

Integrating Automated Corrective Feedback into Nursing ESP Learners' Writing Instruction in Iranian Context

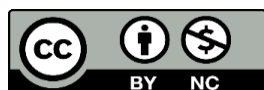
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Article Info	Abstract
<p>Article type: Research Article</p> <p>Article history: Received May 09, 2025 Received in revised form August 18, 2025 Accepted September 27, 2025 Published online September 30, 2025</p> <p>Keywords: Automated written corrective feedback, ESP learners, ESP writing, writing self-efficacy.</p>	<p>Recent developments in technology-mediated language instruction have shown that AI-provided or automated feedback constitutes a viable pedagogical intervention in language classrooms. Nonetheless, few studies have examined the utility of automated feedback for improving learners' writing ability and learner factors in the English for Specific Purposes (ESP) course. This study aimed to determine the effects of automated, written, corrective feedback-informed writing instruction on nursing learners' writing ability, writing self-efficacy, foreign language engagement, and self-regulated language learning. Moreover, it examined these learners' perspectives on this approach to writing instruction. A mixed-methods design was used to conduct the study. Fifty-two participants were recruited from nursing ESP learners in two intact classes at a university of medical sciences. Moreover, a semi-structured interview was used to collect data on these participants' attitudes towards the utility of automated feedback. The data were analyzed using t-tests, MANOVA, and thematic analysis. The results showed that automated written corrective feedback significantly improved the learners' writing ability and ameliorated their writing self-efficacy, foreign language engagement, and self-regulated language learning. Furthermore, learners generally had favorable attitudes towards this type of feedback and preferred it to traditional teacher-provided feedback. The results can empower ESP lecturers to integrate automated feedback into writing instruction in ESP courses in foreign language contexts.</p>

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Introduction

The examination of the related literature shows that researchers have paid considerable attention to Written Corrective Feedback (WCF) in language instruction (e.g., Aghaei et al., 2022; Khalili et al., 2022; Sanchooli et al., 2022). Ellis (2000b) stated that WCF encompasses language teachers' reactions to learners' erroneous uses of the target language, aiming to make them aware of the reasons behind their errors and to empower them to self-correct their language use. WCF has witnessed various changes owing to the recent technological advancements, including Artificial Intelligence (AI) (Han & Sari, 2022). More specifically, various AI systems, such as Write to Learn (Ranalli et al., 2017), have been developed to provide language learners with WCF across various aspects of their written work. Shermis and Burstein (2003) noted that these AI systems compare learners' written work with natural language data repositories and identify writing errors, including semantic, structural, and rhetorical types. Consequently, these systems may be effective in reducing language teachers' workload in crowded language classes where they must provide individual learners with WCF (Hockly, 2019).

Most previous studies of AI-provided or automated WCF (e.g., Chew et al., 2019; Li et al., 2015; Tang & Rich, 2017; Wilson & Roscoe, 2020) have mainly examined its effectiveness in improving learners' writing ability. Only a few studies have investigated the effects of this feedback type on learners' affective factors (i.e., Sherafati & Mahmoudi Largani, 2022). In language instruction, learners' affective factors include their attitudes and emotions that may exert considerable influence on their language acquisition in classroom contexts (Tang & Rich, 2017). Among these factors, learners' Writing Self-Efficacy (WSE), Foreign Language Engagement (FLE), and Self-Regulated Language Learning (SRLL) have attracted considerable attention (Teng et al., 2018). WSE refers to learners' attitudes towards their second-language writing ability (Usher & Pajares, 2008). Additionally, FLE assesses learners' capacity to utilize their cognitive and affective resources to expedite language acquisition (Fredricks et al., 2004). In addition, SRLL specifies the learners' capability to determine their language acquisition objectives and to manage their learning behaviors effectively (Kormos, 2012).

These studies have mainly focused on general English courses and have disregarded the ESP courses. Therefore, there is a need for additional studies on learner factors in ESP courses to provide empirical evidence of the utility of automated WCF across diverse academic settings. Considering the lack of adequate research on the role of AI systems and automated feedback in the learners' affective factors, the present study made an effort to determine the extent to which the automated feedback of a specific AI system influenced Iranian nursing ESP learners' writing performance, along with their WSE, FLE, and SRLL. In this way, the study tried to provide a better understanding of the efficacy of automated WCF in foreign language classrooms in the era of technology-mediated language instruction.

