The Impact of Computerized Dynamic Assessment on Iranian EFL Learners' Pronunciation: The Moderating Role of Digitalized Feedback

Abstract

We explored Computerized Dynamic Assessment's (CDA) effect on Iranian English as a Foreign Language (EFL) learners' pronunciation skills, with a focus on the moderating role of Digitalized Corrective Feedback (CF). Three intact classes from a language institute in Shiraz, Iran, totaling 60 lower-intermediate EFL learners, were assigned randomly to control and experimental groups. The treatment conditions received either CDA-only or CDA-plus Digitalized CF interventions, while the control group received traditional online instruction without mediation. Pretest and posttest assessments were conducted using a teacher-made pronunciation test. Results revealed significant improvements in pronunciation skills among learners in the experimental groups compared to the control group. Particularly, the CDA-only group demonstrated notable enhancements in pronunciation accuracy, while the CDA-plus CF group exhibited even greater improvements. The integration of Digitalized CF with CDA proved particularly effective in providing personalized and targeted feedback, leading to substantial advancements in learners' pronunciation proficiency. These findings underscore the potential of technology-enhanced interventions, such as CDA and Digitalized CF, in enhancing pronunciation instruction and offer valuable insights for language educators, materials developers, syllabus designers, and policymakers. Embracing dynamic assessment practices and integrating technology into language education policies can foster more effective and engaging language learning experiences for EFL learners.

Keywords: Computerized Dynamic Assessment, Digitalized Corrective Feedback, Zone of Proximal Development, Pronunciation Skills

Introduction

Dynamic Assessment is proposed as a different set of assumptions against teaching to the test notion (Ravitch, 2010). Poehner and Lantolf (2013) believe that teaching to the test prioritize teaching and learning excellence leading up to the test, under the premise that this activity pauses during the test itself, and learner capacities remain consistent throughout the testing process. On the other hand, dynamic assessment which originated from Vygotsky's (1978) Socio-Cultural Theory (SCT), sheds light on the importance of instruction and assessment integration by considering key concepts of SCT, mediation, and zone of proximal development (ZPD).

Lantolf (2009) defined DA as a harmonious fusion of instruction and assessment into a fluid and dynamic process. Moreover, DA is based on the assumption that human skills manifest as individuals engage in guided activities and leverage cultural resources available to them (Poehner & Lantolf, 2013). To put it differently, as stated by Mehri Kamrood et al, (2019) utilizing ZPD-based mediation in DA methods not only facilitates a deeper understanding of learners' developmental diagnoses but also enhances their existing competence. According to Kargar Behbahani and Karimpour (2024), ZPD-mediation intends to assess a) the abilities of learners in identifying and resolving their own problems, b) the amount and efficacy of mediation needed by

learners, c) learners' development during assessment as a result of gaining control over L2 communication resources. Hence, learners' responsiveness to mediation can be considered as their progress and development (see Bakhoda & Shabani, 2019a; Poehner, 2008).

DA researchers (Bakhoda & Shabani, 2019a; Kargar Behbahani & Karimpour, 2024; Mehri Kamrood et al, 2019) believe that tracing learners' ZPD-based mediation could be electronically presented. In other words, since DA limits the mediator in providing mediation to the learners, CDA can tackle the limitation of DA by not just diagnosing pupils' fully matured skills but also their budding abilities by providing them with graduated assistance for challenging items and monitoring the level of support required for those tasks (Zhang & Lu, 2019). Therefore, a paramount advantage of the CDA over DA is that CDA tests have the potential to trace learners' development and assess their ZPDs.

There are a large number of burgeoning studies investigating DA in various contexts (Azizi & Namaziandost, 2023; Ghahderijani et al., 2021; Rezai et al., 2023, among many others) Further, literature records that to overcome the limitations proposed by DA mediations, researchers have turned to computerized delivery of mediations (Abdel-Al Ibrahim et al, 2023). Even though CDA studies have shed some light on second language (L2) education (e.g., Andujar, 2020; Kushki et al., 2022, among many others) to the best knowledge of researchers, studies are scarce regarding CDA on EFL learners' pronunciation.

A wealth of studies has examined feedback effectiveness in L2 pronunciation (e.g., Dai & Wu, 2023; Sippel & Martin, 2023). However, according to Baker and Burri (2016), despite pronunciation's essential role in communicative proficiency, the process of providing feedback on pronunciation is excessively time-intensive and demanding for teachers. Hence, many teachers may not bother themselves give feedback to their learners.

While traditional assessment methods often focus on evaluating learners' abilities at a fixed point in time, DA emerges as a promising alternative grounded in SCT, emphasizing instruction and assessment integration. However, despite its potential, DA's effectiveness may be constrained by the limitations in providing timely and tailored mediation to learners. In response to this challenge, CDA presents itself as a solution, offering the ability to diagnose learners' abilities, provide graduated support, and track their developmental progress efficiently.

