

Fostering Reading Autonomy through AI-Driven Instruction: Evidence from a Mixed-Methods Study of Iranian EFL Learners**Abstract****Article Type:****Original Research****Authors:****Mahnam Saeid¹**ORCID: [0009-0005-0316-614X](#)**Najmeh Maghsoudi²**ORCID: [0000-0003-3404-6077](#)**Farzaneh Iranmanesh³**ORCID: [0000-0002-3884-0297](#)**Article History:****Received:** 2026.02.20**Accepted:** 2026.06.10**Published:** 2026.06.15

The growing integration of artificial intelligence (AI) into English language education has created new opportunities to enhance reading instruction. This study investigated the effect of AI-driven reading instruction on EFL learners' reading autonomy and explored learners' perceptions of AI-driven reading environments. A sequential explanatory mixed-methods design including a quasi-experimental pretest–posttest nonequivalent control-group design followed by the qualitative phase using extreme (polar) case sampling and semi-structured interviews, was employed during a five-week intervention. Fifty-four intermediate EFL learners from a Language school in Kerman, Iran were selected through Oxford Placement Test and were randomly assigned to an experimental group (n = 27), which received AI-driven reading instruction through ReadTheory, and a control group (n = 27), which received traditional reading instruction. Quantitative data were collected using pre- and post-tests of reading autonomy questionnaire, while qualitative data were obtained through semi-structured interviews. The quantitative data were analyzed using Analysis of Covariance (ANCOVA) after checking the required assumptions, and the interview data were analyzed through inductive thematic analysis. The findings revealed that AI-driven instruction significantly enhanced learners' overall reading autonomy as well as its cognitive, metacognitive, affective-motivational, and action-oriented dimensions. However, no statistically significant improvement was found in the social dimension of reading autonomy. Furthermore, qualitative findings indicated that learners perceived ReadTheory as a tutor-like support system, providing personalized and adaptive learning for them. The study concludes that AI-driven platforms can serve as a valuable pedagogical tool for enhancing learners' reading autonomy when integrated with appropriate instructional support.

Key Words: EFL learners, AI-driven reading instruction, Artificial Intelligence, Reading autonomy, ReadTheory

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1. Introduction

Artificial Intelligence (AI) has emerged as a powerful shift in global education, revolutionizing how teachers design instruction, how students engage with content, and how learning outcomes are assessed (Zhang & Tian, 2025). From automated feedback systems to adaptive tutoring and generative content creation, AI technologies have redefined teaching and learning processes across disciplines (Cui, 2025). Over the past five years, the educational sector has witnessed accelerated adoption of artificial intelligence (AI) tools, including intelligent tutoring systems (ITSs), driven by growing emphasis on personalization, learner autonomy, and data-informed pedagogy (Buele et al., 2025). ITSs are AI-based educational systems designed to provide personalized instruction, adaptive feedback, and learning support by responding to learners' individual needs and performance. Consequently, these technological capabilities can foster more adaptable and learner-centered learning environments that promote learner autonomy rather than passive dependence on automated systems (Godwin-Jones, 2019; Ji et al., 2023).

Central to this discussion is the concept of autonomy which refers to the capacity of an individual or group to make independent decisions, and act according to self-determined principles, free from external control or interference (Benson, 2016). In educational settings, autonomy implies the extent to which how much learners are generally expected to independently choose the appropriate materials and methods for their learning (Humphreys & Wyatt, 2014). Learner autonomy underscores the concept that students assume responsibility for their own education. Contemporary theoretical frameworks conceptualize learner autonomy as a socially and technologically mediated, context-dependent construct, transcending the traditional view of autonomy as a purely individual cognitive trait (Teng, 2019). In line with this multidimensional conceptualization, learner autonomy encompasses not only cognitive and metacognitive regulation but also social dimensions, including learners' ability to seek support, collaborate with peers, and engage constructively with teachers to enhance learning.

Within English as a Foreign Language (EFL) context, autonomy is shaped not only by cognitive capacity but also by affective and sociocultural factors, including learners' beliefs, self-efficacy, motivation, identity negotiation, and access to supportive learning opportunities. Autonomous learners actively determine what, when, and how to study, establish personal learning objectives, and monitor their developmental trajectories (Benson, 2016). A substantial body of research on language learning has examined individualized learning, self-access, and self-directed learning as approaches that can support the development of learner autonomy

(Benson, 2011). Such pedagogical approaches are particularly salient in language learning environments, where sustained independent practice and self-regulation are indispensable for long-term proficiency gains (Ghorbandordinejad & Ahmadabad, 2016).

More specifically, reading autonomy defined as learners' capacity to independently select texts, apply comprehension strategies, monitor understanding, and adapt approaches as needed (Grabe & Stoller, 2011) is of paramount importance in AI-supported EFL instruction. Recent innovations in AI-driven reading environments have substantially expanded the possibilities for adaptive reading instruction. Unlike conventional digital reading systems that offer uniform activities, AI-based platforms can dynamically adjust text complexity, generate individualized feedback, recommend pertinent materials, and respond adaptively to learner performance (Shafiee Rad et al., 2024).

AI tools can assist learners in text selection, question generation, summarization, and progress monitoring, aligning with Benson's (2011) view of autonomy as learners' capacity to exercise control over their own learning rather than simply learning independently. In reading instruction, autonomous learners are encouraged to interrogate AI suggestions, compare multiple textual interpretations, and reflect on their comprehension strategies, thereby concurrently developing reading autonomy (Porayska-Pomsta et al., 2024). In AI-supported environments, the negotiation process becomes more complex since learners interact not only with teachers and peers but also with intelligent systems and algorithmic recommendations. In this regard, Hockly (2024) emphasized that AI tools can support autonomy when learners are encouraged to question AI outputs, personalize prompts, evaluate feedback critically, and make informed learning decisions independently.