The relevant studies on automated feedback have mainly focused on its role in improving learners' writing ability (e.g., Cheng, 2017; Chew et al., 2019; Hassanzadeh & Fotoohnejad,

2021; Zhang, 2020; Zhang & Hyland, 2018). Nonetheless, these studies have disregarded learner factors that play a pivotal role in language learning (Sun & Wang, 2020). Language learners' WSE, FLE, and SRLL constitute three of their main factors, closely interrelated (Csizér & Tankó, 2017), that affect their writing skill development (Su et al., 2018). Research suggests that technology-mediated language instruction is likely to have a beneficial effect on learners' WSE (e.g., Rahimi & Fathi, 2021), FLE (e.g., Zhang, 2020), and SRLL (e.g., Boykin et al., 2019). Notwithstanding, few studies (e.g., Sherafati & Mahmoudi Largani, 2022) have provided empirical evidence in this regard. In addition, there is a lack of research on the utility of automated WCF in ESP courses.

The present study sought to address this research gap by examining the effects of automated WCF on nursing ESP learners' writing ability, WSE, FLE, and SRLL in Iran. Hence, the study focused on three learner factors —Writing Self-Efficacy (WSE), Foreign Language Engagement (FLE), and Self-Regulated Language Learning (SRLL) — that are closely associated with one another (Csizér & Tankó, 2017). The selection of these factors was informed by Bandura's (1997) social cognitive theory, which argues that individuals' skill-related perceptions are likely to influence their behavior. Moreover, this choice was supported by empirical studies (e.g., Pajares & Johnson, 1996; Han & Hiver, 2018) that have indicated that learners' WSE, FLE, and SRLL are likely to influence their attention to writing tasks and their cognitive processing of task-specific language. Moreover, it scrutinized these learners' perspectives on this writing instruction approach. To this end, the following research questions were raised in this study:

- Does automated WCF have a significant impact on nursing ESP learners' writing ability, WSE, FLE, and SRLL?
- What are ESP nursing learners' perspectives on the effects of automated WCF on their writing ability, WSE, FLE, and SRLL?

Literature review

ESP Writing

Writing ability constitutes one of the main prerequisites to individuals' academic and professional success (Tsai, 2022). According to AlMarwani (2020), this skill plays a pivotal role in learners' academic progress in foreign-language contexts, as it enables them to share field-specific information and ideas with an international audience. As Hyland (2019) explained, to write persuasive essays on certain topics, language users need to take specific measures. More specifically, they need to brainstorm ideas, organize the relevant ideas based on their topic, develop cohesive paragraphs (using their ideas) based on the rhetorical conventions of the relevant language, revise the paragraphs to ensure their comprehensibility, and edit the piece of writing based on the grammatical rules of the pertinent language.

Budjalemba and Listyani (2020) averred that the process of writing, including academic writing in ESP courses, poses greater challenges for language learners who are not proficient

in the target language and are not adequately informed about the research conventions of their field. Likewise, Bulqiyah et al. (2021) noted that ESP learners face three main challenges in writing tasks: selecting appropriate field-specific vocabulary, using correct grammatical structures, and applying writing mechanics, including punctuation conventions. In addition, Huang and Wilson (2021) noted that most ESP learners are unable to develop and use macro-level writing skills, including idea organization and paragraph development using details.

The above-mentioned challenges to writing skill development in ESP courses highlight the necessity for technical and field-specific writing instruction in these courses (Cheng & Zhang, 2021). According to Cheng et al. (2021), feedback, including WCF, is an essential aspect of writing instruction that is likely to help learners address most of their writing errors in class. Bitchener (2018) noted that teachers are the agents who provide learners with WCF in most academic settings. Nonetheless, the provision of timely and effective WCF increases their heavy workload and may reduce their instructional efficiency (Latifi & Noroozi, 2021).

