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Impact of Technology-Enhanced Personalized Language Learning on Iranian EFL Learners' Writing Skill

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ABSTRACT

Objective: The integration of technology into language education has transformed learning environments, allowing for more individualized instruction. However, limited research has explored the effects of technology-enhanced personalized language learning (TEPLL) on writing skills across different learner characteristics. This study aimed to examine the impact of TEPLL on the writing skills of Iranian EFL learners, considering the moderating effects of proficiency level, age, and gender.

Methods: The study was conducted in Fall 2024 with 120 Iranian EFL learners across three proficiency levels (pre-intermediate, intermediate, and advanced). Participants were randomly assigned to either a TEPLL group, which used Moodle for personalized activities, or a traditional instruction group. Writing performance was assessed before and after the intervention.

Results: Findings indicated that the TEPLL group showed significantly greater improvement in writing skills compared to the traditional instruction group. The positive effects of TEPLL were particularly evident among higher proficiency and adult learners. Gender did not significantly moderate the impact of TEPLL.

Conclusions: TEPLL proves to be an effective approach for enhancing writing skills in EFL contexts, particularly for advanced and adult learners. The results underscore the importance of integrating technology-based personalization and tailoring instructional design based on learner proficiency.

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Introduction

Recognizing the limitations of traditional, one-size-fits-all approaches, education is undergoing a significant shift towards personalized learning (PL) to address the diverse needs of learners (Beese, 2019; Walkington & Bernacki, 2020; Hwang et al., 2014). In the context of English as a Foreign Language (EFL) education, PL involves tailoring instructional content, pace, and feedback mechanisms to individual student profiles, often leveraging technology to provide differentiated activities and support diverse learning trajectories. This shift is particularly crucial in EFL education, where learners exhibit varying learning styles and face unique challenges. Recent advancements in mobile and adaptive technologies (Fauziningrum et al., 2023; Sari, 2021) have expanded opportunities for personalized language practice, yet their implementation in structured EFL curricula remains underexplored. The growing demand for individualized learning drives this shift, particularly in EFL contexts where learner diversity necessitates adaptable pedagogies. Technology-enhanced personalized language learning (TEPLL) specifically leverages digital resources to facilitate these personalized learning paths, promote active participation, and create a more stimulating learning environment.

However, the effective implementation of TEPLL is challenging, especially in a specific cultural context such as Iran (Jalili, 2020). Learners in such contexts may lack established self-study habits or exhibit cultural attitudes that influence technology adoption and its perceived value in learning (Kuddus, 2018; Giacomo & Puglisi, 2020). Addressing the documented difficulties Iranian EFL learners encounter in academic writing (Akbari, 2015), alongside Iran's comparatively low ranking in global English proficiency (EF EPI, 2023), this study explored the impact of TEPLL on the development of writing skills. Furthermore, it considered the mediating roles of proficiency level, gender, and age within the specific Iranian context. This research, therefore, argues that the integration of TEPLL significantly enhances the writing proficiency of Iranian EFL learners compared to traditional methods, and critically examines how learner characteristics such as proficiency level and age, though not gender, moderate these pedagogical benefits, offering vital insights for tailoring technological interventions in similar EFL settings.

The integration of technology into language learning has developed considerably, driven by advancements in both technology and pedagogical understanding. While early Computer-Assisted Language Learning (CALL) primarily focused on structured exercises (Chapelle, 2001; Levy,

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1997), the advent of the internet and mobile technologies have prompted a shift toward more communicative, learner-centered, and personalized approaches (Kukulska-Hulme & Shield, 2008; Warschauer & Meskill, 2013). Mobile-Assisted Language Learning (MALL) allows access to learning resources anytime and anywhere (Stockwell, 2010), while broader Technology-Enhanced Language Learning (TELL) seeks to leverage digital tools for enhanced engagement and individualized learning experiences.

