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Bridging Criticality and Digital Literacy in the Age of AI: A Mixed-Method Comparative Study of Teachers' and Learners' Perceptions of Critical Digital Pedagogy in Iranian EFL Institutes

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Abstract

This mixed-methods study examined Iranian EFL teachers' and learners' perceptions of critical digital pedagogy within AI-enhanced learning environments across several private language institutes. Grounded in Freirean critical pedagogy and digital literacy frameworks, the study explored how engagement with AI-assisted tools influences attitudes, pedagogical awareness, and agency in language learning [1,2]. Participants included 15 teachers and 60 learners who completed pre- and post-intervention surveys and semi-structured interviews over six weeks. Quantitative findings indicated significant improvement in both groups' digital literacy and pedagogical attitudes, with positive correlations between AI familiarity, self-efficacy, and critical engagement. Qualitative analysis of interview data revealed four emergent themes: 1) democratization of classroom dialogue through AI mediation, 2) redefined teacher identity and learner agency, 3) ethical and emotional ambivalence toward AI tools, and 4) the rise of reflective digital citizenship. Together, these findings suggest that AI-supported environments can foster the humanistic and emancipatory goals of critical pedagogy while reshaping traditional power dynamics in EFL instruction. The study underscores the need for teacher training programs that integrate AI literacy with critical pedagogical reflection to ensure equitable and transformative digital practices in education quality. These findings position Critical Digital Pedagogy as a viable framework for integrating AI technologies in ways that sustain dialogic engagement, ethical awareness, and learner agency.

Keywords: AI-enhanced Learning, Critical Digital Pedagogy, Digital Literacy, EFL, Freirean Pedagogy, Mixed-Methods

1. Introduction

The accelerating integration of artificial intelligence (AI) and digital technologies into education has transformed how knowledge is produced, shared, and experienced worldwide [3-5]. Yet, these rapid changes have also intensified concerns about inequality, algorithmic bias, and the erosion of humanistic values in teaching. Globally, educators are seeking pedagogical models that can critically engage with AI's social, ethical, and epistemic implications rather than merely adopting digital tools for efficiency [6,7]. This tension (between technological innovation and critical awareness) creates an urgent research gap: how can educators and learners cultivate agency, reflection, and ethical responsibility in AI-mediated learning environments? Addressing this question is particularly timely as educational systems worldwide grapple with balancing automation with democratic, human-centered pedagogy.

In response to this global challenge, the present study draws upon Freirean critical pedagogy to frame AI and digital literacy as tools for emancipation rather than domination. Freire (1970) viewed education as a dialogic and transformative process through which learners develop critical consciousness [8]. When merged with contemporary digital and AI literacies, this framework provides a means to examine how technology can foster (not hinder) equitable participation and reflective dialogue [9]. Integrating these perspectives allows for a reconceptualization of classroom power dynamics, positioning AI not as a neutral assistant but as a catalyst for critical inquiry and shared knowledge creation [10].

The rapid integration of digital technologies and AI into education has profoundly transformed the pedagogical landscape, including English as a Foreign Language (EFL) instruction. In contexts such as Iran, where private language institutes serve as key sites of English education, digital learning environments are becoming increasingly prevalent. Yet, these technological shifts often reproduce traditional hierarchies and teacher-centered instruction rather than promoting learner agency or critical engagement. As Giroux (2020) contends, education in the digital age must not only transmit knowledge but also cultivate critical consciousness—an awareness of the social, political, and ethical dimensions of technology use. This transformation calls for an instructional paradigm that integrates Freirean critical pedagogy (Freire, 1970) with digital literacy and AI literacy, empowering both teachers and learners to question, interpret, and co-create knowledge in technologically mediated spaces.

Recent years have witnessed growing scholarly interest in Critical Digital Pedagogy (CDP), as an approach that reimagines traditional critical pedagogy within online and AI-supported learning contexts [1,11-13]. CDP positions digital tools not as neutral delivery systems but as ideological constructs that shape how knowledge is produced and circulated [14]. As Tan, Voogt, and Tan (2024) argue, digital pedagogy must evolve beyond mere tool use to encompass reflexive and ethical engagement with technology. Similarly, Allen and Kendeou (2024) emphasize that AI literacy in education requires understanding how algorithms structure information access and representation. Within the EFL field, these perspectives are particularly significant: language learning is inherently dialogic and cultural, and digital mediation profoundly affects how learners interact, negotiate meaning, and perceive their social roles [15,16].

Despite this theoretical momentum, empirical research applying CDP principles in EFL contexts remains limited, especially in the Global South [14,17]. Iranian studies have historically emphasized critical pedagogy's influence on reading comprehension and learner empowerment, yet few have examined how teachers and learners conceptualize digital forms of critical practice. Moreover, while AI-enhanced platforms such as ChatGPT, Grammarly, or Google Classroom are increasingly embedded in Iranian EFL instruction, little is known about how these technologies affect participants' critical awareness and pedagogical values [11,18-21]. Comparative insight into both teachers' and learners' perceptions could therefore illuminate how Critical Digital Pedagogy is understood, enacted, and resisted in contemporary language education.

The present study responds to these gaps by conducting a mixed-method comparative investigation into Iranian EFL teachers' and learners' perceptions of Critical Digital Pedagogy before and after a structured six-week intervention. The study integrates Freirean concepts of dialogue, empowerment, and conscientization with digital and AI literacy frameworks [2,22]. The intervention employed online collaborative projects and reflective discussions using digital tools, including AI-based text generators, to foster critical engagement with technology and language. By combining quantitative survey data with qualitative interview insights, the study seeks to capture not only measurable shifts in perception but also the lived experiences underlying these transformations.

This inquiry is timely for several reasons. First, as post digital education increasingly intertwines human and technological agency, both teachers and learners must develop critical awareness of how power, identity, and access shape digital learning [23]. Second, AI technologies have intensified debates around authorship, authenticity, and epistemic justice in language education [24]. Understanding how EFL practitioners and learners navigate these issues can inform more equitable and reflexive pedagogical frameworks (Zare et al., 2021b) [25]. Third, comparing teachers' and learners' perceptions can reveal potential mismatches in expectations and readiness, which are essential for sustainable integration of critical digital practices. Accordingly, this study addresses three key research questions:

- RQ1: How do Iranian EFL teachers and learners perceive the principles of Critical Digital Pedagogy before and after participating in a CDP-based intervention?
- RQ2: Are there significant differences between teachers' and learners' perceptions of CDP across pre- and post-intervention phases?
- RQ3: How do teachers and learners describe their experiences and challenges in implementing or engaging with CDP-oriented digital practices?