Learners' engagement with WCF is likely to depend on various individual factors (Latifi et al., 2020; Zhang & Hyland, 2022). In this regard, Kerman et al. (2022) indicated that EFL learners' positive attitudes towards peer WCF resulted in its integration into their written work. Moreover, Banihashem et al.'s (2022) study indicated that learners used teacher-provided WCF in their written work when they regarded it as detailed and instructive. Likewise, Mahfoodh (2017) focused on learners' affective factors and reported that EFL learners' satisfaction with feedback and their sense of frustration determined their uptake. Finally, Banihashem et al.'s (2023) study showed that EFL learners' epistemic beliefs were significant factors in their use of WCF in their argumentative tasks.

Learner Factors

In the field of language teaching, learner factors encompass learners' cognitive and affective attributes that are likely to influence their reactions to pedagogical interventions (Wilson & Roscoe, 2020) and may affect the process of their language acquisition (Linnenbrink & Pintrich, 2003).

Self-efficacy constitutes one of the main learner factors that "encompasses individuals' beliefs in their capabilities to organize and execute the necessary actions to achieve specific outcomes" (Bandura, 1997, p. 3). According to Shell et al. (1989), in the writing process, self-efficacy becomes more task-specific and is referred to as WSF. Usher and Pajares (2008) defend WSE as a language learners' perspective on their ability to perform writing tasks, which influences their efforts and endurance. Based on this definition, Teng et al. (2018) itemized three main sub-components of WSE: performance self-efficacy, self-regulatory self-efficacy, and linguistic self-efficacy. As they explained, performance self-efficacy refers to learners' confidence in their ability to achieve the objectives of writing tasks. Moreover, regulatory self-efficacy encompasses learners' beliefs in their ability to manage the process of writing task performance. Lastly, linguistic self-efficacy determines the extent to which learners have confidence in their effective use of the target language in their writing tasks.

Empirical studies of WSE have mainly followed two research lines. First, a number of these studies have examined the relationship between learners' WSE and affective factors. For instance, Woodrow's (2011) study showed that learners with higher WSE scores experienced lower foreign language anxiety than those with lower WSE scores. Second, some studies have examined the relationship between WSE and writing performance. In this regard, Golparvar and Khafi's (2021) study indicated that learners' higher WSE scores were positively correlated with their effective performance on writing tasks. Nonetheless, there is insufficient research on the impact of pedagogical interventions (e.g., automated WCF) on learners' WSE.

Language learners' FLE is another important learner factor in language instruction (Angelovska et al., 2021). Fredricks et al. (2004) argued that FLE refers to the process by which language learners leverage their information-processing capacity and positive feelings to take measures that facilitate and expedite their language acquisition. In line with this definition, Eerdemutu et al. (2024) identified three main sub-components of FLE: cognitive, emotional, and behavioral. As they explained, the cognitive aspect of FLE refers to learners' optimal use of their information-processing capabilities to perform language tasks. Moreover, the emotional aspect of this construct refers to learners' use of positive emotions to manage psychological stress and improve their performance in class. Finally, the behavioral aspect of FLE refers to the measures learners take to expedite their second-language acquisition.

Some of the studies of language learners' FLE have mainly focused on its relationship with language learning. For instance, Zhang et al. (2020) examined the relationship between learners' FLE and their listening and speaking abilities. The results of this study showed a positive correlation between FLE and the relevant skills. Other studies have sought to identify predictors of FLE. In this regard, Yang et al.'s (2024) study reported that EFL learners' gender significantly predicted their FLE. A few studies have examined the role of FLE in learners' motivation. Regarding this line of research, Oga-Baldwin and Nakata's (2017) study indicated that language learners' FLE had a significant positive correlation with their language learning motivation.

Finally, language learners' SRL is considered one of the main affective factors that determine their academic success (Kanlapan & Velasco, 2009). Kormos (2012) defined SRL as language learners' ability to establish learning objectives and manage language-learning behaviors that facilitate task engagement and the achievement of prespecified goals. Considering the pivotal role of SRL in language acquisition, Tseng et al. (2017) identified four main sub-components of SRL: boredom, awareness, goal, and emotion. They explained that boredom refers to learners' ability to prevent it from interfering with effective task performance. Moreover, awareness shapes learners' understanding of the measures that improve their language learning. In addition, the goal determines learners' ability to set language-learning objectives tailored to their needs. Lastly, emotion determines the learners' ability to suppress their negative emotions that prevent them from performing their tasks.