Within the context of EFL instruction in Iran, where traditional assessment practices often prevail, the potential impact of CDA on learners' pronunciation remains largely unexplored. Despite the copious literature on DA and the efficacy of feedback in L2 pronunciation instruction, the intersection of CDA and its moderating effect on enhancing Iranian EFL learners' pronunciation skills remains inadequately investigated.

Therefore, this research seeks to address the following key queries:

1. What is the impact of CDA on Iranian EFL learners' pronunciation skills within the framework of SCT?
2. How does digitalized feedback, facilitated through CDA, moderate the relationship between DA and Iranian EFL learners' pronunciation improvement?
3. What is the comparative effect of CDA-only sessions and CDA-plus digitalized feedback on Iranian EFL learners' pronunciation skills?

By elucidating these questions, this study aims to contribute to both theoretical understanding and practical implications for language teaching and assessment in the Iranian EFL context, shedding light on the potential of technology-enhanced dynamic assessment in fostering effective pronunciation instruction and learner development.

Literature Review

Theoretical Framework

Computerized Dynamic Assessment

Initially conceptualized by Feuerstein to gauge the capacity of underperforming kids (Feuerstein et al., 1979), DA has primarily been utilized in assessing cognitive developmental potential by psychologists (Lidz, 1987, 1991; Lidz & Elliott, 2000). More recently, DA has emerged as an alternative to traditional static assessments like standardized tests. The objective of DA is not to supplant other forms of testing but to supplement them.

DA practices trace their origins back to Vygotsky's cognitive development theory and his concept of the ZPD (Minick, 1987; Vygotsky, 1978). Vygotsky (1978) explicates ZPD as the space between an individual's present developmental stage, evaluated by their independent problem-solving abilities, and the level of their potential development, assessed through their problem-solving tasks with adult guidance or collaboration with more proficient peers. Thus, the ZPD highlights capacities that are yet to be realized fully and functions still in the process of internalization. Mediation is a pillar of ZPD and forms the cornerstone of Vygotsky's SCT. Vygotsky theorized that advanced cognitive abilities are influenced by social and cultural factors, emerging from our interactions with individuals and with tangible and symbolic tools (e.g., literature, numerical systems, language, or computers) fashioned by others across diverse contexts and time frames (Lantolf & Poehner, 2004). In essence, our world connection is mediated.

The significance of ZPD in education lies in its focus on learner capabilities that are most responsive to instructional intervention. It involves a dynamic interplay between learners' current abilities and the challenges they face. This interplay is resolved through the provision of external forms of mediation, enabling learners to excel their present skills. Consequently, DA offers more than what static assessment methods can achieve alone. It not only enables assessors and teachers to grasp learners' current abilities but, more significantly, unveils their latent potential, which is currently emerging (Lantolf & Poehner, 2004).

Recently, there has been a surge in the adoption of CDA within EFL settings. CDA, rooted in SCT, seamlessly blends instruction and assessment by offering students tailored electronic mediation. This innovative approach draws on SCT principles and the learner-centric philosophy of DA, where educators intervene in students' activities to expand and enrich their learning potential while also assessing their progress (Van der Veen et al., 2016). Rather than merely providing correct answers, this approach utilizes computer technologies to offer instructional programs that reassess the covered topics, aiming to evaluate various competencies within the learners.

L2 Electronic Corrective Feedback

CF involves instructors and peers providing responses to learners' incorrect L2 utterances. The recent surge in research on oral CF stems from its importance in both pedagogy and theory. Educators are keen on determining the timing and method of integrating CF into classroom

teaching, while theorists, such as Krashen (1981) and Gass (1997), debate whether negative feedback, highlighting errors in the L2, is crucial for L2 development or if exposure to positive models alone suffices. Empirical investigations indicate that CF can enhance L2 proficiency, although its efficacy may be influenced by contextual variables and learner characteristics (Li, 2010; Lyster & Saito, 2010).

Lyster and Ranta (1997) delineate six corrective strategies. Consequently, in response to the faulty utterance 'He has dog,' one may:

- Reformulate it (recast) as 'A dog';
- Explicit correction by stating, 'No, you should say "a dog"';
- Clarification request with a prompt like 'Sorry?';
- Metalinguistic feedback such as 'You require an indefinite article';
- Prompt the correct form through elicitation by asking 'He has ...?'; or
- Repetition as 'He has dog?'