Despite the burgeoning interest in AI applications within educational contexts, existing research on AI-assisted language learning has primarily examined learning achievement, vocabulary acquisition, writing performance, speaking practice and learner engagement in EFL contexts (Teng, 2024; Wang & Guo, 2025; Xie et al., 2024; Yang, 2025). In the context of Iran where students face significant challenges in developing and fostering reading autonomy, which is critical for their academic success and personal growth (Zarei & Ghahremani, 2010), evidence regarding its role in fostering reading autonomy remains scarce. Moreover, previous studies have relied predominantly on quantitative designs, providing limited insight into how learners experience AI-assisted reading or perceive its contribution to autonomous learning. Consequently, the mechanisms through which AI may foster reading autonomy remain insufficiently understood. Furthermore, the cultural and educational setting in Iran presents

distinct hurdles that may affect the efficacy of AI tools. Given the distinctive characteristics of Iranian EFL education including limited authentic English exposure, teacher-centered instructional traditions, restricted access to technology, and varying levels of digital literacy, the transferability of findings from other educational contexts cannot be assumed (Derakhshan & Noughabi, 2024; Lak et al., 2017). Consequently, comprehending the appropriate integration of these technologies into the Iranian EFL curriculum is increasingly recognized as essential for improving reading autonomy.

This investigation distinguishes itself through several novel contributions by shifting the focus from mere technological convenience to a thorough examination of how AI-driven reading instruction can facilitate or impede learning outcomes. This study theoretically may enhance the understanding of the intersection between AI and reading autonomy in resource-constrained environments like Iran. The findings of this investigation are expected to provide practical insights for EFL teachers utilizing AI tools in their classrooms. Results from both quantitative and qualitative phases may guide decisions regarding instructional design and the incorporation of digital tools, ensuring responsiveness to learners' needs. Furthermore, curriculum developers and educational policymakers may find the results useful for assessing the potential advantages and barriers of incorporating AI-driven platforms into language programs, especially in EFL contexts where conventional methods could rarely be responsive to learners' affective and cognitive needs.

Accordingly, the present study may contribute to the literature in three ways. First, it examined AI-assisted instruction with a specific focus on reading autonomy, an outcome that has received considerably less attention than language achievement. Second, it employed a sequential explanatory mixed-methods design to integrate quantitative evidence with learners' qualitative experiences, thereby providing a more comprehensive understanding of how AI supports autonomous reading. Third, it extended the evidence base to the Iranian EFL context, where contextual characteristics may influence learners' adoption and perceptions of AI-assisted learning. Accordingly, the investigation addressed the following research questions:

RQ1. Does AI-driven instruction significantly affect EFL learners' reading autonomy?

RQ2. What are Iranian EFL learners' perceptions of AI-driven reading instruction?

2. Review of the Related Literature

2.1. Artificial Intelligence and EFL Pedagogy

AI integration in second/foreign language education has encouraged many researchers to study its instructional effects. Previous research suggests that the integration of AI into language education has evolved progressively over time, encompassing diverse applications such as intelligent tutoring systems, automated language assessment, personalized learning, and, more recently, generative AI (Bahroun et al., 2023; Huang et al., 2023). Correspondingly, the fast growth of generative AI has increased academic interest in how AI may change EFL pedagogy and classroom practice (Bahroun et al., 2023). In EFL education, AI systems are increasingly associated with communicative practice, instructional scaffolding, and interactive language support (Pan & Wang, 2025).

AI systems can contribute to cognitive engagement by reducing unnecessary mental load and helping learners focus more directly on the main learning tasks instead of peripheral processing demands (Hsiao & Chang, 2024). Some AI-based environments go further and support higher-order thinking through scenario tasks and adaptive simulations in which learners need to make decisions and evaluate consequences (Liu & Fan, 2025).

Researchers have confirmed that successful AI integration requires balancing technological efficiency with communicative, emotional, and instructional goals (Koul & Nayar, 2021). In this vein, Hockly (2024) contended that AI should function as a support mechanism within language education rather than as a replacement for pedagogical expertise or teacher presence, emphasizing that its educational value depends largely on how effectively teachers deploy these tools into pedagogically meaningful learning experiences rather than using them solely for automation. According to Hockly (2024), the educational value of AI is related to the way it is integrated into learning. AI can support learning when it encourages learners to reflect on the feedback they receive and use it to guide later learning. This also requires learners to question AI-generated suggestions instead of accepting them automatically (Hockly, 2024; Porayska-Pomsta et al., 2024). Features such as real-time feedback and performance visualization facilitate metacognitive reflection and strategic regulation, while certain intelligent tutoring systems (ITSs) incorporate reflective prompts and revision suggestions to scaffold these processes (Kaswan et al., 2024).

2.2. Theoretical Framework

The current study was grounded in Self-Determination Theory (SDT), which describes autonomy and competence as basic psychological needs (Deci & Ryan, 2000). When learners feel autonomous, they often show stronger motivation and persistence. From the point of view of SDT, autonomy is a basic psychological need that supports intrinsic motivation. In this theory, autonomy indicates that learners feel their actions come from personal choice. SDT suggests that individuals have an inherent propensity for development and self-regulation when their psychological requirements are met, which is particularly applicable in educational settings, such as language acquisition (Ryan & Deci, 2000).

In the realm of AI-driven reading instruction, SDT offers a comprehensive framework for analyzing how technology-enhanced educational settings can either bolster or diminish learners' intrinsic motivation and autonomous participation. When learners feel their reading is self-directed, they usually show more persistence, engagement, and better performance too. In reading classrooms, autonomy-supportive environments help students develop stronger inner motivation to read (Guay, 2022). This kind of motivation often leads to more sustained reading effort and deeper comprehension over time. Moreover, Competence support, a central component of SDT, is equally relevant to AI-supported reading. In other words, learners who receive adaptive feedback and appropriate scaffolding, can gain a clearer picture of their progress and become more confident in their ability to manage reading tasks independently (Deci & Ryan, 2000; Guay, 2022; Hsiao & Chang, 2024).