By situating Critical Digital Pedagogy within Iranian EFL institutes, this research aims to extend global understandings of critical digital literacy in AI-enhanced environments. It contributes to theory by integrating Freirean pedagogy with emerging AI literacy discourses and to practice by offering actionable insights for designing equitable, empowering digital language education.

2. Literature Review

2.1. Critical Pedagogy in Language Education

The notion of critical pedagogy traces to Paulo Freire's foundational work, in which education is understood as a process of conscientization (critical awareness) rather than mere banking of knowledge (Freire, 1970). In language education, this implies that learners become agents who reflect on and transform their linguistic and social realities, rather than passive recipients of target-language forms. As Henry A. Giroux (2020) reiterates, the classroom is a site of cultural politics and must engage learners in questioning power, identity and representation. For EFL contexts (especially in contexts such as Iran) critical pedagogy has been applied to reading comprehension, vocabulary development and learner motivation where critical strategies were used to improve Iranian EFL learners' reading comprehension through critical pedagogy [11]. This body of work emphasises the importance of learners' voices, reflection and dialogic practice in language classrooms.

In the field of English language teaching (ELT), critical perspectives have deepened in recent years. Velásquez-Hoyos &

Villegas López (2024) argue that emerging trends in ELT require addressing social inequalities, language ideologies and the power dimensions of language teaching. Their review emphasises that language pedagogy cannot remain neutral but must engage with identity, culture and justice. Moreover, in EFL contexts instructors often operate under structural constraints (policy, curriculum, exam pressures) that challenge the full enactment of critical pedagogy. Hence, investigating how critical pedagogical aims translate into actual classroom practice remains imperative.

In sum, critical pedagogy in language education frames the classroom as a space of empowerment. For the present study, the key take-aways are: (a) learners and teachers need to reflect on the sociopolitical dimensions of language learning, (b) dialogue and collaborative inquiry are essential, and (c) agency and voice must be central. These theoretical insights guide how CDP might be conceptualized for EFL contexts.

2.2. Digital and Critical Digital Pedagogy

The term "digital pedagogy" has gained currency as educational contexts increasingly incorporate online, blended and technology-mediated instruction. Yet, as Suárez-Guerrero, Gutiérrez-Esteban & Ayuso-Del Puerto (2024) show in a systematic review, the conceptualization of digital pedagogy is not homogeneous: they found two dominant semantic fields—one oriented towards methodology and tool use, and the other oriented towards critical/political understandings of pedagogy and technology. In their words, "the term 'digital pedagogy' should not be conflated with the deployment of 'digital tools'" (p. 453).

CDP builds upon both strands by explicitly interrogating how digital technologies shape knowledge production, interaction, power and identity (Stommel, 2014; Morris & Stommel, 2018). Morris & Stommel (2018) emphasise that digital tools are not neutral—they carry assumptions about access, participation, surveillance, and commodification of learning. For instance, they ask: Who controls the platform? Whose voice is elevated or concealed? What are the implications of algorithmic mediation of student contributions?

In language education, the interplay between digital pedagogy and critical pedagogy is still emerging. The special collection edited by Spence & Brandão (2020) on "Critical Digital Pedagogies in Modern Languages" illustrates that although language practitioners increasingly use digital tools (CALL, MALL, TELL), there is often uncertainty about how to integrate critical literacies and identity thinking. Their survey found that although many language practitioners are comfortable with digital engagement, fewer feel prepared to engage with the ideological or critical dimensions of digital mediation.

Empirical research supports this gap. For example, the study "Digital learning and the ESL online classroom in higher education: teachers' perspectives" (2023) examined how university EFL teachers in Hong Kong perceived the shift to online instruction. While teachers appreciated flexibility, they also reported concerns about engagement, community and maintaining dialogic interaction. These mixed outcomes suggest that simply shifting to digital spaces does not automatically engender critical pedagogy. Thus, CDP requires intentional design of digital tasks that foreground power, voice, reflection and collaboration rather than just content delivery.

In the Iranian EFL context, although critical pedagogy has been applied, less attention has been paid to how digital contexts (and increasingly AI-mediated environments) affect teacher and learner perceptions of critical pedagogy. This gap is one of the motivating factors behind the present study [11].

2.3. Digital Literacy, AI Literacy, and Language Learning

Digital literacy has traditionally been defined as the ability to access, evaluate, create, and communicate information using digital technologies. However, recent scholarship argues that the rise of AI, algorithmic mediation, and generative tools require a rethink of literacy definitions. Tiernan's review shows that existing frameworks for digital literacy have been slow to respond to AI's implications, recommending a more agile, participatory, and critical approach to digital/AI literacy.

Similarly, Walter (2024) argues that AI literacy in higher education must include not only technical understanding of AI tools, but also critical thinking about prompt engineering, ethical implications, and societal impact. AI literacy thus becomes an extension of digital literacy, which requires learners and teachers to question how generative algorithms, data biases, and platform affordances shape what counts as "knowledge".

In language learning settings, digital and AI literacies influence how learners engage with tools such as chatbots, automated feedback systems, online corpora, or language-learning apps [26]. For instance, while CALL has been widely studied, the critical dimension (how learners negotiate identity, agency, and mediation through digital tools) is underexplored. The work of Tan, Voogt & Tan (2024) presents a framework for digital pedagogy emphasizing design and enactment in language learning environments [22]. Though the exact article could not be accessed in full, the broader literature maintains that effective digital pedagogy in language contexts now must account for multiliteracies, multimodal meaning-making, and critical digital literacies.

Moreover, AI literacy frameworks emphasize socio-technical dimensions: Mills (2024) describes a four-pillar model of AI literacy: 1) understanding AI scope and technical dimensions; 2) interacting responsibly with generative AI; 3) considering socio-technical issues (bias, ethics); and 4) reflecting on social/future implications. For EFL education, this means teachers and learners should not only use digital tools, but reflect on how those tools influence interaction, authorship, voice and power.