The potential of CF appears to be boosted with the rise of new technological tools capable of delivering automated corrective feedback (Klimova & Pikhart, 2022). While recent research has delved into electronic written CF (see Altamimi & Masood, 2021; Mohsen, 2022), there is a noticeable dearth of studies investigating various forms of digital CF. Notably, Altamimi and Masood's (2021) investigation highlights a limited exploration of diverse digital feedback formats in L2 learning tasks, with the majority of studies focusing on recasts and metalinguistic feedback. This trend aligns with the findings of Fathimah's (2020) research, wherein instructors predominantly employed recasts to address students' errors, while students themselves expressed a preference for direct and explicit feedback.

Empirical Studies on the Effect of CDA on L2 Learning

In perhaps the latest study on the efficacy of CDA in EFL learning, Kargar Behbahani and Karimpur (2024) delved into the transformative capacity of CDA on learners' explicit and implicit grasp of grammar. To investigate this phenomenon, these researchers implemented an interventionist CDA, wherein 27 learners received customized mediation during assessment, while a control group (N = 25) did not. The outcomes challenged the traditional dichotomy between explicit and implicit knowledge, demonstrating that CDA boosts proficiency in both facets of language proficiency.

Relatedly, Ebadi and Saeedian (2019) endeavored to explore the impact of CDA in unlocking learners' latent potential in enhancing reading comprehension skills. A cohort of 32 adult EFL students participated in this investigation. To gauge students' learning potential, the study employed Kozulin and Garb's (2002) methodology known as the Learning Potential Score (LPS). The LPS quantifies the extent of mediation likely required for individual learners or groups to progress in their learning journey. Findings revealed that learners with comparable pretest scores exhibited varying or markedly divergent DA posttest scores, leading to disparate LPS outcomes. Leveraging the principles of CDA, students deemed at-risk are presented with opportunities to address some of the hurdles encountered in traditional testing environments.

In another interesting study, Zangoei et al. (2019) presented the findings of a doctoral dissertation aimed at integrating assessment and instruction in L2 pragmatics comprehension using an interventionist CDA. In this method, the test is administered through a computerized platform that offers graduated hints, ranging from explicit to implicit, standardized for all participants. To facilitate this process, a web-based software named CDA of Speech Acts, Routines, and Implicatures (CDASRI) was developed. Participants in this study numbered 137 and ranged in age from 16 to 36, representing upper-intermediate to advanced proficiency levels, and were drawn utilizing convenience sampling. Participants engaged in the assessment. Based on the number of hints or mediations utilized by each participant, CDASRI provided three scores: the actual score (traditional assessment score), the mediated score (with hints), and the learning potential score. Statistics revealed that the test had a positive impact on test-takers' pragmatic comprehension skills. Additionally, a significant disparity between the mediated and actual scores of learners underscored variations in their responsiveness to mediation, influenced by their individual ZPD levels. Consequently, it can be inferred that conventional static assessments overlook a considerable portion of learners' capabilities by disregarding their potential for growth, focusing solely on their initial performance.

Another inquiry investigating CDA's utility for enhancing L2 acquisition is that of Estaji and Saeedian (2020). They delved into the utilization of DA and explored the effects of mediation provided through computer, human, and a combination of both on the reading comprehension of L2 learners. Employing a mixed-methods approach, 20 pupils were divided into three groups. Data collection involved the utilization of DIALANG as a placement test, two custom-made software programs, and the researcher as an evaluator. The qualitative analysis of transcripts provided insights into the dialogic exchanges between the mediator and learners, while the quantitative analysis, employing ANCOVA, revealed that posttest results showed less mediation and higher scores in the non-mediated category obtained through Non-Dynamic Assessment (NDA). Additionally, a comparison between the human-only and computer-only groups demonstrated no significant statistical difference ($p > .05$), suggesting similar influences of both types of mediation on text grasp. Furthermore, the results underscored computer-mediated mediation, particularly in conjunction with human mediation.

Based on the comprehensive literature review provided, it is evident that while DA and CDA have gained traction in language learning contexts, particularly in EFL settings, their application and impact on learners' pronunciation skills remain largely unexplored. While studies have delved into the transformative potential of CDA in enhancing various language skills, including grammar and reading comprehension, the specific effects of CDA on L2 pronunciation have not been investigated. Furthermore, the integration of electronic and digital CF with CDA to study their combined effect on L2 pronunciation has yet to be explored. Despite the growing body of literature on DA, CDA, and CF in language learning contexts, there appears to be a notable gap in research focusing on the intersection of these elements and their impact on pronunciation skills among Iranian EFL learners. Thus, we tackle this lacuna by exploring CDA's impact and digitalized CF on Iranian EFL learners' pronunciation proficiency, thereby contributing to a deeper understanding of dynamic assessment practices in language learning and pedagogy.