Several studies of SRL have focused on its impact on learners' writing ability. For instance, Rahimi and Fathi's (2021) study showed that learners' development and use of SRL strategies

ameliorated their writing ability. Other studies have examined the relationships between learners' involvement in language instruction and their SRL. In this regard, Ellis and Folley's (2011) study showed that learners' ability to make language assessment choices improved their SRL. Finally, very few studies (i.e., Sherafati & Mahmoudi Largani, 2022) have examined the role of technology-mediated language instruction in learners' SRL.

Method

Design

The present study employed an explanatory mixed-methods design. This design enables the researchers to gather data on the examined variables in two phases, comprising a quantitative phase and a qualitative phase. The study's qualitative findings are used to explain and interpret the quantitative results (Creswell & Creswell, 2017). Likewise, in this study, the researchers first gathered quantitative data on the effect of automated WCF (i.e., independent variable) on ESP learners' writing ability, WSE, FLE, and SRL (i.e., dependent variables). Next, they used the interview protocol to collect qualitative data on the learners' perspectives on automated WCF in their classes.

Participants

In light of the objectives, the researchers selected 52 intermediate-level male and female nursing ESP learners from two intact classes (i.e., 26 learners per class) at a university of medical sciences in Iran as participants through convenience sampling. These participants were aged 19 to 24 and spoke Azeri, Persian, or Kurdish as their first language. Moreover, their language-learning experience ranged from 2 to 3 years. The researchers obtained written informed consent from all of the participants prior to the onset of the study. Table 1 provides detailed information about these learners:

Table 1

Demographic Information about Participants

Characteristic	N
Gender	
Male	24
Female	28
Age Group	
19-21	38
22-24	14
First Language	
Azeri	23
Persian	11
Kurdish	18

In addition, the researchers themselves were the other group of participants, since they rated the participants' performances on the study's writing pretest and posttest.

Instruments

The researchers used a proficiency test, two free-writing tests, and two Likert-scale questionnaires to gather data. Consequently, they used Cronbach's Alpha (CA) to assess instrument reliability in a pilot study involving 22 male and female nursing ESP learners whose characteristics were similar to those of the participants in the main study. Moreover, the researchers used exploratory factor analysis and Confirmatory Factor Analysis (CFA) to scrutinize the construct validity of these instruments. The following section itemizes the above-mentioned instruments and explains each instrument in detail.

Proficiency Test

To examine participants' proficiency levels and ensure homogeneity, the researchers used Allan's (2004) Oxford Placement Test (OPT). This test comprises three sections: grammar, vocabulary, and reading comprehension. Each of these test sections involves 20 items. The CA analysis indicated a reliability index of .84. In addition, CFA results indicated that the instrument's validity was .92 and that it could be used in the Iranian context.

Writing Pretest and Posttest

The researchers developed two writing tests as the study's pretest and posttest, based on the textbook *Oxford English for Careers: Nursing 1* (Grice, 2009). More specifically, they randomly selected two textbook topics and used one as the pretest and the other as the posttest. In each of these tests, participants had to write a 500-word essay on the relevant topic in one hour.

Writing Textbook

In this study, the researchers used Grice's (2009) textbook, *Oxford English for Careers: Nursing 1*, to develop the writing pretest and posttest. They chose this textbook because it is one of the most widely taught ESP textbooks worldwide. Moreover, it empowers nursing students to develop their required language skills in hospital settings and other medical centers effectively (Grice, 2009). This textbook provides nursing ESP students with appropriate academic writing tasks. In addition, the researchers used this textbook to develop the writing tasks of the treatment sessions.