2.3. Empirical Studies

Research on the use of AI in EFL teaching and learning has expanded rapidly in recent years. Studies have examined a wide range of AI-supported tools and their contributions to language development, instructional effectiveness, learner engagement, and assessment across diverse educational contexts. Overall, the findings suggest that AI can positively support language learning, although researchers have also identified limitations and emphasized the need for further investigation (Tlili et al., 2023). Building on this body of research, learners' reading autonomy has emerged as an important area of inquiry in AI-supported instruction within EFL contexts.

Recent theoretical discussions explain that learner autonomy in AI-supported environments should be understood not only as independent behavior, but also as a socially and technologically mediated process. Benson (2016) argued that autonomy develops through

interaction with learning environments and available resources rather than through isolation from others. Similarly, Teng (2019) explained that autonomy is closely connected with learner agency and identity construction because learners actively negotiate goals, strategies, and self-perceptions during language learning.

In the context of AI-assisted language skill development, Çelik et al. (2024) reported that AI-driven text simplification systems enhanced reading comprehension and inferential skills by aligning textual complexity with individual learner proficiency. In a related vein, recent studies indicate that AI-supported feedback and adaptive reading platforms can foster reading engagement and self-regulated learning through personalized support, automated feedback, and opportunities for strategic regulation (Pan et al., 2025; Tang et al., 2026).

Several studies focus on adaptive AI environments and their role in strengthening autonomous behavior. For instance, Mohammadi Zenouzagh et al. (2023) explained that AI-based design creates interactive settings where learners can work with visual, auditory, textual, and symbolic input at the same time. Because learners can choose how they receive and process information, they make more decisions during learning. This freedom of choice in mode and path can support independent learning habits. In such environments, learners are not only content receivers but also active selectors of input. This approach matches the broader movement toward personalized learning systems where AI gives adaptive feedback and context-sensitive support. Research in Iranian EFL contexts indicates that learners' motivation varies according to perceived competence, with advanced learners demonstrating heightened intrinsic drive when activities correspond to their ability (Derakhshan & Azari Noughabi, 2024).

In several AI-based platforms, learners have the capacity to regulate their own pacing, select specific skill domains, review performance outcomes, and track their progress through dashboards and analytical reports (Çelik et al., 2024). Furthermore, Ji et al. (2023) contended that digital platforms offer unique opportunities for fostering learner autonomy by providing access to a wide range of resources, promoting self-directed practice, and facilitating communication beyond the conventional constraints of the classroom.

Other researchers connect AI-supported learning with emotional and metacognitive dimensions of autonomy. For example, Namaziandost and Rezai (2024) studied learner autonomy together with emotional regulation and mindfulness in intelligent environments. Their findings suggested that AI systems that are sensitive to learner emotions could increase intrinsic motivation and metacognitive awareness. When AI tools adjust feedback style, task difficulty, and support level based on learner state, they can reduce anxiety and cognitive overload. In this way,

AI is a technical system as well as a kind of responsive learning partner. It supports resilience and self-awareness, which are both important for sustainable autonomy. However, the authors also noted that effects are not equal for all learners, and individual differences still matter.

Feedback-focused AI research also shows strong links with autonomy development. As an illustration, Yin et al. (2024) examined AI-supported formative feedback and reported positive effects on motivation, cognitive load, and academic performance. Their results indicated that immediate and dialog-based feedback encourages learners to monitor their understanding more frequently. In the same way, Broadbent and Poon (2015) asserted that digital environments that promote adaptive feedback and goal monitoring increase metacognitive involvement and support self-directed learning.

The above studies provide a comprehensive and contemporary overview of the intersection between AI and learner autonomy, effectively weaving together empirical findings, theoretical frameworks, and pedagogical implications. Its primary advantage lies in its multi-dimensional scope, successfully bridging cognitive, emotional, and metacognitive dimensions of autonomy and recent applied research on adaptive platforms. The studies also highlight the nuanced, socially mediated nature of AI-supported autonomy, moving beyond simplistic views of independence to emphasize critical AI literacy and reflective decision-making. However, they suffer from a noticeable drawback of presenting positive findings without significant contextual variability across studies (e.g., differing EFL proficiency levels, AI tool types, and instructional settings). The reviewed studies, in general, lack a critical comparative analysis that would weigh the robustness of evidence against their limitations, considering the complexities, risks, and inconsistent results that likely exist in this rapidly evolving field.

3. Method

3.1. Research Design

This study adopted a sequential explanatory mixed-methods design. In the first phase (quantitative), a quasi-experimental pretest–posttest nonequivalent control-group design was used to examine the effects of AI-driven reading autonomy instruction on Iranian EFL learners' reading autonomy. Following the quantitative analysis, a qualitative phase was conducted to explain and elaborate the quantitative findings (Ary et al., 2019). Six participants were selected through extreme (polar) case sampling based on the Reading Autonomy Questionnaire results from the experimental group. Semi-structured interviews were then conducted, to explain and

enrich the quantitative findings, and the interview data were analyzed using inductive thematic analysis following the six-phase procedure.

The study was conducted at a private English language school in Iran, where English is taught as a foreign language through structured classroom instruction. Students typically receive limited opportunities to use English outside formal educational settings, making classroom-based instruction the primary source of language exposure. In recent years, AI-powered language learning tools have become increasingly accessible, however, their integration into EFL instruction remains limited and largely depends on individual teachers' initiatives rather than institutional policy. Consequently, investigating AI-driven reading autonomy in this context was considered feasible for understanding how technology can supplement conventional classroom practices.