Method

Design

We employed a pretest-posttest control design, where pupils were initially assessed for their baseline pronunciation proficiency (pretest) before undergoing the intervention. Following the intervention, participants were reassessed (posttest) to measure any changes in their pronunciation skills. The control group (CG) underwent the same assessment procedure but did not receive the intervention, allowing for comparison with the experimental group (EG) to evaluate the intervention's efficacy in improving pronunciation proficiency.

Setting and Participants

The inquiry was set at a prominent academy situated in Shiraz, Iran, with participants drawn from three intact classes. Each class comprised 20 learners, evenly distributed between male and female students, and aged between 18 and 21 years old. All participants shared Farsi as their first language (L1) and were learning English as their L2. Notably, none of the learners had prior experience visiting an English-speaking country. The participants were randomly assigned to one of three groups: the CG, which received no intervention; an Experimental Group (EG1) receiving CDA only; and another Experimental Group (EG2) receiving both CDA and electronic Corrective Feedback (CF). Additionally, using an Oxford Quick Placement Test (OQPT), all the pupils were identified as lower-intermediate ones.

Instruments

The study utilized several instruments to assess the participants' pronunciation accuracy and proficiency. Firstly, the OQPT was administered, revealing that all learners were lower-intermediate EFL learners. The primary textbook used for instruction was American English File 2. To evaluate language learners' pronunciation accuracy, a teacher-made test consisting of 100 words was employed. Each correctly pronounced word was assigned a score of .25 points. This test's content validity was ensured by selecting words from the textbook and corroborating the content validity through consultation with two PhD holders in Applied Linguistics. Additionally, the test's construct validity was established using the known-group technique (Ary et al., 2019), where 10 language teachers sat the same test, showing performance distinct from the participants at the study's outset. For the posttest, another validated teacher-made test was administered. It's worth noting that the classes were conducted online using the Google Meet platform.

The study employed a variety of tools to thoroughly evaluate the participants' pronunciation accuracy and overall proficiency in EFL. Initially, the OQPT was administered to ascertain the participants' English proficiency level, revealing that all learners fell within the lower-intermediate range. Throughout the instructional period, the primary textbook utilized was American English File 2, providing structured content for language learning. To meticulously gauge the participants' pronunciation accuracy, a teacher-crafted test comprising 100 words was meticulously designed. Each correctly pronounced word was assigned a score of .25 points, ensuring a granular assessment. The test's content validity was rigorously maintained by meticulously selecting words directly from the textbook, while further validation was ensured through consultations with two esteemed PhD holders in Applied Linguistics, who provided invaluable insights and validation. Additionally, the construct validity of the test was fortified using the known-group technique (Ary et al., 2019), involving 10 experienced language teachers who completed the same test, demonstrating distinct performance compared to the participants at the study's outset ($p > .05$), thereby affirming the test's ability to effectively measure the targeted constructs. For the posttest evaluation, another meticulously crafted and validated teacher-made test was administered, ensuring consistency and reliability in assessment practices. It is noteworthy that all classes were

conducted online using the Google Meet platform, facilitating seamless communication and instruction.

Treatment

The treatment was meticulously designed to explore the impact of CDA and Electronic CF on Iranian EFL learners' pronunciation proficiency. In the classrooms where CDA was implemented, the instructional environment was characterized by dynamic and interactive sessions facilitated through computer-mediated activities. Learners engaged with the Google Meet platform that provided tailored tasks and assessments, dynamically adjusting to individual learning needs. For example, learners engaged in pronunciation exercises where the mediator offered varying levels of support based on their performance, effectively targeting their ZPD. In contrast, classrooms utilizing Electronic CF incorporated technology-driven feedback mechanisms, where learners received immediate and personalized feedback on their pronunciation errors. This feedback could take various forms, such as visual cues highlighting mispronounced words or audio recordings providing correct pronunciation models. For instance, learners recorded their pronunciation attempts and received instant feedback on areas needing improvement, allowing for targeted practice and refinement of pronunciation skills.

In both CDA and Electronic CF classrooms, the instructional approach focused on facilitating learner engagement and autonomy while leveraging technology to enhance learning outcomes. For instance, learners in CDA classrooms engaged in interactive pronunciation drills where the mediator adapted the difficulty level based on their performance, providing scaffolding and support as needed. Similarly, learners in Electronic CF classrooms utilized pronunciation apps or online platforms that offer real-time feedback on their pronunciation attempts, allowing for immediate correction and improvement.

On the other hand, participants in the CG experienced a different instructional setting. While their classes were also conducted online, they received traditional teacher-fronted sessions without the integration of mediation or ZPD-sensitive instruction. In essence, they did not benefit from the dynamic and personalized learning experiences offered in the CDA and Electronic CF classrooms. Instead, their instruction followed a more conventional approach, focusing on teacher-led lectures and exercises without the tailored support and feedback provided by technology-enhanced interventions.