A core theoretical underpinning of this study lies in Constructivism, particularly Vygotsky's (1978) emphasis on learning as a social and active process where knowledge is co-constructed through experience and interaction. TEPLL, as implemented in this study, directly embodies these constructivist principles. For instance, Moodle-based activities such as collaborative brainstorming in forums and structured peer review provide learners with platforms for social interaction, where they can negotiate meaning and build upon each other's understanding of writing conventions and argumentation. Furthermore, the provision of personalized feedback via Moodle serves as a crucial scaffolding mechanism, akin to interacting with a 'more knowledgeable other.' This tailored guidance, focuses on individual students' zones of proximal development, prompted learners to actively reflect on their work, experiment with new linguistic forms, and iteratively refine their writing skills, rather than passively receiving decontextualized corrections.

The principles of Self-Determination Theory (SDT) (Deci & Ryan, 2000) are also central to understanding TEPLL's potential. SDT posits that intrinsic motivation is fostered when individuals' needs for autonomy, competence, and relatedness are met. In TEPLL, personalized feedback and tailored assignments delivered through Moodle aim to bolster learners' sense of competence by providing specific, actionable advice and tasks appropriately challenging for their current skill level, thereby increasing their perceived ability to succeed. The peer review processes and forum interactions on Moodle can cultivate relatedness, fostering a supportive online community where learners felt connected to their peers and the instructor. While the degree of autonomy can vary in TEPLL implementations, elements like reflective writing prompts (encouraging self-assessment of learning strategies) and the ability to engage with Moodle resources at a pace somewhat dictated by individual needs can support this. By addressing these psychological needs, TEPLL endeavors to create a more intrinsically motivating learning environment conducive to sustained engagement and skill development in writing.

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Research highlights the potential benefits of TEPLL. For example, studies show that digital device use fosters personalization, authenticity, and connectivity, which are essential for self-directed learning (Jung et al., 2017). Several studies demonstrate that TEPLL and MALL can improve language learning outcomes, especially in vocabulary acquisition (Muharom et al., 2022). However, there are challenges that must be acknowledged when implementing TEPLL. Mellati and Khademi (2015) highlight how MALL can provide access to materials at any time but can be difficult to implement. Studies emphasize the importance of structured integration of digital tools by teachers, along with adequate teacher training (Cao et al., 2023; Leshchenko et al., 2023). A study by Moazemi Godarzi et al. (in press) in Iran found that while Iranian EFL learners generally have positive attitudes towards TEPLL, technical issues, inadequate content, and lack of preparation can hinder its effectiveness.

Despite these advancements, several gaps remain. First, the long-term effects of specific TEPLL interactional features on learner perceptions and outcomes require further investigation (Jung et al., 2017). Second, while there's growing evidence of TEPLL's potential, its effectiveness can vary significantly depending on contextual factors, learner characteristics, and implementation strategies. Crucially, limited research exists on TEPLL within the Iranian EFL context, particularly considering the interplay of proficiency level, gender, and age. Stanley and Lehman's (2015) argument that prescribed learning paths can hinder learner agency also raises concerns about how personalization is operationalized in TEPLL. Often, personalization focuses heavily on adaptive content delivery without considering the importance of learner autonomy and exploration. This study aimed to address existing gaps by examining whether TEPLL significantly improves the writing skills of Iranian EFL learners compared to traditional instruction. It also investigated whether any potential impact of TEPLL is influenced by learner proficiency, gender, and age. To achieve these aims, the following research questions guided this study:

RQ1: Does the use of TEPLL significantly boost the writing skills of Iranian EFL learners compared to those who receive conventional instruction?

RQ2: Is the potential impact of TEPLL instruction on writing skills, if any, mediated by the learners' level of proficiency, gender, and age?

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Material and Methods

Context and Participants

The study focused on a target population of 170 Iranian EFL (English as a Foreign Language) learners from five language institutes in Isfahan, Iran. These participants were categorized into three proficiency levels: pre-intermediate, intermediate, and advanced. To facilitate the recruitment process, a convenience sampling method was employed, resulting in the selection of 120 participants. This approach allowed for a practical and efficient gathering of data (Sekaran & Bougie, 2010).