2.4. Bridging the Gaps: Need for Comparative Mixed-Method Research

The preceding review highlights several gaps relevant to the

current study. First, while critical pedagogy is well established in language education research, its extension into digital and AI-mediated pedagogies remains underdeveloped. Second, although digital pedagogy is widely researched, many studies treat tools as neutral rather than interrogating power, agency, and digital affordances (Suárez-Guerrero et al., 2024). Third, digital literacy research increasingly emphasizes AI but seldom links explicitly to language teaching/learning contexts. Fourth, there is limited empirical research comparing teachers' and learners' perceptions of Critical Digital Pedagogy, especially in the Global South or EFL institute setting.

For example, Ncube & Tawanda (2025) call for more transformative practice research around critical digital pedagogy for the Global South, emphasizing contextualized frameworks and empirical data. Although the work is recent, it underscores the urgent need for context-sensitive studies. Similarly, van Dorresteijn (2024) reviews critical digital pedagogy in higher education and highlights the gap between theoretical framing and enacted practice.

Given the above, a mixed-method design that surveys both teachers and learners pre–post intervention and conducts qualitative interviews can provide comprehensive insight into perception shifts, experiences of implementation, and comparative dynamics (Creswell & Plano Clark, 2018). The present study thus addresses the need for comparative, mixed-method empirical work in an EFL institute context in Iran, integrating critical pedagogy, digital literacy, and AI literacy frameworks.

Collectively, these studies reveal a fragmented but promising foundation for advancing CDP in language education. However, most prior work has been either descriptive or confined to isolated digital interventions, leaving limited empirical evidence of how teachers and learners experience CDP as an integrated process of empowerment and reflection. This gap highlights the need for research that not only measures perceptual change but also captures the lived experiences and tensions that accompany AI-mediated pedagogy. Accordingly, a mixed-method comparative approach was selected to bridge this divide—quantitative data offering measurable evidence of change, and qualitative insights revealing how participants interpret and enact CDP principles in context. Such design responds to recent calls (e.g., Ncube & Tawanda, 2025; Tan et al., 2024) for context-sensitive, practice-based research that unites critical theory with digital innovation in the Global South.

2.3. Related and Empirical Studies

Recent empirical studies have increasingly examined how digital and critical pedagogies intersect within language education, yet comprehensive, comparative, and context-specific research remains limited. In a global review, Ncube and Tawanda (2025) identified critical digital pedagogy as a transformative approach for the Global South, emphasizing inclusivity, learner autonomy, and technological agency in contexts constrained by socio-political hierarchies. Their synthesis demonstrated that while digital tools can amplify democratic participation, their success depends on the educator's capacity to design critically oriented and culturally responsive learning experiences.

Empirical work in EFL contexts provides partial evidence of such potential. Barjesteh, Alipour, and Vaseghi (2013) demonstrated that critical pedagogy strategies improved Iranian learners' reading comprehension and engagement, suggesting that dialogic instruction enhances critical awareness. Building on this line, Barjesteh and Isaee (2024) found that technology-mediated instruction significantly enhanced EFL learners' vocabulary and listening comprehension, pointing to the mediating role of digital tools in promoting deeper interaction and learner agency. Similarly, Baskara (2024) explored ChatGPT-integrated critical digital pedagogy in higher education, finding that AI-assisted reflective dialogue encouraged student autonomy, critical literacy, and ethical digital practices.

At a broader level, Allen and Kendeou (2024) proposed the ED-AI Literacy framework, which integrates critical thinking, metacognition, and socio-emotional competencies into digital education—a model highly relevant to language learning. Their work underscores the need for AI literacy as part of a holistic critical digital pedagogy. In parallel, Tan, Voogt, and Tan (2024) advanced a multidimensional framework for digital pedagogy design and enactment, highlighting collaboration, reflexivity, and critical inquiry as essential pillars for meaningful technology integration. Complementarily, Jones (2025) introduced the concept of "literacies of repair," suggesting that learners must engage critically with digital platforms to reconstruct ethical and equitable learning practices. Despite these advances, empirical studies remain fragmented, particularly in the Iranian EFL context. Most have focused on discrete skills (reading, writing, or vocabulary) rather than broader shifts in perception, identity, or critical consciousness. Furthermore, comparative mixed-method designs exploring both teachers' and learners' perceptions over time are notably scarce. This gap substantiates the rationale for the present study, which aims to examine how a six-week Critical Digital Pedagogy intervention influences both Iranian EFL teachers' and learners' perceptions across multiple institutes.

3. Methodology

3.1. Research Design

This study employed an explanatory sequential mixed-method design incorporating a one-group pretest–posttest intervention framework. In the first phase, quantitative data were collected through a structured survey administered before and after a six-week instructional intervention grounded in principles of CDP. The purpose of the quantitative phase was to examine changes in participants' perceptions of dialogic engagement, empowerment, and reflective digital practices following exposure to AI-enhanced instruction. In the second phase, qualitative data were collected through semi-structured interviews to provide deeper explanatory insights into the quantitative patterns observed. The qualitative findings were used to elaborate, contextualize, and interpret the statistical results, thereby strengthening the interpretive validity of the study through methodological complementarity.

3.2. Participants

Participants were recruited from six private English language institutes across three major Iranian cities (Tehran, Mashhad, and Shiraz). The selection of multiple institutes enhanced the generalizability of findings across diverse institutional cultures and instructional traditions. A total of 150 participants took part in the study, comprising 120 EFL learners (68 female, 52 male) and 30 EFL teachers (17 female, 13 male). The learners' ages ranged from 18 to 27 years (M = 21.3, SD = 2.4), representing intermediate to upper-intermediate proficiency levels as determined by the Oxford Placement Test (Allan, 1992). The teachers had between 3 and 15 years of experience (M = 7.8 years, SD = 3.1). Participants were selected through purposive sampling, ensuring familiarity with online learning tools and willingness to engage in digital-based reflective activities. Consent forms were distributed both digitally and in print, and all participants were informed of the study's purpose, procedures, and confidentiality measures. Ethical approval was obtained from the Research Ethics Committee of Ayatollah Amoli Branch of Islamic Azad University.

3.3. Instruments

3.3.1. Critical Digital Pedagogy Perception Scale (CDPPS)

A 28-item Critical Digital Pedagogy Perception Scale (CDPPS) was developed drawing on prior measures of digital literacy, critical pedagogy orientation, and AI literacy [2,11,20,]. It included three subscales: Dialogic Engagement (10 items, α = .88), Digital Empowerment (9 items, α = .84), and Critical Reflection (9 items, α = .86). Items were rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The Persian version underwent expert validation and pilot testing (n = 30), yielding overall reliability of α = .91.