Data Analysis Procedures

The study's first objective is to ensure the efficacy of CDA in enhancing Iranian EFL learners' pronunciation. Another objective is to ascertain the effect of digitalized CF in facilitating EFL learners' L2 pronunciation. As a result, to measure CDA's effect on L2 pronunciation, an independent samples t-test was conducted. Similarly, to ensure the effect of digital CF coupled with CDA, another t-test was performed to help us see the EG2 and the CG disparity. Finally, to find out the comparative effect of CDA-only and CDA-plus digital feedback a further t-test was run.

Findings

The Potentials of CDA-only Sessions on L2 Pronunciation

The first objective targeted the potential of CDA-only sessions on Iranian EFL learners' pronunciation skills. To this end, a t-test was needed to compare and contrast the performance of EG1 and the CG on the pre-and posttest. However, a one-way Kolmogorov-Smirnov (K-S) Test, was first run to ensure data normality.

Table 1.

One-Sample Kolmogorov-Smirnov Test

		Pretest Scores	Posttest Scores
N		60	60
Normal Parameters	Mean	2.900	10.333
	Std. Deviation	1.271	5.876
Most Extreme Differences	Absolute	.169	.128
	Positive	.169	.126
	Negative	-.131	-.128
Kolmogorov-Smirnov Z		1.306	.995
Asymp. Sig. (2-tailed)		.166	.275

Table 1 indicates that on both pretest and posttest, the data was normally distributed ($p > .05$).

Table 2.

Group Statistics on the Pretest

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest Scores	CDA-only	20	3.050	1.234	.276
	CG	20	3.150	1.268	.283

Table 2 demonstrates that both CDA-only ($N = 20$, $M = 3.050$, $SD = 1.234$) and the CG ($N = 20$, $M = 3.150$, $SD = 1.268$) performed similarly on the pretest.

Table 3.

Independent Samples Test on the Pretest

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper

Pretest Scores	Equal variances assumed	.016	.899	-.253	38	.802	-.100	.395	-.901	.701
	Equal variances not assumed			-.253	37.973	.802	-.100	.395	-.901	.701

Table 3 reveals that on the pretest, no disparity was observed between the CDA-only group and the CG (t = -.253, df = 38, p > .05).

Table 4.

Group Statistics on the Posttest

	Group	N	Mean	Std. Deviation	Std. Error Mean
Posttest Scores	CDA-only	20	12.000	2.675	.598
	CG	20	3.100	1.552	.347

Table 4 illustrates that the CDA-only group (N = 20, M = 12.000, SD = 2.675) outperformed the CG (N = 20, M = 3.100, SD = 1.552) on the posttest.

Table 5.

Independent Samples Test on the Posttest

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Posttest Scores	Equal variances assumed	2.150	.151	12.867	38	.000	8.900	.691	7.499	10.300
	Equal variances not assumed			12.867	30.494	.000	8.900	.691	7.488	10.311

Table 5 illustrates a significant difference on the posttest in favor of the CDA-only condition (t = 12.867, df = 38, p = .001) with a large effect size (.760).

The Potentials of CDA-plus Digitalized CF on L2 Pronunciation

As, through the conduction of the K-S Test, the data normality had been assumed (p > .05), a t-test was run to examine the potential of CDA-plus Digitalized CF on L2 pronunciation.

Table 6.

Group Statistics on the Pretest

	Group	N	Mean	Std. Deviation	Std. Error Mean

Posttest Scores	CDA-plus CF	20	2.500	1.277	.285
	CG	20	3.150	1.268	.283

As shown in Table 6, the CDA-plus CF (*N* = 20, *M* = 2.500, *SD* = 1.277) performed similarly to the CG (*N* = 20, *M* = 3.150, *SD* = 1.268) on the pretest.

Table 7.

Independent Samples Test on the Pretest

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pretest Scores	Equal variances assumed	.058	.810	-1.615	38	.115	-.650	.402	-1.464	.164
	Equal variances not assumed			-1.615	37.998	.115	-.650	.402	-1.464	.164

Table 7 discloses no significant difference between the conditions on the pretest (*t* = 38, *df* = 38, *p* > .05).

Table 8.

Group Statistics on the Posttest

	Group	N	Mean	Std. Deviation	Std. Error Mean
Posttest Scores	CDA-plus CF	20	15.900	2.653	.593
	CG	20	3.100	1.552	.347

On the posttest, as indicated in Table 8, the CDA-plus CF (*N* = 20, *M* = 15.900, *SD* = 2.653) outperformed the CG (*N* = 20, *M* = 3.100, *SD* = 1.552).