Of the 120 selected participants, 60 were assigned to the experimental group (EG), while the remaining 60 formed the control group (CG). This allowed for an exploration of the impact of TEPLL across different language proficiencies. The study focused on adolescents and adults, excluding children due to their unique cognitive and developmental factors.

All participants were Iranian EFL learners with Persian as their first language, ensuring a homogeneous linguistic context. Within each proficiency level, there were 20 participants, and the sample included a representation of both adolescents and adults aged 11 to 35. The classes were mixed, with both male and female learners. The following table details the needed enlightenment of the participants:

Table 1. Demographic and Group Distribution of Participants

Group	Age Group	Proficiency Level	N	Gender
EG	Adolescent	Pre-intermediate	10	Male/Female
	Adolescent	intermediate	10	Male/Female
	Adolescent	Advanced	10	Male/Female
	Adult	Pre-intermediate	10	Male/Female
	Adult	Intermediate	10	Male/Female
	Adult	Advanced	10	Male/Female
CG	Adolescent	Pre-intermediate	10	Male/Female
	Adolescent	Intermediate	10	Male/Female
	Adolescent	Advanced	10	Male/Female
	Adult	Pre-intermediate	10	Male/Female
	Adult	Intermediate	10	Male/Female
	Adult	Advanced	10	Male/Female
First Language		Persian		
Target Language		English		

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In addition to the main participants, two experienced EFL raters were selected through purposive sampling to participate in the study. These raters were instructors with over 10 years of experience in teaching writing courses. One was female, and one was male. Both held M.A. degrees in TEFL.

Instruments

This study utilized various textbooks as instructional materials, taking into account the participants' diverse proficiency levels. "American English File," a five-level English course for adults and young adults, was employed for the pre-intermediate group. The "Top Notch" textbook series, written by Saslow and Ascher (2006) and designed for adults and young adults, was used for the intermediate level group. Finally, the "Summit" textbook, a four-level course designed to follow "Top Notch" or other intermediate courses, was utilized for the advanced level group.

Several instruments were employed in this study, including the Oxford Quick Placement Test (OQPT). The OQPT was administered as a general language proficiency test to select a homogeneous pre-intermediate, intermediate, and advanced sample of EFL students and divide them into suitable groups for the study. The OQPT (version 2), consists of two sections: Section one investigates various language aspects, including situations, cloze passages, and completion items. Section two comprises 20 multiple-choice items, with 10 items related to cloze passages and 10 completion-type items. The scoring criteria provided by the test developers categorize learners based on their scores. Those with scores ranging from 18 to 29 are considered elementary, 30 to 39 points indicate pre-intermediate level, 40 to 47 points signify intermediate level, 48 to 54 points reflect advanced level, and 55 to 60 points indicate proficiency.

The study also employed writing pretest and post-test. The writing test asked participants to write an essay based on given subjects, allowing them to choose contexts associated with their chosen topic. The writing topics were drawn from the writing sections of the course textbooks: American English File, Top Notch, and Summit. The participants were given 30 minutes to write 300-350 words and edit their writing. The writing post-test was identical to the pretest, with the same subjects. Moreover, to ensure the content validity of the pretest and post-test, three language experts reviewed the writing subjects. Inter-rater reliability, indicating the degree of agreement among independent raters, was also investigated. Two raters independently evaluated the participants' writing levels, and separate inter-rater reliability coefficients were calculated for the pre-test and post-test. The inter-rater reliability for the pre-test was .80, while the inter-rater

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reliability for the post-test was .70. The validity of the writing prompts was established through expert review by three language experts, ensuring content validity and relevance to the curriculum. Finally, the writing rubric was adapted from the public version of the IELTS Examination Board, as taken from the British Council website, and was used to assess the writing pre-test and post-test. Each writing test was evaluated using a rubric, as per IELTS Examination procedures. The rubrics evaluate the responses on four different levels: (1) Task Response or Achievement, (2) Coherence and Cohesion, (3) Lexical Resource and (4) Grammatical Range and Accuracy. These evaluation characteristics are the founding criteria for marking and assessing students' writing performance. Each of these characteristics is marked on a scale that ranges from 0 to 9, with 9 describing an expert user who has fully operational command of the language: appropriate, accurate and fluent with complete understanding.