3.3.2. Semi-Structured Interview Protocol

Following the quantitative phase, 12 teachers and 20 learners were randomly selected for semi-structured interviews lasting 25–35 minutes each. Questions probed participants' evolving views of classroom dialogue, autonomy, use of digital platforms, and critical awareness of technology-mediated learning. Example questions included:

- "How did digital tools influence your classroom interactions and critical thinking?"
- "In what ways did the intervention change your understanding of language learning as a social and ethical process?"

All interviews were conducted in Persian, transcribed verbatim, and later translated into English for analysis. The Critical Digital Pedagogy Perception Scale (CDPPS) was developed through a systematic multi-stage process to ensure conceptual alignment and measurement validity. Initially, item generation was guided by the theoretical foundations of Critical Digital Pedagogy, particularly constructs related to dialogic engagement, learner empowerment, and reflective digital practices in digitally mediated learning environments. These constructs were derived from established theoretical and empirical literature in critical pedagogy, digital literacy, and technology-enhanced language education.

Following initial item development, the preliminary version of the scale was subjected to expert review to evaluate content relevance, clarity, and construct alignment. The expert panel consisted of specialists in applied linguistics, educational technology, and teacher education with experience in digital pedagogy and research methodology. Based on their feedback, minor revisions were made to improve wording clarity, remove redundancy, and strengthen conceptual coherence. To assess internal consistency reliability, Cronbach's alpha coefficients were calculated for the overall scale and its subdimensions using IBM SPSS Statistics. The results indicated strong internal consistency for the instrument, with reliability coefficients of α = .88 for Dialogic Engagement, α = .84 for Digital Empowerment, and α = .86 for Critical Reflection. The overall scale demonstrated excellent reliability (α = .91), exceeding commonly accepted thresholds for social science research. These findings suggest that the instrument demonstrated stable measurement properties and was appropriate for assessing participants' perceptions of Critical Digital Pedagogy within AI-enhanced instructional contexts.

3.4. Procedure

The intervention was implemented over a six-week instructional period in six Iranian language institutes. It was designed around the core principles of Freirean problem-posing education and digital literacy frameworks, emphasizing dialogue, collaboration, and reflection as transformative pedagogical tools [1,12,27]. Before the intervention began, all participating teachers attended a two-hour online orientation workshop facilitated by the research team. The workshop introduced the concept of CDP, demonstrated practical examples of digital activities, and explained the assessment and reflection cycles. Teachers were encouraged to adapt materials to their classroom realities while maintaining the dialogic and reflective spirit of the framework. During Weeks 1 and 2, the focus was on building critical awareness and establishing a dialogic classroom culture. Teachers introduced learners to the foundational ideas of critical pedagogy (voice, power, and representation) through short readings, TED-style talks, and online discussions about issues such as global Englishes and digital identities. Learners participated in guided conversations on messaging norms, online expression, and cultural stereotypes in digital media. Teachers acted as facilitators rather than authorities, prompting students to question whose voices dominate digital discourse and how language shapes perspectives. The classes were semi-flipped: students reviewed digital materials asynchronously on a shared Google Classroom space before meeting for in-person dialogues.

In Weeks 3 and 4, the intervention shifted toward digital collaboration and co-creation. Learners were organized into mixed-ability groups of four to five members and assigned problem-based projects linking English learning with real-world concerns. For instance, one group developed a bilingual blog on environmental communication, while another created a podcast episode critiquing gender bias in advertisements. These collaborative tasks were hosted on interactive platforms such as Padlet, Edmodo, and Google Docs, allowing participants to co-author texts, comment

on peers' posts, and provide critical feedback. Teachers integrated short language-focused mini-lessons within these activities to ensure linguistic development accompanied critical engagement. Reflection journals were maintained on a weekly basis, in which learners documented emerging insights about language, society, and digital citizenship.

The final phase, Weeks 5 and 6, centred on reflective synthesis and the integration of AI-assisted learning tools. Learners were introduced to ChatGPT and similar generative-AI interfaces as dialogic partners for brainstorming, paraphrasing, and reflecting on social topics. Teachers emphasized ethical use, bias detection, and the evaluation of AI-generated content. For example, learners compared their own written reflections with AI-generated responses to identify differences in tone, stance, and ethical reasoning. Class sessions involved group debates about whether AI could replicate human empathy or critical judgment in education. These conversations encouraged meta-cognitive reflection on technology's role in shaping language learning and human communication. Teachers concluded each week with collective discussions summarizing the evolving understanding of empowerment and responsibility in digital environments. At the end of the six weeks, participants completed the posttest version of the CDPPS. This was followed by semi-structured interviews with twelve teachers and twenty learners, focusing on perceived changes in engagement, autonomy, and digital awareness. The entire process (from training to final data collection) lasted approximately eight weeks, including preparatory and follow-up stages. All digital artifacts, such as learner posts, comments, and AI-generated drafts, were securely stored and anonymized to preserve confidentiality and allow cross-validation of qualitative themes.

To complement the quantitative data, semi-structured interviews were conducted with 12 teachers and 20 learners (25–35 minutes each). Questions explored changes in participants' classroom dialogue, autonomy, and ethical awareness during the CDP intervention. Examples included: "How did digital tools influence your critical thinking?" and "What challenges did you face when using AI for reflective learning?" Interviews were held in Persian, transcribed verbatim, and translated into English.

3.5. Data Analysis

Quantitative data were analyzed using IBM SPSS Statistics version 29.0. Paired-samples t-tests were conducted to compare pretest and posttest mean scores within groups, while multivariate analysis of variance (MANOVA) was employed to examine between-group differences across the three subscales of the Critical Digital Pedagogy Perception Scale based on posttest scores. Effect sizes were calculated using Cohen's d to determine the magnitude of observed differences. Prior to conducting inferential analyses, statistical assumptions including normality, linearity, and homogeneity of variance were examined using standard diagnostic procedures (e.g., inspection of skewness and kurtosis values, visual assessment of histograms and Q–Q plots, and Levene's test for equality of variances) to ensure the appropriateness of parametric statistical procedures. Statistical significance was determined at the conventional alpha level of ($\alpha = .05$). Qualitative data were coded through Braun and Clarke's (2021) six-step thematic analysis using MAXQDA software to facilitate systematic coding, data organization, and theme development. Two independent coders established intercoder reliability ($\kappa = .89$). Codes were grouped into higher-order themes representing dialogic engagement, empowerment, and reflection. Finally, both strands were integrated through a joint display matrix to identify convergences and divergences between teachers' and learners' experiences.