3.2. Participants

The participants were adult EFL learners at a Language School in Kerman, Iran. Fifty-four intermediate-level learners (26 females and 28 males), aged between 18 and 35, were recruited from two intact classes. The study involved adult participants who were native Persian speakers and had at least two years of prior experience learning English. After screening with the English proficiency test (Oxford Quick Placement Test), eligible students were retained in the study. One intact class served as the experimental group ($n=27$) which received English reading intervention supported by AI, while the other served as the control group ($n=27$) following traditionally-based English reading activities. Both groups took pre-tests before the intervention and posttests after the instructional period to assess changes in their reading autonomy.

In the qualitative phase of the study, a polar sampling strategy was employed to select participants from the experimental group for participation in semi-structured interviews. Polar sampling, is a widely recognized type of purposive sampling strategy where the researcher intentionally selects cases that represent extreme or contrasting positions on a particular dimension of interest (Creswell & Creswell, 2018). By sampling the highest and lowest scores, a polar sampling is created allowing for a strong comparative analysis, where the fundamental aim is to illuminate the mechanisms and dynamics that distinguish these two groups. This approach is particularly effective in an explanatory sequential design for explaining quantitative results, as it uncovers "why" and "how" outcomes differ. The core logic is that these extreme cases are information-rich and can provide powerful insights that typical cases might not reveal.

Accordingly, three participants who obtained the highest scores and three participants who

obtained the lowest scores on the post-test Reading Autonomy Questionnaire in the experimental group were selected for semi-structured interviews. The interviews were conducted to explore the participants' experiences with the AI-driven reading intervention and to gain deeper insights into the factors that shaped their levels of reading autonomy. More specifically, the qualitative data were used to explain and elaborate on the quantitative findings by examining how participants perceived the intervention, engaged with its activities, and experienced its influence on their reading autonomy.

3.3. Instruments and Materials

3.3.1. English Proficiency Test

To ensure the selection of a relatively homogeneous sample with respect to English language proficiency, Oxford Quick Placement Test Version1 (2001) was administered as a criterion-referenced measure. Oxford Quick Placement Test is a widely utilized assessment tool consisting of 60 items and requiring approximately 60 minutes to complete, designed to evaluate general English language ability. It yields results, with proficiency levels reported according to the Common European Framework of Reference (CEFR) scale, ranging from A1 to C2.

3.3.2. Coursebook

Both experimental and control groups used American English File 3 authored by Latham-Koenig et al. (2019) as the main coursebook in the study. Regular classroom instruction was the same for both groups. The only difference was the supplementary reading activities introduced during the final 15 minutes of each lesson.

3.3.3. AI-Driven Reading Platform

The next instrument implemented in the study was ReadTheory which is a free online educational tool (<https://readtheory.org>) designed to enhance students' background knowledge, vocabulary, and reading comprehension empowering them to become autonomous readers. It offers complimentary reading exercises for EFL/ ESL pupils and compiles their progress reports for teacher utilization. It utilizes an AI algorithm to assess the learners' current reading ability and identify suitable materials for subsequent exercises. To utilize this online platform, a teacher must establish a class in which students can register using a certain code. In this study, students were instantly taken to a pre-test that assesses their reading level. The instructor (first author) received data regarding the students' progress within a specified timeframe.

3.3.4. Analogous Worksheets

The control group utilized ReadTheory worksheets, consisting of reading texts and comprehension activities without any adaptive features. To maintain equivalence with the experimental group's adaptive content, the instructor (first researcher) initially examined the reading texts of the experimental group to choose texts that were analogous in genre and topic to those in the ReadTheory database.

3.3.5. Reading Autonomy Questionnaire

Autonomy in Reading Comprehension Questionnaire, developed and validated by Shirzad and Ebadi (2020), was also used as the instrument to assess the participants' reading autonomy. This instrument comprised 30 items on a five-point Likert scale (ranging from strongly disagree, scored as 1 to strongly agree, scored as 5).

The measure encompassed affective, metacognitive, cognitive, action-oriented, and social dimensions with each item having one score. The cognitive subscale pertained to the deliberate use of emotive methods to enhance reading comprehension. The metacognitive dimension involved the deliberate oversight of reading strategy utilization during practice. The action-oriented subscale pertained to the selection of effective tactics for enhancing reading proficiency, including the consumption of English newspapers, periodicals, and novels. Moreover, the emotive dimension entailed addressing emotional barriers impacting learners' engagement with English reading, including anxiety, shyness and tension. The social dimension reflected learners' ability to seek support, collaborate with peers, and make effective use of teachers and other social resources to facilitate reading development. Its inclusion was consistent with contemporary conceptualizations of learner autonomy, which view autonomy as a socially situated construct that extends beyond independent self-regulation to encompass meaningful interaction and collaboration with others (Teng, 2019).

The Cronbach's alpha for the questionnaire's reliability index as reported by Shirzad and Ebadi (2020) was 0.92, signifying a good level of reliability for the instrument. To test the internal consistency reliability in the present study, Cronbach's alpha was calculated for the Autonomy in Reading Comprehension Questionnaire showing good levels of reliability for the pre-test (0.83) and post-test (0.86).

3.3.6. Semi-structured Interviews

During the qualitative phase, semi-structured interviews were conducted face-to-face to explore the experiences of EFL learners (in experimental group) who were engaged with the

ReadTheory AI platform. The interviews were designed to complement the quantitative findings by shedding light on the subjective dimensions of learning with AI, particularly identifying the learners' perceptions of the usefulness and effectiveness of AI driven reading instruction. Participants were invited to share their thoughts on significant changes in their reading autonomy since using ReadTheory. Interview questions also addressed shifts in reading autonomy.

To ensure participants' comfort and clarity of expression, interviews were given the option to respond in either English or Persian. This linguistic flexibility helped mitigate potential language barriers and encouraged more authentic responses. All interviews were audio-recorded with informed consent, then transcribed verbatim for analysis. This qualitative data was essential in triangulating the findings.