Intervention

This research study explored the effectiveness of TEPLL on L2 writing skills. To ensure the validity and clarity of our research instruments, particularly the writing prompts and the rubric adapted from the IELTS Examination Board, a pilot study was conducted prior to the main investigation. This pilot involved 20 Iranian EFL learners who mirrored the characteristics of the main study participants (e.g., similar age range, proficiency levels, and L1 background as those targeted for the main study) but were not part of the final sample. Based on their performance on the pilot writing tasks and their feedback, minor adjustments were made to the wording of some writing prompts for enhanced clarity and to ensure they were equally accessible across proficiency levels. The rubric application was also refined based on initial inter-rater discussions from the pilot to ensure consistent scoring.

The main study involved 120 Iranian EFL college students, selected from a larger pool of 170 based on their scores on the OQPT, ensuring homogeneity within the designated proficiency groups (pre-intermediate, intermediate, advanced). These 120 participants were randomly assigned to either an EG or a CG, each with 60 members.

The EG, further sub grouped by proficiency, received TEPLL-based instruction for four weeks, delivered primarily through Moodle (Modular Object-Oriented Dynamic Learning Environment). Moodle is a widely-used, open-source Learning Management System (LMS) that provides a flexible platform for creating and delivering online courses and facilitating various learning

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activities. Its features allow educators to organize content, create assignments, facilitate communication through forums and messaging, track student progress, and provide personalized feedback. For this study, Moodle was chosen for its capacity to host diverse activity types, support asynchronous learning, and enable the specific personalized strategies central to our intervention. The TEPLL intervention included personalized feedback, tailored assignments, structured peer review, reflective writing activities, and various interactive tools available within the Moodle environment. Crucially, prior to the intervention, the EG participants received a dedicated two-hour training session on effectively navigating and utilizing the Moodle platform. This training covered essential functionalities such as accessing course materials, submitting assignments through designated drop boxes, using the peer review tools, participating in discussion forums, and understanding how to access instructor feedback. This preparatory training aimed to minimize the impact of varying technological literacy on the study results and ensure all EG participants could engage fully with the TEPLL components. The CG received the same core writing materials and topics but through traditional, non-personalized classroom teaching methods without the use of Moodle for these specific activities. Both groups completed pre- and post-writing tests to assess the impact of the interventions.

The TEPLL intervention effectively utilized several key functionalities of the Moodle learning management system to support students' writing development. Moodle's assignment submission feature enabled the instructor to provide personalized feedback directly on student drafts. This involved using Moodle's annotation tools or attaching feedback files to address individual grammatical errors and encourage deeper argumentation and critical thinking. For example, when a student wrote, "I think that the government should do more for the poor peoples," the instructor commented, "Good start! Consider using more precise language: Instead of 'poor peoples,' perhaps 'low-income families.'" This asynchronous feedback method allowed for tailored guidance on students' writing.

The intervention also allowed for tailored assignments, where specific requirements could be adjusted based on individual student performance. Moodle facilitated the assignment of different versions of the argumentative essay task to specific student groups or individuals. For instance, a student struggling with grammatical accuracy might receive a modified assignment emphasizing error reduction, potentially with access to Moodle-hosted grammar support resources. Conversely,

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a student with strong grammar skills might be given a more complex assignment requiring in-depth analysis and counter-arguments, possibly linked to advanced academic writing guides on Moodle. This ensured that assignments catered to individual learning needs and provided appropriate levels of challenge.