Table 9.

Independent Samples Test on the Posttest

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	

									Lower	Upper
Posttest Scores	Equal variances assumed	7.335	.010	18.619	38	.000	12.800	.687	11.408	14.191
	Equal variances not assumed			18.619	30.643	.000	12.800	.687	11.397	14.202

As revealed in Table 9, the EG2 significantly outperformed the CG on the posttest (t = 18.619, df = 30,643, p = .001) with a large effect size (.823).

The Comparative Effect of CDA-only and CDA-plus CF on L2 Pronunciation

To compare and contrast the efficacy of CDA-only and CDA-plus CF on L2 pronunciation, a t-test was conducted.

Table 10.

Group Statistics on the Pretest

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest Scores	CDA-only	20	3.050	1.234	.276
	CDA-plus CF	20	2.500	1.277	.285

Table 10 shows that on the pretest, both CDA-only (N = 20, M = 3.050, SD = 1.234) and CDA-plus CF (N = 20, M = 2.500, SD = 1.277) performed almost the same.

Table 11.

Independent Samples Test on the Pretest

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pretest Scores	Equal variances assumed	.142	.708	1.385	38	.174	.550	.397	-.254	1.354
	Equal variances not assumed			1.385	37.956	.174	.550	.397	-.254	1.354

Based on Table 11, the difference between the two EGs was minute on the pretest (t = 1.385, df = 38, p > .05).

Table 12.

Group Statistics on the Posttest

	Group	N	Mean	Std. Deviation	Std. Error Mean
Posttest Scores	CDA-only	20	12.000	2.675	.598
	CDA-plus CF	20	15.900	2.653	.593

According to Table 12, the CDA-plus CF (N = 20, M = 15.900, SD = 2.653) outperformed the CDA-only (N = 20, M = 12.000, SD = 2.675) on the posttest.

Table 13.

Independent Samples Test on the Posttest

		Levene's Test Equality of Variances		fort-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Posttest Scores	Equal variances assumed	.393	.535	-4.628	38	.000	-3.900	.842	-5.605	-2.194
	Equal variances not assumed			-4.628	37.997	.000	-3.900	.842	-5.605	-2.194

Table 13 showcases that, on the posttest, a significant difference was observed between the two EGs in favor of the CDA-plus CF (t = -4.628, df = 38, p = .001) with a large effect size (.327).

Discussion

The findings offer valuable insights into the effectiveness of different interventions aimed at improving Iranian EFL learners' pronunciation skills. Firstly, the results demonstrated that CDA alone significantly contributed to enhancing learners' pronunciation proficiency. This aligns with previous research emphasizing the benefits of dynamic assessment approaches in language learning contexts (Kargar Behbahani & Karimpur, 2024; Ebadi & Saeedian, 2019). The integration of CDA facilitated personalized learning experiences, allowing learners to receive tailored support and feedback based on their individual needs. This dynamic interaction between learners and computer-mediated tasks effectively targeted their ZPD, enabling them to perform beyond their current skill level (Lantolf & Poehner, 2004). Thus, the findings underscore the efficacy of CDA as a viable approach to improving pronunciation skills among Iranian EFL learners.

Secondly, the study revealed that combining CDA with Digitalized CF resulted in even greater improvements in pronunciation proficiency. This finding highlights the benefits of incorporating feedback mechanisms into language learning interventions (Li, 2010; Lyster & Ranta, 1997). The integration of Digitalized CF provided learners with immediate and personalized feedback on their

pronunciation errors, allowing for targeted practice and refinement of pronunciation skills. The combination of CDA and Digitalized CF offered a synergistic effect, leveraging the strengths of both approaches to maximize learning outcomes. This emphasizes the importance of integrating technology-enhanced feedback mechanisms into dynamic assessment practices to enhance pronunciation instruction effectively.

Furthermore, the comparison between CDA-only sessions and those incorporating CDA-plus CF revealed that the latter yielded significantly greater improvements in pronunciation skills. This suggests that the addition of Digitalized CF to CDA interventions enhances the efficacy of pronunciation instruction, leading to more pronounced advancements in learners' proficiency. The results highlight the complementary nature of CDA and Digitalized CF, with the combination of both interventions offering the most significant benefits in terms of pronunciation improvement. This underscores the importance of considering a holistic approach to language instruction, integrating multiple strategies and resources to optimize learning outcomes.