Several procedures were implemented to enhance the trustworthiness and methodological rigor of the qualitative component of the study. First, interview protocols were carefully designed to align with the research questions and the theoretical constructs underlying Critical Digital Pedagogy. All interviews were conducted in Persian to ensure participant comfort and authenticity of expression. The interview data were subsequently translated into English using a meaning-preserving translation approach. To ensure linguistic accuracy and semantic equivalence, translated excerpts were reviewed and cross-checked by a bilingual academic familiar with both the linguistic and educational contexts of the study.

Second, a systematic coding process was followed during data analysis. Initial codes were generated through repeated reading of interview transcripts, after which related codes were grouped into broader thematic categories reflecting shared conceptual meanings. The development of themes followed a recursive and iterative process consistent with established thematic analysis procedures. Third, multiple strategies were employed to strengthen analytical credibility and transparency. These included maintaining an audit trail documenting coding decisions and theme development, engaging in ongoing reflexive reflection regarding researcher assumptions, and triangulating findings across quantitative and qualitative data sources. Together, these procedures contributed to the overall trustworthiness, dependability, and interpretive integrity of the qualitative findings.

4. Results

4.1. Quantitative Findings

To assess the impact of the six-week CDP intervention, quantitative data were collected from the pretest and posttest administrations of the CDPPS. Paired-sample t-tests were conducted to examine within-group differences, followed by a multivariate analysis of variance (MANOVA) to compare teachers' and learners' post-intervention perceptions across the three subscales: Dialogic Engagement, Digital Empowerment, and Critical Reflection.

4.1.1. Descriptive Statistics and Paired-Sample Comparisons

As shown in Table 1, both teachers and learners experienced notable improvements across all subscales after participating in the CDP intervention. The results demonstrated significant pre–post gains for both groups, with teachers showing slightly higher effect sizes.

Group	Subscale	Pretest M (SD)	Posttest M (SD)	t(df)	p	Cohen's d
Teachers (n=30)	Dialogic Engagement	3.46 (0.41)	4.28 (0.38)	7.12	<.001	1.30
Teachers (n=30)	Digital Empowerment	3.33 (0.47)	4.12 (0.45)	6.54	<.001	1.20
Teachers (n=30)	Critical Reflection	3.51 (0.50)	4.35 (0.44)	7.90	<.001	1.44
Learners (n=120)	Dialogic Engagement	3.22 (0.46)	3.98 (0.43)	10.84	<.001	0.99
Learners (n=120)	Digital Empowerment	3.17 (0.50)	3.91 (0.47)	9.61	<.001	0.88
Learners (n=120)	Critical Reflection	3.24 (0.49)	3.96 (0.45)	10.13	<.001	0.92
Note: DE = Dialogic Engagement; DEM = Digital Empowerment; CR = Critical Reflection. All gains were statistically significant (p < .001), indicating that the CDP intervention effectively enhanced participants' perceptions of dialogic, digital, and reflective learning dimensions.						

Table 1: Pretest and Posttest Mean and Standard Deviations for Teachers and Learners Across three CDPPS Subscales

4.1.2. Between-Group Comparisons

A Multivariate Analysis of Variance (MANOVA) was conducted to examine post-intervention differences between teachers and learners on the three subscales: Dialogic Engagement, Digital Empowerment, and Critical Reflection. The assumption of homogeneity of covariance matrices was met (Box's $M = 9.47$, $p = .214$), allowing interpretation of multivariate results. The MANOVA revealed a statistically significant multivariate effect of group on the combined dependent variables, *Wilks' Λ* = .86, $F(3,146) = 7.84$, $p < .001$, partial $\eta^2 = .14$, indicating a moderate effect size. Univariate ANOVAs were subsequently performed for each subscale to determine where specific differences occurred. The results are summarized in Table 2.

Subscale	Teachers M (SD)	Learners M (SD)	F(1,148)	p	Partial η²	Interpretation
DE	4.28 (0.38)	3.98 (0.43)	9.72	.002	.06	Teachers more dialogically engaged post-intervention
DEM	4.12 (0.45)	3.91 (0.47)	5.18	.024	.03	Moderate increase in teachers' self-efficacy in digital practices
CR	4.35 (0.44)	3.96 (0.45)	14.56	<.001	.09	Stronger reflective orientation among teachers
Note: DE = Dialogic Engagement; DEM = Digital Empowerment; CR = Critical Reflection; η² = partial eta squared						

Table 2: MANOVA and Univariate Analyses Comparing Teachers' and Learners' Posttest Scores

These results suggest that both teachers and learners benefited from the CDP intervention, but teachers experienced greater perceptual gains, particularly in *Critical Reflection and Dialogic Engagement*. These results indicate that both teachers and learners benefited from the CDP intervention, with teachers demonstrating higher posttest scores across the three subscales, particularly in Critical Reflection and Dialogic Engagement. The observed differences suggest varying degrees of engagement with dialogic and reflective dimensions of critical digital pedagogy between the two groups. In sum, the statistical findings reinforce that the CDP model effectively enhanced participants' perceptions, with teachers showing a stronger transformation in dialogic and reflective dimensions as the core indicators of critical digital consciousness.

4.1.3. Correlation Analysis

To further explore the relationships among the three subscales of the Critical Digital Pedagogy Perception Scale (CDPPS), namely *Dialogic Engagement (DE), Digital Empowerment (DEM), and Critical Reflection (CR)*, Pearson correlation coefficients were computed using participants' posttest scores (N = 150). The results, presented in Table 3, indicate strong, positive, and significant correlations among all three constructs, suggesting that participants who perceived higher dialogic engagement also tended to report greater digital empowerment and critical reflection.