Peer review was facilitated through Moodle, providing students with opportunities to evaluate and learn from each other's work. Students used a structured rubric to guide their feedback, focusing on aspects such as clarity, argumentation, and the use of evidence. For example, Student D's essay stated: *'Climate change is a big problem*.' Student E, reviewing Student D's essay, commented: *'I agree, but your argument would be stronger if you included specific examples of the effects of climate change and suggested concrete actions*.' The structured rubric and online platform ensured constructive and focused peer feedback.

Reflective writing was regularly incorporated using Moodle's journal or forum features to encourage self-monitoring and identification of areas for improvement. An example prompt was: "*What challenges did you face this week, and what strategies did you use to overcome them*?" encouraged students to reflect on their writing process. For instance, Student F wrote, "*I found it hard to organize my ideas, but creating an outline helped*. Also, peer feedback helped me see weaknesses in my argument." This practice fostered self-awareness and metacognitive skills.

Finally, interactive tools, particularly Moodle forums, were extensively utilized to promote collaborative brainstorming and idea generation. Students actively engaged in discussions, suggesting and refining essay topics. For example, for example, Student G suggested: "*The impact of social media on teenagers*," prompting others to offer suggestions on focusing the topic, identifying sources, and developing arguments. Student H mentioned: "*The use of technology among young adults is growing fast*." The Moodle forum thus facilitated idea sharing, constructive criticism, and the cultivation of a supportive learning environment that promoted collaborative learning.

Descriptive statistics were calculated for mean, standard deviation, and reliability. The standard error of the mean was obtained, and the Skewness ratio was used to examine the normality of distribution. To examine the inter-rater reliability of the writing pretest and post-test, an alpha of .80 was calculated. Inferential statistics were conducted to analyze the impact of TEPLL on learners' writing skills. Independent samples t-tests were used to address the first and second

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research questions. To identify the role of proficiency level, gender, and age, ANCOVA and mediation analysis were conducted, addressing the second research questions.

Results

Before utilizing research instruments, their reliability indices were estimated through a pilot study. Twenty EFL learners who shared similar characteristics with the main participants in the study were randomly selected and piloted. As shown in Table 3 the reliability induces of the research instruments are presented.

Table 2. Reliability Indices of the Tests in the Study

Test	Index
Writing Pretest	.80
Writing Post-test	.70

As shown in Table 2, the study ensured the reliability of its research instruments before collecting data. To determine the appropriate statistical analysis, the distribution of the data was investigated. Normality testing revealed that the data for proficiency level was normally distributed, while the data for age level was not. Despite the non-normal distribution of age level data, parametric t-tests were applied due to the large sample size and the need to compare independent and dependent means. This decision was supported by the central limit theorem.

Table 3. Shapiro-Wilk Test Results for Normality Test

		Statistic	df	Sig.
Writing	Adolescent	0.954	73	0.009
	Adult	0.941	47	0.02
Writing	Intermediate	0.936	30	0.071
	Advanced	0.934	8	0.557

According to Table 3, the p-value has risen above 0.05, indicating that the variances between the groups are not significantly different. This meets the assumption of homogeneity of variances.

The Impact of TEPLL on Writing Skills

The research question one was intended to examine if the use of TEPLL significantly boost the writing skills of Iranian EFL learners compared to those who receive conventional instruction. In the first step, the writing pre-test scores were compared to investigate the participants' initial writing abilities and to determine if any pre-existing differences existed between the EG and CG.

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Table 4. Descriptive Analysis of Pre-test Writing Scores: EG and CG

Group	N	Min.	Max.	Mean	SD.
EG	60	2.50	4.00	3.48	1.70
CG	60	2.00	3.00	3.08	1.78

As presented in Table 4, the EG exhibited a mean writing pre-test score of 3.48 with a standard deviation of 1.70. The CG, on the other hand, achieved a mean score of 3.08 and a standard deviation of 1.78. Therefore, there were slight differences in the pre-existing writing abilities of the participants in EG and CG, with the EG exhibiting a slightly higher mean score. To determine if these differences were statistically significant, an independent samples t-test was conducted.