The findings align closely with the theoretical framework of CDA rooted in Vygotsky's cognitive development theory and his concept of the ZPD. Vygotsky's framework emphasizes the importance of mediation in facilitating learning and cognitive development, highlighting the role of interactions with more knowledgeable others and culturally mediated tools in advancing learners' abilities (Lantolf & Poehner, 2004; Vygotsky, 1978). In this study, the implementation of CDA interventions provided learners with personalized and dynamic learning experiences, tailored to their individual needs and abilities. By dynamically adjusting tasks and assessments based on learners' performance, CDA facilitated interactions within their ZPD, enabling them to perform beyond their current skill level. This resonates with Vygotsky's notion that learning occurs most effectively when learners are guided and supported in a zone where their abilities are not fully realized but are emerging (Lantolf & Poehner, 2004).

Furthermore, the integration of Digitalized CF into CDA interventions further underscores the learner-centric philosophy of CDA and its alignment with Vygotsky's framework. Digitalized CF provided learners with immediate and personalized feedback on their pronunciation errors, serving as a form of mediation to guide their learning process. This interaction between learners and technology, mediated by instructional programs and feedback mechanisms, reflects Vygotsky's (1978) emphasis on external mediation's role in facilitating learning and development. Additionally, the facilitation observed in pupils' pronunciation following the combination of CDA and Digitalized CF highlights the synergistic effect of integrating technology-enhanced interventions within the framework of CDA, enabling learners to achieve meaningful advancements in their proficiency.

The findings contribute novelty to the field of language education by exploring CDA's impact on Iranian EFL learners' pronunciation skills, while also exploring the moderating role of Digitalized CF. This study represents the first attempt to examine the effect of CDA on pronunciation among Iranian EFL learners, addressing a significant gap in the existing literature. Furthermore, by integrating Digitalized CF with CDA, this study offers a novel approach to pronunciation instruction, leveraging technology-enhanced interventions to enhance learning outcomes. The innovative combination of CDA and Digitalized CF provides a unique framework for personalized and dynamic pronunciation instruction, offering valuable insights into the potential of technology-enhanced approaches in language learning contexts. Overall, this inquiry adds to the growing body of research on dynamic assessment practices and the integration of technology in language

education, advancing our understanding of effective strategies for pronunciation instruction in EFL settings.

These findings offer valuable implications for stakeholders in language pedagogy. For language teachers, the findings offer valuable insights into the efficacy of CDA combined with Digitalized CF in improving learners' pronunciation skills. By incorporating technology-enhanced interventions into their teaching practices, language teachers can provide personalized and dynamic learning experiences tailored to individual learners' needs and abilities. The integration of CDA and Digitalized CF allows teachers to offer immediate and targeted feedback on pronunciation errors, facilitating learners' progress and development in real time. Additionally, the study highlights the importance of incorporating dynamic assessment practices into language instruction, emphasizing the value of assessing learners' abilities within their Zone of Proximal Development (ZPD) to maximize learning outcomes. Language teachers can leverage the findings of this study to enhance their teaching methodologies and effectively address pronunciation challenges in the classroom.

For materials developers, the study underscores the potential of technology-enhanced interventions, such as CDA and Digitalized CF, in enhancing pronunciation instruction materials. By integrating these innovative approaches into language learning materials, developers can create interactive and adaptive resources that cater to learners' individual needs and promote meaningful engagement with pronunciation tasks. The incorporation of CDA and Digitalized CF into materials design can offer learners opportunities for personalized practice and feedback, fostering a more dynamic and effective learning environment. Furthermore, materials developers can utilize the findings of this study to design resources that align with the principles of dynamic assessment and facilitate learners' development within their ZPD, ultimately enhancing the quality and effectiveness of pronunciation instruction materials.

For syllabus designers, the study provides valuable insights into the integration of technology-enhanced interventions into language learning curricula. By incorporating CDA and Digitalized CF into syllabus design, designers can create comprehensive and innovative programs that prioritize pronunciation instruction and address learners' individual learning needs. The integration of these approaches into syllabi can offer learners opportunities for personalized assessment and feedback, ensuring that pronunciation instruction is tailored to their specific abilities and goals. Additionally, syllabus designers can leverage the findings to develop curricula that promote dynamic assessment practices and facilitate learners' progress within their ZPD, ultimately enhancing the overall quality and effectiveness of language learning programs.

For policymakers, the study highlights the importance of supporting the integration of technology-enhanced interventions into language education policies and initiatives. By recognizing the potential of approaches such as CDA and Digitalized CF in improving pronunciation instruction, policymakers can advocate for the implementation of innovative strategies that enhance learning outcomes for EFL learners. Additionally, policymakers can prioritize the integration of dynamic assessment practices into language education policies, ensuring that assessment practices align with current research findings and best practices in the field. Furthermore, policymakers can support initiatives aimed at providing teachers with training and resources to effectively integrate technology-enhanced interventions into their teaching practices, ultimately promoting more dynamic and learner-centered approaches to language instruction. By embracing the implications of this study, policymakers can contribute to the advancement of language education policies that

prioritize the integration of technology and dynamic assessment practices, ultimately enhancing the quality and effectiveness of pronunciation instruction for EFL learners.