Subscale				M	SD
1. Dialogic Engagement	—	.67***	.71***	4.05	0.45
2. Digital Empowerment	—	—	.68***	3.96	0.47
3. Critical Reflection	—	—	—	4.05	0.46
Note: *p < .001 (two-tailed). DE = Dialogic Engagement; DEM = Digital Empowerment; CR = Critical Reflection*					

Table 3: Pearson Correlations among CDPPS Subscales (Posttest)

The strongest correlation emerged between Dialogic Engagement and *Critical Reflection* ($r = .71$, $p < .001$), highlighting the reciprocal nature of critical dialogue and reflective consciousness in digital learning environments. This aligns with Freire's (1970) assertion that reflection and dialogue are inseparable dimensions of transformative learning. The association between *Dialogic Engagement* and *Digital Empowerment* ($r = .67$, $p < .001$) suggests that as participants became more comfortable engaging in dialogic, participatory practices, their sense of technological confidence and agency also increased. This reflects the view of Tan

et al. (2024) that dialogic interaction mediates the transition from digital competence to digital empowerment. Finally, the correlation between *Digital Empowerment* and *Critical Reflection* ($r = .68$, $p < .001$) indicates that developing digital confidence was closely linked to participants' capacity for critical thought and ethical awareness as the core tenets of critical digital pedagogy [1]. Taken together, these intercorrelations demonstrate that CDP constructs operate synergistically rather than independently, reinforcing the integrated nature of dialogic, digital, and reflective competencies. Participants' strengthened ability to question, analyze, and engage critically in AI-mediated language tasks suggests that critical pedagogy in digital environments fosters holistic cognitive and affective growth.

4.2. Overview of Comparative Outcomes

Before turning to the qualitative themes, it is useful to visualize the comparative posttest outcomes between teachers and learners to contextualize the subsequent narratives. As shown in Figure 1, both groups demonstrated improvement across the three subscales of the CDPPS (dialogic engagement, digital empowerment, and critical reflection). Although teachers showed slightly higher mean gains in critical reflection, learners exhibited stronger growth in digital empowerment.

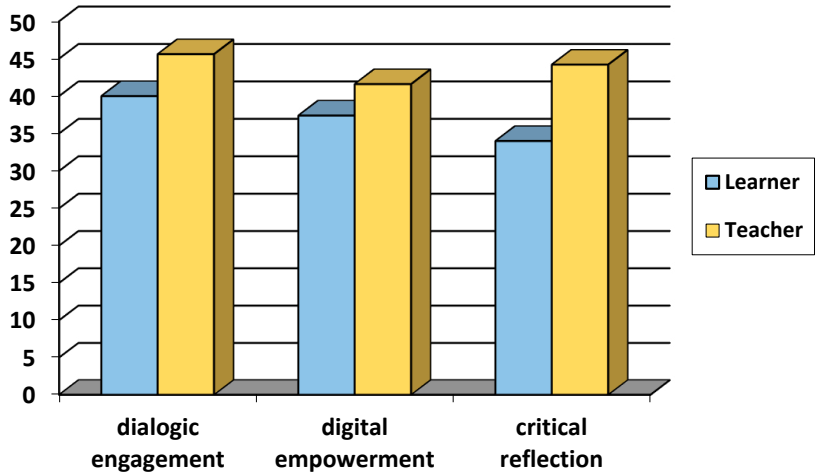

Figure 1: Comparison of Teachers' and Learners' Posttest Mean Scores Across CDPPS Subscales

As observed in Figure 1, bars represent mean values on three subscales: Dialogic Engagement (DE), Digital Empowerment (DEM), and Critical Reflection (CR). Error bars indicate standard deviations. All differences were statistically significant ($p < .05$). This general pattern reflects how teachers and learners negotiated different but complementary dimensions of Critical Digital Pedagogy during the six-week intervention. While teachers emphasized reflective and ethical considerations of AI-mediated practices, learners focused on agency and confidence in digital tools for language learning.

4.3. Qualitative Findings

To complement the quantitative results and gain a deeper understanding of participants' experiences with CDP, semi-structured interviews were conducted with 12 EFL teachers and 16 university students from four language institutes. The interviews, conducted in Persian and translated into English, were analyzed thematically using Braun and Clarke's (2021) six-step approach. Data triangulation across participant groups enhanced the credibility of the findings. Thematic analysis revealed four overarching themes: 1) transformation of classroom dialogic culture, 2) emergence of digital empowerment, 3) development of critical reflection and agency, and 4) tensions surrounding AI-mediated learning. The emergent themes from thematic analysis of interviews are depicted in Figure 2, below.

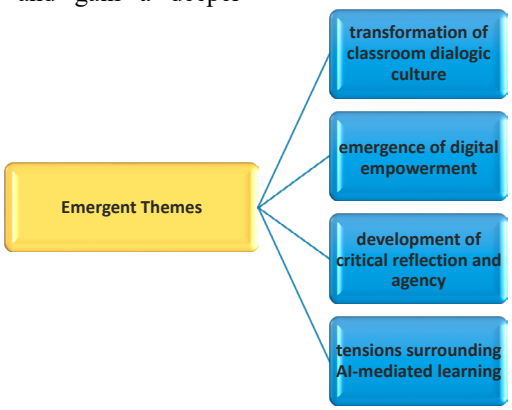

Figure 2: Emergent Themes from Thematic Analysis of Interviews

4.3.1. Theme 1: Transformation of Dialogic Culture

Both teachers and learners described a shift from one-directional instruction toward collaborative meaning-making. Teachers noted that digital platforms created spaces for equal voice, allowing students to question, negotiate, and co-construct ideas.

"Before this project, I was the only one talking. Now, students ask questions through the platform even after class hours." *(Teacher 3)*

"Our discussions felt more like teamwork, not teacher control. I felt my opinions mattered." *(Learner 6)*

"Dialogues online gave me time to think before speaking. It changed my confidence level." *(Learner 10)*

"The digital forums made reflection easier; I could revisit classmates' ideas later." *(Teacher 8)*

Such responses illustrate Freirean dialogic engagement realized through digital mediation, where both groups experienced heightened mutual respect and critical questioning.

4.3.2. Theme 2: Emergence of Digital Empowerment

Participants expressed significant growth in their ability to navigate, critique, and apply digital resources. Learners particularly emphasized increased technological confidence, while teachers spoke about pedagogical creativity with AI tools.

"I used to fear digital tools, but now I create my own AI-based quizzes." *(Teacher 2)*

"After these weeks, I'm not just following instructions. In fact, I search, compare, and verify information myself." *(Learner 9)*

"Integrating AI feedback helped me monitor my own learning more effectively." *(Learner 13)*

"I started sharing digital resources with colleagues; that never happened before." *(Teacher 5)*

This empowerment dimension confirms the quantitative finding that digital empowerment correlated strongly with dialogic engagement and critical reflection.