3.4. Data Collection and Analysis Procedures

Data collection was carried out in two distinct stages, aligned with the sequential explanatory mixed methods design. In the first phase, quantitative data were collected from both the control and experimental groups to assess the effects of AI integration on learners' reading autonomy. Before the ReadTheory intervention, all participants completed Oxford Quick Placement Test to assess their English proficiency. They completed Reading Autonomy Questionnaire to establish a baseline for targeted variable. The participants of both groups had already enrolled in a 15-session general English course in an English language school. The course met three days per week totally taking five weeks with each class lasting 90 minutes. The same instructor (first author) affiliated with the language school where the study was conducted, taught both groups. To minimize potential bias, participants were informed that participation was voluntary, their responses would remain confidential, and their decision to participate or withdraw would not affect their course grades or standing within the institute. During the qualitative phase, the researcher adopted a reflexive stance by recognizing that prior experience in AI-assisted language learning could influence data interpretation.

All ethical issues were rigorously upheld during the investigation. Prior to data collection, informed consent was obtained from all participants, with protecting their identities and maintaining confidentiality. In order to ensure homogeneity during the intervention phase, both groups studied the same material (American English File 3). The difference was in how they were exposed to the supplementary materials that were practiced during the last fifteen minutes of their regular class time. The experimental group used ReadTheory AI platform including diverse features of adaptive and personalized reading, diverse genres and topics, instant and interactive feedback and explanations, and progress tracking. The control group participants, on the other

hand, were exposed to the same texts in print (derived from ReadTheory Platform) and in non-interactive form. At the end of the intervention period, the same Reading Autonomy questionnaire, administered at the beginning of the semester, was filled out by the participants of both groups as the post-test.

To complement the numerical data, the second stage of the investigation involved qualitative data collection. A subset of students from the experimental group were selected based on polar sampling (Cresswell & Cresswell, 2018) to participate in semi-structured interviews to provide deeper insights into their learning experiences. These interviews explored how participants reflected on the AI-driven reading intervention and its impact on learners' reading autonomy. Participants could use Persian or English during the interviews, depending on which language they felt more comfortable with. Having participants' consent, all interviews were audio-recorded and transcribed to facilitate detailed analysis.

Both quantitative and qualitative approaches were used to analyze the data. Once the data collection was complete, the analysis began by first ensuring the normality of the dataset. Preliminary descriptive statistics helped identify any irregularities and provide general overview of participants' performance before and after the intervention. To examine the first research question, ANCOVA was conducted after satisfying assumptions of normality and homogeneity of variances to assess the control and experimental groups in terms of pre- and post-AI implementation.

In the qualitative phase of the study, individual interviews were audio-recorded, transcribed verbatim, and analyzed using inductive reflexive thematic analysis (Braun & Clarke, 2023). Inductive reflexive thematic analysis is a data-driven qualitative approach in which themes are developed from the dataset rather than imposed through pre-existing theoretical frameworks or coding schemes. This approach enables researchers to identify patterns of shared meaning grounded in participants' experiences while remaining open to unexpected insights that emerge during analysis (Braun & Clarke, 2023). An inductive approach was considered appropriate because the qualitative phase aimed to explore learners' experiences of AI-driven reading instruction and to provide an in-depth explanation of the quantitative findings from the participants' perspectives. The analysis followed Braun and Clarke's (2023) six recursive phases: (1) familiarization with the data, (2) systematic coding, (3) generating initial themes, (4) developing and reviewing themes, (5) refining, defining, and naming themes, and (6) writing up the analysis by integrating themes with illustrative participant extracts.

To enhance the trustworthiness of the qualitative findings, the researchers employed

several strategies based on Lincoln and Guba's (1985) criteria. Credibility was strengthened through prolonged engagement with the data, iterative analysis, and member checking, whereby participants were invited to review and confirm the accuracy of the researchers' interpretations. Dependability was enhanced by maintaining a detailed audit trail documenting the coding and theme development process. Confirmability was addressed through reflexive memo writing and regular discussions among the research team regarding emerging interpretations. Transferability was facilitated by providing rich, thick descriptions of the participants, research context, and findings, enabling readers to judge the applicability of the results to other contexts. Consistent with the principles of reflexive thematic analysis (Braun & Clarke, 2023), no inter-coder reliability or coding agreement statistics were calculated, as coding was regarded as an interpretive and reflexive process rather than a procedure aimed at achieving coder consensus.

4. Results

The first research question examined whether AI-driven instruction significantly affected EFL learners' reading autonomy. The corresponding null hypothesis stated that AI-driven instruction would have no significant effect on EFL learners' reading autonomy and its components (cognitive, metacognitive, affective-motivational, action-oriented, and social factors). Prior to the main analysis, the assumptions underlying ANCOVA were examined. As shown in Table 1, Levene's tests were non-significant ($p > .05$), supporting the homogeneity of variances.

Table 1.

Levene's Test of Homogeneity of Variance

Variable	Levene's Test	
	F	P
Reading Autonomy	0.807	0.373
Cognitive Factors in RA	0.755	0.389
Metacognitive Factors in RA	3.50	0.065
Affective Motivational Factors in RA	0.125	0.725
Action Oriented Factors in RA	0.483	0.490
Social Factors in RA	2.402	0.127

Descriptive statistics for reading autonomy and its sub-dimensions are presented in Table 2. At the pre-test stage, the two groups showed similar mean scores regarding the study variables. Following the intervention, only minor changes were observed in the control group. The experimental group demonstrated higher post-test scores in overall reading autonomy and in the cognitive, metacognitive, affective-motivational, and action-oriented dimensions. A minor decline

was evident in the social dimension.

Table 2.

