluency. Moreover, overcoming limitations such as inadequate network infrastructure, internet connectivity issues, and lack of awareness about AORISs among educators will be essential for advancing research in this area. Conducting studies with larger sample sizes would also allow for more generalizable findings.

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