4.3.3. Theme 3: Development of Critical Reflection and Agency

Both groups highlighted a new awareness of *social and ethical dimensions* of technology-mediated education. Participants described critically examining biases in AI outputs and reflecting on how language learning can reproduce or challenge inequalities.

"AI translation sometimes showed cultural bias. it made us talk about fairness in language." *(Learner 3)*

"We discussed how technology could silence or amplify certain voices in class texts." *(Teacher 7)*

"I now question where the materials come from and who benefits from them." *(Learner 15)*

"Critical reflection became part of our routine; it wasn't just grammar anymore." *(Teacher 1)*

This theme captures Freire's (1970) notion of conscientization, where reflection evolves into ethical and social awareness through digital dialogue.

4.3.4. Theme 4: Tensions Surrounding AI-Mediated Learning

Despite overall positive outcomes, some participants expressed concern about the *potential depersonalization and overreliance on AI tools*. They feared that technology might replace genuine teacher–student connection.

"Sometimes AI feedback felt too mechanical. I still needed my teacher's reassurance." *(Learner 4)*

"Managing the ethical use of AI in assessment was tricky; some students depended too much on it." *(Teacher 9)*

"When we used chatbots for conversation, I missed the warmth of real interaction." *(Learner 7)*

"Balancing critical dialogue and AI speed was challenging. We need clearer policies." *(Teacher 11)*

These tensions underscore the importance of pedagogical balance, regarding AI as a supportive, not substitutive, tool within a humanizing educational paradigm.

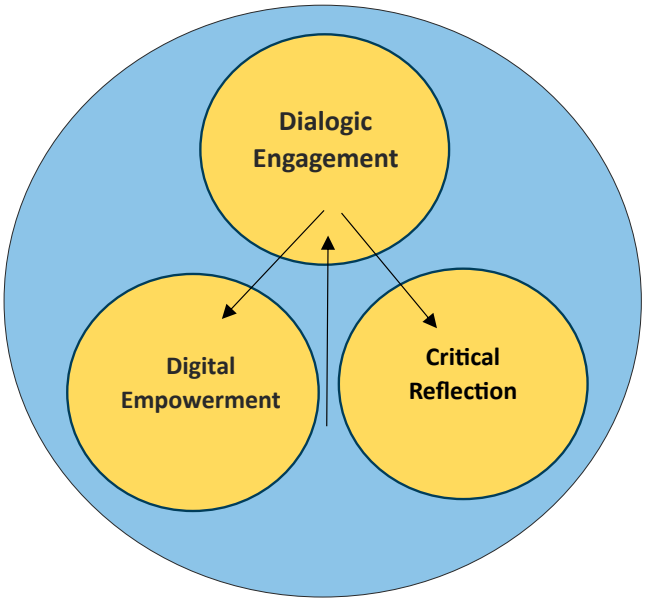

Figure 3: Thematic Model of Interrelations among Dialogic Engagement, Digital Empowerment, and Critical Reflection Emerging from Qualitative Analysis

Figure 3 illustrates the interconnection between dialogic engagement, digital empowerment, and critical reflection, all grounded in humanistic interaction. The cyclical arrows show how each component reinforces the others, while the outer ring represents the ethical–affective tensions surrounding AI use. This model emphasizes that sustainable Critical Digital Pedagogy depends on balancing technological agency with reflective humanity.

To demonstrate the integration of quantitative and qualitative findings within the explanatory sequential mixed-method design, a joint display table was constructed. Table 4 presents a systematic alignment between quantitative outcomes and qualitative themes, highlighting how interview data were used to explain and contextualize the statistical patterns observed following the instructional intervention.

Research Question	Quantitative Result	Qualitative Theme	Integrated Interpretation
RQ1: How did participants' perceptions of dialogic engagement change following the intervention?	Significant increase in dialogic engagement scores from pretest to posttest	Increased opportunities for open discussion and collaborative interaction	The quantitative improvement in engagement scores is supported by participants' descriptions of more interactive and participatory classroom practices enabled by AI-mediated instruction.
RQ2: How did participants perceive changes in learner empowerment?	Positive shift in empowerment-related survey items following the intervention	Enhanced sense of autonomy and confidence in using digital tools	Survey results indicating increased empowerment are explained by participants' experiences of greater independence and decision-making opportunities in technology-supported learning environments.
RQ3: How did participants reflect on critical digital practices in AI-supported learning environments?	Improvement in reflection-related scale scores after the intervention	Development of critical awareness regarding responsible and purposeful technology use	The improvement in reflective practice scores corresponds with participants' accounts of becoming more mindful and evaluative in their engagement with AI technologies.

Table 4: Integrated Joint Display of Quantitative and Qualitative Findings

5. Discussion

This study demonstrates how CDP, grounded in Freirean critical principles and digital literacy frameworks, can reshape both teachers' and learners' conceptions of dialogue, empowerment, and reflection. Quantitative results confirmed significant perceptual gains, while qualitative findings revealed transformation in classroom discourse, teacher identity, and ethical awareness. A closer examination of the quantitative differences suggests that teachers' stronger gains in Critical Reflection may be associated with their greater professional agency and familiarity with reflective teaching practices, which likely supported deeper engagement with dialogic and ethical dimensions of digital pedagogy. During the intervention, teachers frequently connected digital tools to broader social and moral considerations, indicating a more developed orientation toward reflective praxis. In contrast, the comparatively smaller gap in Digital Empowerment between teachers and learners suggests that both groups experienced substantial growth in technological confidence, reinforcing the idea that guided technology integration can enhance digital literacy across roles and levels of expertise. These results support the idea that CDP fosters the dialogic and reflective dimensions central to Freire's (1970) pedagogy.

The strong correlations among Dialogic Engagement, Digital Empowerment, and Critical Reflection indicate that these constructs form a mutually reinforcing cycle of critical digital consciousness. This pattern aligns with the "critical digital loop" described by Morris and Stommel (2018), where engagement fuels empowerment, and empowerment deepens reflection. Similarly, Jones (2025) highlights that digital literacies evolve from technical competence to ethical and reflective practice as learners gain agency. Thus, CDP functions as both a theoretical and practical bridge between Freirean pedagogy and contemporary AI literacy discourses.