For parents, this study highlights the importance of embracing technology-enhanced language learning interventions to support their children's pronunciation development. By encouraging their children to engage with CDA and Digitalized CF, parents can provide valuable opportunities for personalized and targeted learning experiences at home. Additionally, parents can play an active role in advocating for the integration of dynamic assessment practices and technology-enhanced interventions in their children's language learning curriculum. By staying informed about innovative approaches to language instruction and supporting their children's engagement with technology-enhanced learning resources, parents can contribute to their children's overall language proficiency and academic success.

For learners, this study underscores the potential of CDA and Digitalized CF in facilitating pronunciation improvement and overall language development. Learners can take an active role in leveraging technology-enhanced interventions to enhance their pronunciation skills by engaging with CDA and Digitalized CF platforms. By embracing dynamic assessment practices and utilizing technology-enhanced learning resources, learners can personalize their language learning experience, receive immediate feedback on their pronunciation errors, and track their progress over time. Additionally, learners can advocate for the integration of CDA and Digitalized CF in their language learning curriculum, encouraging educators to adopt innovative approaches to pronunciation instruction that prioritize individualized learning and growth.

For school principals, this study provides valuable insights into the potential benefits of integrating technology-enhanced interventions, such as CDA and Digitalized CF, into language learning curricula. School principals can support language educators in adopting dynamic assessment practices and leveraging technology to enhance pronunciation instruction. By providing teachers with access to training and resources on CDA and Digitalized CF, school principals can empower educators to create more dynamic and effective language learning environments. Additionally, school principals can advocate for the allocation of resources towards the implementation of technology-enhanced interventions in language education, recognizing the importance of innovative approaches in promoting students' language proficiency and academic achievement. Through strategic leadership and support, school principals can foster a culture of innovation and excellence in language education, ultimately enhancing the overall learning experience for students.

Conclusion

In conclusion, this study has shed light on the effectiveness of CDA and its integration with Digitalized CF in enhancing Iranian EFL learners' pronunciation skills. Through the implementation of CDA interventions, learners were provided with personalized and dynamic learning experiences that facilitated interactions within their ZPD, enabling them to perform beyond their current skill level. Additionally, the integration of Digitalized CF further enhanced the effectiveness of CDA interventions, offering learners immediate and targeted feedback on pronunciation errors. The findings of this study underscore the potential of technology-enhanced interventions in promoting meaningful advancements in pronunciation proficiency and contribute novel insights to the field of language education.

Furthermore, this study has important implications for language teachers, materials developers, syllabus designers, and policymakers. Language teachers can leverage the findings of this study to enhance their teaching methodologies and effectively address pronunciation challenges in the classroom. By incorporating technology-enhanced interventions into language learning materials and syllabi, materials developers and syllabus designers can create comprehensive and innovative resources that promote dynamic and effective pronunciation instruction. Additionally, policymakers can support initiatives aimed at integrating technology and dynamic assessment practices into language education policies, ultimately enhancing the quality and effectiveness of pronunciation instruction for EFL learners.

Overall, this study adds to the growing body of research on dynamic assessment practices and the integration of technology in language education. By demonstrating the effectiveness of CDA and Digitalized CF in improving pronunciation skills, this study provides valuable insights into innovative approaches to language instruction. Moving forward, further research is warranted to explore additional factors influencing pronunciation proficiency and to investigate the long-term effects of technology-enhanced interventions on language learning outcomes. Through continued investigation and innovation, language educators can continue to refine their approaches to pronunciation instruction, ultimately fostering more effective and engaging language learning experiences for EFL learners.

In brief, the study recognizes the transformative potential of technology-enhanced interventions, such as CDA and Digitalized CF, in language education. Witnessing the significant improvements in learners' pronunciation skills, particularly when CDA was combined with Digitalized CF, reinforces belief in the efficacy of DA practices and the value of integrating technology into language learning environments. The findings are encouraged by the personalized and targeted learning experiences facilitated by CDA and Digitalized CF, which empower learners to take ownership of their language development journey. Moreover, the researchers acknowledge the importance of continued research and innovation in DA practices and technology-enhanced interventions, recognizing that there is still much to learn about how best to support language learners' needs and optimize their learning outcomes. Moving forward, the researchers are committed to further exploring the potential of CDA and Digitalized CF in language education and advocating for their integration into language learning curricula on a broader scale. Through ongoing reflection and collaboration, future researchers can contribute to the advancement of effective and engaging language instruction practices, ultimately enriching the language learning experiences of EFL learners worldwide.

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