Table 5. Independent Samples T-test: Comparison of Pre-test Writing Scores

Groups	N	Mean	SD	Levene's Test for Equality of Variances		t-test for Equality of Means		
				F	Sig.	t	df.	Sig. (2-tailed)
EG	60	3.48	1.70	7.63	0.001	2.494	118	0.67
CG	60	3.08	1.78					

As indicated in Table 5, the EG exhibited a mean pre-test score of 3.48 (SD = 1.70), while the mean of the CG was 3.08 (SD = 1.78). The independent samples t-test revealed no significant difference in pre-test writing scores between the two groups ($t(118) = 7.63$, $p > .05$). Therefore, it can be concluded that the groups were comparable in terms of writing ability at the beginning of the study.

To answer the first research question, the writing performance of the EG and CG obtained through the use of post-test scores was compared. Table 8 provides descriptive analyses of the writing post-tests for the EG and CG, respectively.

Table 6. Descriptive Analysis of Writing Post-test Scores: EG and CG

Group	N	Min.	Max.	Mean	SD.
EC	60	3.00	5.77	4.88	1.03
CC	60	2.50	2.05	3.22	1.62

As presented in Table 6, the EG achieved a mean writing post-test score of 4.88 with a standard deviation of 1.031. The CG, on the other hand, obtained a mean score of 3.22 and a standard deviation of 1.622. Descriptive statistics indicate that the EG (M = 4.88, SD = 1.031) outperformed the CG (M = 3.22, SD = 1.622) on the writing post-test. This preliminary finding suggests a

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potential positive impact of the TEPLL intervention on participant performance. To confirm whether this difference was statistically significant, an independent samples t-test was conducted. The results are presented in Table 7.

Table 7. Independent Samples t-test Results for Writing Post-test

Groups	N	Mean	SD	Levene's Test for Equality of Variances		t-test for Equality of Means		
				F	Sig.	t	df.	Sig. (2-tailed)
EG	60	4.88	1.03	7.22	0.001	2.48	118	0.000
CG	60	3.22	1.62					

As shown in Table 7, the EG achieved a mean writing post-test score of 4.88 (SD = 1.03), while the CG obtained a mean score of 3.22 (SD = 1.62). An independent samples t-test revealed a significant difference in writing post-test scores between the two groups ($t(118) = 7.22$, $p < .05$). These results indicate that the EG significantly outperformed the CG in writing performance.

The Impact of TEPLL Mediated by Proficiency, Gender, and Age

The research question two examined the potential effect of TEPLL instruction on writing skills in terms of the learners' level of proficiency, gender, and age. In order to answer this question, first, the results for the level of proficiency groups (i.e., pre-intermediate, intermediate, and advanced) were calculated in the writing post-test through one way ANOVA.

Table 8. Results of One-Way ANOVA in the Post-test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	639.467	1	1.352	3.093	.000
Within Groups	3308.400	57	2.539		
Total	3947.867	60			

As illustrated in Table 8, a significant difference was found among three proficiency groups in writing because $p<0.05$ and $F(1, 57) =3.093$. However, to find out the location of the difference, post-hoc analysis was conducted. Table 9 shows the results of Tukey HSD analysis.