Descriptive Statistics for Reading Autonomy and Its Dimensions

Time	Variable	Control M	Group SD	Skewness	Kurtosis	Experimental M	Group SD	Skewness	Kurtosis
Pre- test	Reading Autonomy	84.07	9.14	0.23	-0.82	84.22	9.18	-0.61	-0.85
	Cognitive Factors	15.78	3.46	0.81	-0.34	15.19	3.76	0.57	0.01
	Metacognitive Factors	18.89	5.42	0.02	-0.38	18.18	5.11	0.14	0.87
	Affective- Motivational Factors	11.89	2.65	0.52	-0.93	11.67	2.22	0.18	-0.71
	Action- Oriented Factors	16.18	2.24	-0.61	-0.91	15.93	2.38	-0.20	-0.97
	Social Factors	21.33	4.19	-0.16	-0.99	22.63	3.80	-0.72	-0.36
Post- test	Reading Autonomy	85.67	9.48	0.46	-0.41	104.89	8.94	1.03	1.13
	Cognitive Factors	15.93	3.75	0.80	-0.41	21.81	3.22	0.92	0.97
	Metacognitive Factors	19.04	5.27	-0.06	0.04	26.67	3.04	0.94	1.05
	Affective- Motivational Factors	12.33	2.75	0.14	-1.01	15.93	2.79	-0.03	-0.58
	Action- Oriented Factors	16.74	1.75	-0.55	-0.44	20.78	2.19	0.95	0.52
	Social Factors	21.63	4.63	-0.83	-0.26	18.70	4.58	-0.08	-0.98

To examine the assumption of homogeneity of regression slopes, the interaction between groups and pre-test scores was tested. As shown in Table 3, none of the interactions reached statistical significance ($p > .05$). Therefore, the assumption of homogeneous regression slopes was met.

Table 3.

Test of Interaction between Groups and Pre-Test Autonomy Scores

Interaction Term	F	P
Group × Reading Autonomy	1.655	.204
Group × Cognitive Factors	0.536	.467
Group × Metacognitive Factors	0.003	.960

Group × Affective-Motivational Factors	1.068	.306
Group × Action-Oriented Factors	0.054	.466
Group × Social Factors	2.724	.105

Table 4 presents the ANCOVA results examining the effect of AI-driven instruction on reading autonomy and its dimensions after controlling for pre-test performance. Significant group effects were observed for overall reading autonomy, $F = 141.575$, $p < .001$, partial $\eta^2 = .735$, indicating that students who received AI-supported instruction achieved substantially higher adjusted post-test scores than those in the control group. The effect size was exceptionally large, suggesting that AI-driven instruction accounted for a considerable proportion of the variance in reading autonomy beyond students' initial performance.

Similarly, significant group differences were found for the cognitive ($F = 53.809$, $p < .001$, partial $\eta^2 = .513$), metacognitive ($F = 57.981$, $p < .001$, partial $\eta^2 = .532$), affective-motivational ($F = 23.690$, $p < .001$, partial $\eta^2 = .317$), and action-oriented ($F = 64.361$, $p < .001$, partial $\eta^2 = .558$) dimensions. All partial η^2 values exceeded the conventional threshold for a large effect, indicating that AI-supported instruction had substantial practical as well as statistical significance across these aspects of reading autonomy. The strongest effects were observed for overall reading autonomy and the action-oriented and metacognitive dimensions, suggesting that AI-driven instruction was particularly effective in promoting students' independent regulation and strategic engagement with reading tasks.

In contrast, the group difference for the social dimension was not statistically significant, $F = 3.897$, $p = .054$, partial $\eta^2 = .071$. Although the effect size approached the moderate range, the evidence was insufficient to conclude that AI-supported instruction produced meaningful improvements in the social aspects of reading autonomy.

Table 4.

ANCOVA Results for the Effect of AI-Driven Instruction on Reading Autonomy and Its Dimensions

Outcome Variable	F	p	Partial η^2
Reading Autonomy	141.575	<.001	.735
Cognitive Factors	53.809	<.001	.513
Metacognitive Factors	57.981	<.001	.532
Affective-Motivational Factors	23.690	<.001	.317
Action-Oriented Factors	64.361	<.001	.558
Social Factors	3.897	.054	.071

Moreover, to address the second research question, the analysis of the interview data revealed that learners generally viewed ReadTheory as a tool that led to greater independence

in reading. Three themes emerged from the analysis: (1) RT as a tutor-like support system, (2) immediate feedback as a source of confidence and motivation, and (3) adaptivity and personalization.

A. Tutor-Like Support System

The first theme which emerged from the analysis was learners' perception of RT as a tutor-like support system. Participants described RT as providing guidance that enabled them to work through reading tasks independently while still receiving instructional support. Rather than relying continuously on the teacher, learners viewed the platform as an accessible source of explanations and assistance during the learning process. As participant 2 explained, *"RT acted like a tutor for me. It gave me support and explanations when I made mistakes."* Similarly, participant 6 remarked that RT *"acts like a private tutor."* These comments suggest that learners perceived the platform not merely as a digital tool but as an instructional companion that scaffolded their reading and comprehension. The availability of continuous support allowed learners to monitor their understanding, correct errors, and progress at their own pace. This perceived tutor-like role also appeared to reduce dependence on the teacher while fostering greater learner autonomy and responsibility for learning.

B. Immediate Feedback

The second and most prominent theme that emerged from the analysis was the value of immediate feedback. All participants emphasized the importance of receiving instant information about the accuracy of their responses, describing it as a key feature that supported both learning and engagement. Rather than waiting for teacher evaluation, learners were able to identify and address errors immediately, enabling them to reflect on their performance while the learning experience was still fresh. As participant 6 explained, *"Knowing my mistakes right away helped me remember the correct answer better,"* suggesting that timely feedback strengthened comprehension and retention. Similarly, participant 3 noted that *"feedback made me more independent because I started correcting myself,"* indicating that immediate feedback encouraged learners to monitor and regulate their own learning.