Building on the theoretical insights discussed above, the pedagogical implications of these findings highlight how Critical Digital Pedagogy can be operationalized in AI-supported language learning environments. Findings show that AI-supported environments can enhance critical engagement when situated within reflective, dialogic frameworks. Teachers reported integrating AI-based platforms for co-authoring and assessment, while learners demonstrated growing confidence and autonomy. These outcomes affirm Tan et al.'s (2024) digital pedagogy design framework emphasizing collaboration and critical inquiry.

Importantly, participants' concerns about depersonalized AI feedback echo Allen and Kendeou's (2024) *ED-AI Literacy* model, which insists that AI literacy must include ethical and emotional awareness. Rather than displacing human judgment, AI should act as a reflective tool that sustains empathy and justice in education. CDP thus offers a pathway for teacher education to integrate critical AI awareness which encourages both technical proficiency and ethical sensitivity.

Beyond facilitating access and automation, AI technologies reconfigure the very nature of classroom dialogue and learner agency. Through tools such as generative text models and adaptive feedback systems, learners no longer interact solely with teachers but with algorithmic interlocutors that shape their reasoning, tone, and ethical stance. This shift transforms critical dialogue into a triadic process involving the learner, the teacher, and the AI

system. Within *the ED-AI Literacy* framework, such interaction demands awareness of how algorithms mediate participation and representation [2]. Jones (2025) further argues that learners must develop "literacies of repair," using reflection to identify and correct the biases or silences embedded in AI outputs. In this study, participants' engagement with AI-generated texts encouraged them to question Barjestehity, reinterpret knowledge, and assume greater responsibility for meaning-making as the evidence that AI mediation can deepen rather than diminish critical consciousness when guided by Freirean principles.

Within the Iranian EFL context, the study highlights that CDP can democratize classroom interaction and challenge hierarchical traditions of teaching. This contextual sensitivity underscores the importance of adapting digitally mediated pedagogical innovations to culturally grounded educational norms rather than assuming universal patterns of technology adoption. Participants described feeling "heard" in online spaces, suggesting that digital dialogue can redistribute classroom power when guided by critical pedagogy. However, the data also reveal ongoing cultural tensions: participants valued technological fluency yet continued to seek human warmth and reassurance from instructors. This finding resonates with Giroux's (2020) view that digital education must remain humanizing, rooted in care and mutual recognition.

Moreover, the results contribute to Global South scholarship (Ncube & Tawanda, 2025) by illustrating how CDP can be contextually adapted to resource-constrained but culturally rich educational settings. Through ethically mediated AI use, teachers and learners co-constructed new forms of digital citizenship grounded in reflection and agency. Collectively, these findings suggest that Critical Digital Pedagogy can serve as a transformative framework for aligning technological innovation with humanistic educational values in digitally evolving language learning environments.

6. Conclusion

This study examined how a CDP intervention informed by Freirean theory and digital literacy frameworks affected teachers' and learners' perceptions of dialogic engagement, digital empowerment, and critical reflection in Iranian EFL contexts. Quantitative findings revealed significant pre–post gains for both groups, while qualitative results uncovered deepened awareness of equity, ethics, and human agency in technology-mediated learning. Together, the results underscore the transformative potential of dialogic, participatory, and AI-reflective pedagogy. Future research may extend this line of inquiry by examining how Critical Digital Pedagogy operates across diverse educational contexts, learner populations, and technological infrastructures to better understand its long-term impact on digital agency and ethical engagement.

Despite its promising outcomes, this study faced several limitations. The six-week duration, though sufficient for perceptual change, may not have captured long-term attitudinal or behavioral transformations. Future longitudinal studies could investigate sustained impacts on teaching practice and learner autonomy. Moreover, while efforts were made to include multiple institutions, cultural and infrastructural differences across Iranian universities may have influenced participants' digital access and readiness. Finally, AI integration was exploratory; subsequent studies could adopt more structured AI literacy components or compare different AI tools' pedagogical effects.

Subsequent studies should experiment with structured AI literacy modules and compare various AI platforms' pedagogical impacts. Mixed-method designs remain particularly valuable for capturing both quantifiable gains and nuanced ethical reflections. Ultimately, CDP research must continue to explore how human–AI collaboration can serve the emancipatory, human-centered aims of education envisioned by Freire.

The results advocate for embedding CDP within teacher education and curriculum design. Professional development programs should foreground critical digital literacy, ethical AI use, and dialogic facilitation strategies [28]. For learners, curricula that promote critical inquiry, empathy, and civic engagement through language and technology can help cultivate the next generation of ethically informed digital citizens. As aptly mentioned by Zhou et al. (2025), AI enhances curriculum design and multilingual communication, but overreliance may harm language proficiency. Effective integration strategies require institutional support, targeted training, and resource development, in line with Sustainable Development Goal 10 [29].

By merging Freirean humanism with AI-era realities, educators can create language classrooms that are not only technologically enriched but also socially transformative.

Declarations

Competing Interests

All of the authors declare no conflict of interest.

Funding

This work received no funding.

Consent to Publish

The authors affirm that all individual participants provided informed consent for publication of this paper.

Consent to Participate

Before participation, all individuals were informed about the purpose of the study, the voluntary nature of their involvement, and their right to withdraw at any time without penalty. Written informed consent was obtained from all participants prior to the commencement of data collection. Participant confidentiality and anonymity were strictly maintained throughout the research process, and all data were used solely for academic and research purposes.

Ethics statement

Ethical approval for this study was obtained from the Research Ethics Committee of Ayatollah Amoli University prior to data collection (Approval No. 2025-719; Date: 5/Feb/2025). All

procedures involving human participants were conducted in accordance with institutional and national ethical standards governing educational research.

Confidentiality and Anonymity

All personal information was anonymized using numeric participant codes. Audio recordings, transcripts, and digital data were stored on encrypted drives accessible only to the research team. Identifying information was removed before analysis, and confidentiality was strictly maintained throughout the project.

Use of AI Tools

No generative AI tools were used in designing the study, analyzing the data, or drafting the original manuscript. The author only used Grammarly for language refinement of the paper.

Author Contribution

Conceptualization: H.I.
Investigation: H.I.
Methodology: H.I.
Formal analysis: H.I.
Resources: H.I.
Writing – original draft: H.I.
Writing – review & editing: H.I.
Software: H.I.
Supervision: H.I.

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