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Table 9. Tukey HSD Analysis

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-2.900*	.947	.009	-5.18	-.62
	3	-3.000*	.947	.007	-5.28	-.72
2	1	2.900*	.947	.009	.62	5.18
	3	-.100	.947	.994	-2.38	2.18
3	1	3.000*	.947	.007	.72	5.28
	2	.100	.947	.994	-2.18	2.38

*. The mean difference is significant at the 0.05 level.
(1)= Pre-intermediate
(2)= Intermediate
(3)= Advanced

As presented in Table 9, the difference was found between group 1 (Pre-intermediate) with the group 2 (Intermediate) since p=.009. Moreover, the results showed the difference between group 1 (Pre-intermediate) with the group 3 (Advanced) since p=.007. Accordingly, it is concluded that, compared to intermediate and advanced groups, advanced level learners outperformed in the writing post-test. That is, regarding the potential effect of TEPLL instruction on writing skills, the more proficient the learners are, the more they benefited from the instruction. In addition, the effect of TEPLL instruction on writing skills with respect to gender groups was examined via an independent samples t-test. Table 10 reports the results.

Table 10. Independent Samples T-test by Gender

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
									Lower	Upper
	Equal variances assumed	.036	.849	-1.054	58	.294	-3.080	2.92	-8.857	2.697
	Equal variances not assumed			-1.047	56.59	.298	-3.080	2.94	-.916	2.756

As illustrated in Table 10, the difference between the means of both male and female groups was not statistically significant (F(58)=0.36; p>.05). Therefore, gender variable makes no difference regarding effect of technology-enhanced PLL instruction on writing skills. Moreover, the results for two age groups in the study (i.e. adult and adolescent) in terms of the effect of TEPLL instruction on writing skills were estimated and reported. To find out the difference between two groups an independent samples t-test was run.

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Table 11. Independent Sample T-test Results for Writing Post-test by Age Group

Groups	N	Mean	SD	Levene's Test for Equality of Variances		t-test for Equality of Means		
				F	Sig.	t	df.	Sig. (2-tailed)
Adult	30	4.22	1.132	7.241	0.001	3.466	58	0.000
Adolescent	30	3.75	1.009					

Since the level of Sig., as shown in Table 11, is less than 0.05 set for the study, F (1, 58) = 7.241, p<.05), it can be concluded that generally there is a significant difference between two groups in terms of the writing skill, and the adult group had a better performance.

Discussion

This research examined the effects of TEPLL on Iranian EFL learners' writing performance. It was found that the Experimental Group, which received instruction through TEPLL, performed significantly better compared to the Control Group, which received conventional instruction. Such findings suggest that technology integration is especially effective for higher proficiency learners who can better utilize advanced instructional technologies (Awwad & Tavakoli, 2019; Mohammad, 2023). The improvement is linked to TEPLL's creation of a more engaging and interactive environment (Åkerfeldt, 2014), which promotes more frequent writing practice and dynamic content interaction. For example, in a Moodle forum activity, students were tasked with collaboratively brainstorming ideas for an argumentative essay. One student, Sima, posted a preliminary idea: "*The benefits of using social media*." Another student, Ali, responded: "*That's a good start, but it's too broad. Maybe focus on a specific benefit, like how it helps people connect with others who share their interests*?" Sima then replied: "*Okay, I could write about how social media helps people with rare diseases find support groups.*"

This exchange, facilitated by the interactive nature of the online forum, demonstrates how TEPLL fostered dynamic interaction and the refinement of ideas through collaborative engagement. An interesting finding of this study was the lack of a significant moderating effect of gender on the impact of TEPLL on writing skills. This suggests that, within this particular Iranian EFL context and with the TEPLL intervention designed, both male and female learners benefited comparably from the technology-enhanced personalized approach. This aligns with some previous research, such as Hashemnejad et al. (2014), which also found no significant gender differences in certain