Beyond its instructional value, the participants also associated immediate feedback with increased motivation. The scoring system and the ability to track progress provided learners with visible indicators of achievement, making reading activities more engaging and rewarding. As participant 7 remarked, *"it was like a game,"* highlighting how the feedback mechanism introduced an element of enjoyment into the learning experience. Collectively, these accounts suggest that

immediate feedback functioned not only as a corrective mechanism but also as a motivational scaffold that reinforced learners' confidence, sustained their engagement, and encouraged continued participation in reading tasks.

C. Adaptivity and Personalization

Another recurring theme concerned the adaptive nature of the platform. Interviewees of the experimental group noticed that passage difficulty changed according to their performance so that the system responded to their individual needs. As participant 5 explained, *“If my score was bad, the next one was easier; if I did well, it became more complicated.”* Participant 6 remarked that *“it felt like the website was understanding my level.”* Most participants regarded this individualized adjustment as beneficial because it prevented tasks from becoming either too easy or overly difficult. The personalized progression helped maintain engagement and encouraged learners to continue reading independently. Therefore, the interview data portrayed RT as a supportive environment that enabled students to monitor their progress, work more independently, and assume greater responsibility for their reading development.

Table 5.

Summary of Themes Related to Reading Autonomy

Theme	Description	Participants (n)
Tutor-Like Support System	Functioning as a tutor-like resource, supporting independent practice, reducing reliance on teacher assistance.	6
Immediate Feedback	identifying errors, monitoring progress, developing confidence, becoming more independent, and remaining motivated through gamified features	6
Adaptivity and Personalization	adjusting task difficulty according to learner performance, creating a personalized learning experience	6

5. Discussion

The first research question examined whether AI-driven instruction significantly influenced learners' reading autonomy. The large effect sizes observed across most dimensions indicate that the benefits of AI-driven instruction were not only statistically significant but also educationally meaningful. In particular, the exceptionally large effects for overall reading autonomy, metacognitive, and action-oriented dimensions suggest that AI-supported learning environments can substantially strengthen students' capacity to regulate, monitor, and independently manage their reading processes. These findings imply that integrating AI into reading instruction may produce meaningful improvements in learners' autonomous reading behaviors rather than merely

generating statistically detectable differences. Conversely, the absence of a significant effect on the social dimension suggests that AI-based instruction alone may not adequately foster collaborative or socially mediated aspects of reading autonomy, highlighting the continued importance of peer interaction and teacher-guided collaborative activities.

One possible explanation for the overall developments is that the AI-supported environment required learners to assume a more active role in managing their learning. Instead of relying primarily on teacher guidance, learners were continuously encouraged to make decisions, monitor their progress, respond to feedback, and regulate their learning behaviours. Repeated opportunities to engage in these self-regulatory processes may have strengthened learners' ability to manage reading tasks independently over time. Rather than serving solely as a source of instructional input, the platform appears to have provided a structured environment in which learners could repeatedly practice planning, monitoring, and evaluating their learning, thereby fostering the development of self-regulatory habits that underpin learner autonomy.

This finding is consistent with Benson's (2016) view that learner autonomy develops through learners' active interaction with learning environments and available resources rather than through independent learning alone. It also aligns with Teng's (2019) argument that autonomy involves learners' active regulation of learning goals, strategies, and self-perceptions. In the context of AI-supported learning, the findings further support Hockly's (2024) view that intelligent technologies can foster learner autonomy when they encourage learners to evaluate AI-generated feedback critically, personalize learning activities, and make informed decisions throughout the learning process.

The observed improvements are supported by the studies conducted by Ji et al. (2023) and Çelik et al. (2024), who confirmed that AI-supported systems can promote learner autonomy through responsive learning pathways and individualized instructional support. They also put forward that AI technologies encourage learners to regulate their own learning since they provide continuous access to performance information and personalized recommendations. The substantial improvements in the cognitive and metacognitive dimensions are also consistent with the study by Broadbent and Poon (2015) who found that digital learning environments can strengthen features such as planning and monitoring their learning progress. This finding also aligns with Hsiao and Chang's (2024) argument that AI-assisted learning environments can promote self-regulated learning by reducing extraneous cognitive demands associated with seeking guidance and evaluating performance. In the present study, the immediate availability of feedback and individualized support may have enabled learners to focus more on monitoring their

comprehension, reflecting on their mistakes, and adjusting their reading strategies, thereby fostering more strategic engagement with reading tasks.

The positive effects observed in the affective-motivational and action-oriented dimensions may be attributed to the adaptive and learner-centered features of the AI-supported learning platform, which are consistent with Koul and Nayar's (2021) view that technology-enhanced learning environments should support personalized and learner-centered educational experiences. Immediate feedback, personalized support, and visible evidence of progress provided learners with frequent evidence of improvement. These experiences may have strengthened students' confidence and willingness to engage with reading tasks independently. Similar patterns have been reported by Namaziandost and Rezai (2024), who found that intelligent language-learning environments could support autonomy through enhanced emotional regulation, intrinsic motivation, and metacognitive awareness. In a similar vein, Mohammadi Zenouzagh et al. (2023) concluded that AI-based learning environments provide flexible and interactive learning experiences that encourage learner choice, engagement, and autonomous learning. These findings are also compatible with Guay's (2022) interpretation of Self-Determination Theory, which emphasizes the role of competence and autonomy in sustaining motivation and engagement.

The absence of significant improvement in the social dimension needs further consideration. Although participants became more autonomous in managing their own learning, the platform offered relatively limited opportunities for interaction with peers. As a result, the instructional experience was largely individualized. This finding is noteworthy because contemporary perspectives on autonomy increasingly recognize its social dimension. Benson (2016) and Teng (2019) have argued that autonomy develops not only through self-regulation but also through interaction and collaborative participation. The present findings, therefore, suggest that AI-supported learning environments may be effective in strengthening different dimensions of autonomy. However, social aspects may require additional pedagogical support through collaborative activities and group-based learning tasks.

The second research question explored the students' experiences and perceptions of AI-driven instruction and its role in fostering reading autonomy. The qualitative findings from the interview data revealed that participants described ReadTheory as a resource that encouraged independent learning and increased learners' confidence in dealing with reading tasks. In details, three themes were especially prominent: the platform's tutor-like role, immediate feedback, and adaptivity and personalization. A recurring feature of participants' accounts was the perception

that the platform functioned as a form of individualized support. Learners frequently described ReadTheory as a resource that guided them through reading activities as well as helping them to work independently. This balance between support and independence appears important because learner autonomy does not develop through the complete removal of guidance. Autonomy often emerges when learners receive sufficient support to make decisions and evaluate their own progress. In this regard, the platform acted as a form of instructional scaffolding that encouraged learners to become increasingly self-reliant over time.

Participants attached considerable importance to feedback. Instant access to correct answers and explanations helped them identify mistakes and adjust their reading strategies more effectively. Several interviewees also reported that receiving immediate feedback increased their confidence because they no longer had to wait for teacher evaluation to determine whether they had understood a text successfully. These perceptions are consistent with Yin et al. (2024), who found that chatbot-supported formative feedback promotes learners' monitoring of their understanding through immediate and dialogic feedback, thereby strengthening metacognitive control and self-correction. Likewise, Hockly (2024) emphasized that AI can foster learner autonomy when learners critically evaluate AI-generated feedback, personalize their learning, and make informed learning decisions independently. These findings are further supported by Huang et al. (2023), who argued that AI-supported language learning environments enhance learner autonomy by providing adaptive feedback, personalized learning pathways, and intelligent support that encourage self-regulated learning.

Another notable finding was related to the motivational role of adaptive learning. Participants repeatedly referred to the feature of the platform to adjust task difficulty according to performance and described this process as helping them remain engaged because texts were neither excessively difficult nor overly simple. This balance appeared to create a learning experience that was appropriately challenging while still helping learners to experience success. Similar observations have been reported by Ji et al. (2023), who found that individualized support encourage learners to assume greater responsibility for their learning. The findings also resonate with Yin et al. (2024), who reported that AI-generated formative feedback strengthens reflective thinking and self-monitoring by providing timely and personalized responses. Comparable conclusions were also reached by Mohammadi Zenouzagh et al. (2023) who identified personalization as a key factor contributing to learner autonomy.

Interestingly, students rarely limited their comments to reading improvement. Many spoke about becoming more confident and taking greater responsibility for their own learning. These

perceptions are in line with the findings of Namaziandost and Rezai (2024), who reported positive associations between AI-assisted language learning environments, learner motivation, and autonomy. From a Self-Determination Theory perspective (Deci & Ryan, 2000), these outcomes may stem from the way the platform fostered both competence and autonomy while making progress visible to learners. At the same time, participants acknowledged that opportunities for peer interaction were limited. The platform effectively supported independent learning, yet it did not provide extensive opportunities for collaborative meaning-making or shared problem-solving. This observation echoed the quantitative findings concerning the social dimension of autonomy and reinforced Teng's (2019) argument that autonomy involved both individual and social processes. Consequently, future AI-supported learning environments may benefit from integrating collaborative features that help learners to engage with peers while retaining the advantages of personalized instruction.

6. Conclusion

The present study investigated whether AI-supported reading instruction could enhance EFL learners' autonomy. Those students who used ReadTheory achieved higher levels of reading autonomy than those in the control group, particularly in the cognitive, metacognitive, affective-motivational, and action-oriented dimensions. In contrast, no statistically significant improvement was observed in the social dimension of autonomy. The qualitative findings suggested that tutor-like system, adaptive feedback and personalized learning experiences encourage learners to monitor their own progress and develop a growing sense of responsibility to take control over their reading development. The results support the potential of AI-assisted learning environments to strengthen multiple dimensions of learner autonomy while also highlighting areas that may require additional pedagogical intervention.

Several pedagogical implications can be drawn from the present study for language teachers, curriculum developers, teacher educators, and educational policymakers. The findings suggest that incorporating AI-supported reading tools with adaptive feedback, personalized learning pathways, and progress-monitoring features can create learning environments that foster self-regulated learning. By providing timely guidance, individualized support, and opportunities for learners to monitor their progress, these features may encourage students to take a more active role in managing their learning, develop greater autonomy, and assume increased responsibility for their academic progress. Consequently, educators and curriculum designers may consider integrating such technologies into language instruction to complement teacher support and

promote learners' cognitive and metacognitive development.

However, some limitations should be considered when interpreting the findings. The study was conducted with a relatively small sample of intermediate EFL learners (54) within a specific educational context (an English language learning school in Kerman, Iran), which may limit the generalizability of the results. The intervention lasted only five weeks, preventing an examination of the long-term development of reading autonomy. This investigation addressed the efficacy of AI in the reading autonomy of EFL learners in a single temporal snapshot. While this provided valuable insights into students' immediate reading autonomy toward AI-driven instruction of reading, it did not investigate the participants' longitudinal autonomy. Furthermore, this study relied exclusively on self-reported data, as self-report measures were the most feasible approach for assessing the abstract construct of learner autonomy. In addition, the AI platform primarily supported individualized learning, which may explain the limited impact observed in the social dimension of autonomy. Finally, contextual factors in Iran, such as limitations in internet connectivity and technical infrastructure, may have influenced participants' use of the platform and, consequently, the study's findings.

Future studies are recommended to investigate the long-term effects of AI-driven instruction on the development and sustainability of reading autonomy in different educational settings and proficiency levels. Further studies could explore how AI technologies can better support the social dimension of autonomy by incorporating peer interaction and discussion-based learning activities. Additionally, comparative studies of different AI platforms and feedback systems may provide a clearer understanding of the design features that most effectively support learner autonomy in its various dimensions.

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