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EFL writing contexts. Several factors might contribute to this non-significant gender effect. Firstly, the nature of the Moodle platform and the personalized tasks may have created a learning environment where traditional gender-based differences in learning preferences or technology interaction styles were less pronounced. For example, the asynchronous nature of feedback and forum participation might have mitigated potential differences in classroom participation dynamics that are sometimes observed in face-to-face settings. Secondly, it is possible that access to and familiarity with technology, which can sometimes show gender disparities in other contexts, was relatively equitable among the adolescent and adult learners in this study's sample, particularly those enrolled in language institutes. Furthermore, the specific pedagogical design, focusing on individualized support and structured collaboration, might have appealed equally to both genders. While the sample size for gender subgroups within each proficiency level and age group was modest, and future research with larger, more specifically stratified samples could explore this further, our findings tentatively support the potential of TEPLL to be an inclusive tool, offering equitable opportunities for writing skill development irrespective of gender within this learning environment**.** It also warrants consideration that cultural factors within Iranian educational settings might foster more homogenous approaches to learning technology among genders than in some other cultural contexts, though this would require further specific investigation.

These results are in line with prior studies supporting the effectiveness of TEPLL in language learning (Galla, 2016; Mellati and Khademi, 2015; Jung et al., 2017) for its potential of personalization and self-directed learning (Muharom et al., 2022; Nugroho and Atmojo, 2022; Leshchenko et al., 2023). This potential, however, relies on learners' digital literacy and self-regulation. Specifically, successful TEPLL implementation requires that students possess the skills to effectively navigate online learning platforms, critically evaluate digital resources, and manage their time and learning independently. Without these skills, students may struggle to benefit fully from the personalized and self-directed opportunities offered by TEPLL (Yang, 2023; Klímová et al., 2023). However, this study emphasizes that teacher training and sustainable, technology-mediated learning environments are needed (Choi & Chung, 2021; Leshchenko et al., 2023), while the teachers should be competent in technology and accessible to support the learners (Faramarzi et al., 2021).

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Conclusion and Implications

This study demonstrated the significant positive impact of TEPLL on the writing skills of Iranian EFL learners compared to traditional instruction. Notably, the benefits of TEPLL were more pronounced for adult learners and those with higher existing proficiency levels, while gender did not emerge as a significant moderating factor. These findings have several important implications. Firstly, they underscore the value of integrating technology to personalize language learning, particularly for enhancing writing skills. The results suggest that pedagogical approaches should consider learner age and proficiency, tailoring TEPLL interventions to maximize benefits for specific groups. For instance, adult and advanced learners appear particularly well-suited to leverage the collaborative and self-directed opportunities afforded by platforms like Moodle. The non-significant gender effect is also promising, indicating TEPLL's potential as an equitable tool that can provide parity in learning opportunities. This warrants further investigation into developing adaptive, proficiency-based, and personalized learning systems that cater to diverse learner needs in writing development.

Practically, these findings call for enhanced teacher training to equip educators with the technological competence and pedagogical strategies needed to effectively design and implement TEPLL. Curricula and material development should also evolve to incorporate interactive, age-appropriate, and proficiency-specific TEPLL activities that foster collaborative learning and target specific writing sub-skills.

However, certain limitations of this study must be acknowledged. The quasi-experimental design, reliance on convenience sampling from language institutes in Isfahan, and the relatively short four-week intervention period restrict the generalizability of the findings. The use of specific textbooks and the OQPT for proficiency grouping, while ensuring internal consistency, also represent delimitations.

Therefore, future research should aim to address these limitations. Employing true experimental designs with larger, more diverse samples across various geographical and institutional contexts would enhance external validity. Longitudinal studies are needed to assess the long-term effects of TEPLL on writing skills and learner motivation. Further investigation could also explore the nuanced impact of different TEPLL features on specific writing sub-skills and delve deeper into the cognitive and affective factors (e.g., self-regulation, motivation) that mediate TEPLL's

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effectiveness for different learner profiles.

In conclusion, while acknowledging its limitations, this study provides compelling evidence for the efficacy of TEPLL in the Iranian EFL context, highlighting its particular benefits for adult and advanced learners and its potential as an inclusive pedagogical approach. Continued research and thoughtful implementation are crucial for harnessing the full potential of technology to personalize and enhance language education.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of Islamic Azad University.

Author contributions

All authors contributed to the study conception and design, material preparation, data collection, and analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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