Writing Assessment Framework

Given the objectives, the researchers used Brown and Bailey's (1984) framework to assess participants' performance on the study's writing pretest and posttest. This framework enables researchers to assess three aspects of writing ability: structure, mechanics, and style. Each of these aspects is rated on a 20-point scale. In the present study, the researchers used the inter-rater correlation coefficient (Pallant, 2020) to examine inter-rater reliability. The results showed that the inter-rater reliability indices were .85 and .88 on the writing pretest and posttest,

respectively, and that the writing assessment procedure was satisfactorily reliable. Moreover, CFA results (.95) indicated that this framework had an acceptable validity index in the Iranian context.

WCF Strategy Framework

Ellis's (2009a) WCF strategy framework was used to determine the automated WCF strategy types in the experimental group and to provide WCF to the participants in the control group. This framework distinguishes between focused and unfocused WCF types. It particularizes five WCF strategies in each of these types, including direct, indirect, metalinguistic, electronic, and reformulation-based WCF strategies. As Ellis (2009a) explained, in direct WCF, learners are provided with the correct forms of their errors. Moreover, in indirect WCF, teachers use techniques such as highlighting and underlining to make learners aware of errors in specific parts of their written work. Moreover, in metalinguistic WCF, teachers use explanations to make learners aware of the causes of their errors. In electronic WCF, teachers provide the learners with hyperlinks to corpora to help them self-correct their errors. Finally, in reformulation-based WCF, teachers ask native speakers to rework learners' written work to help learners compare their output with native-speaker language use.

AI System

An AI Criterion (v22.1.0) system was used with WCF on their writing performance. Shermis and Burstein (2003) noted that, in 2002, the Educational Testing Service developed an AI-powered WCF system to provide language learners with automated WCF across diverse aspects of their written work. This system empowers learners to submit their written work and take advantage of its Writer's Handbook section, which explains the WCF for their writing and offers recommendations for correcting erroneous sections.

Writing Self-Efficacy Questionnaire

Given the objectives, the researchers used Teng et al.'s (2018) WSE questionnaire as a pretest and posttest to assess participants' WSE before and after the treatment sessions. They utilized this questionnaire because it was developed based on the state-of-the-art theory of WSE in second-language acquisition (Teng et al., 2018). This instrument encompasses 20 items that are rated on a 7-point Likert scale in the range of not at all true of me to very true of me. The relevant items focus on three main subcomponents of WSE: performance self-efficacy, self-regulatory self-efficacy, and linguistic self-efficacy. The results of the CA analysis indicated that the reliability index of this instrument was .86. Additionally, based on CFA results, the validity index (.93) was satisfactory, and the instrument could be used in the present study.

Foreign Language Engagement Questionnaire

In this study, the researchers used Eerdemutu et al.'s (2024) FLE questionnaire as a pretest and a posttest to examine ESP learners' FLE before and after treatment. This instrument comprises 9 items that focus on three main sub-components of FLE: its cognitive, emotional, and behavioral aspects. They are rated on a 5-point Likert scale from strongly agree to strongly

disagree. Based on the results of CA analysis, the reliability index of this questionnaire was .89. Moreover, CFA results showed that the validity index of this questionnaire (.91) was acceptable it could be utilized in the present study.

Self-Regulated Language Learning Questionnaire

The researchers used Tseng et al.'s (2017) SRL questionnaire as a pretest and posttest to determine the effects of the treatment on participants' SRL. This questionnaire examines four main subcomponents of SRL: boredom, awareness, goal, and emotion. It comprises 20 Likert-scale items rated on a 4-point scale from strongly agree to strongly disagree. According to the CA results, the reliability index for this questionnaire was .85. In addition, CFA results showed that the validity index (.97) was satisfactory and that it could be used in Iran.

Interview

Based on the objectives, the researchers developed a 4-item semi-structured interview protocol to determine ESP learners' perspectives on the utility of automated WCF for improving their writing ability, WSE, FLE, and SRL. The researchers used the qualitative focus-group interview method (Tanggaard, 2008). They first invited 5 ESP learners to participate in a 60-minute focus group interview. These learners were adequately informed about the role of AI in second language acquisition. Second, they served as session facilitators and prompted these learners to discuss various aspects of automated WCF in language classes. The researchers recorded the interview session. Third, the researchers used thematic analysis (Braun & Clarke, 2021) to extract codes and themes from the interview data and to develop the primary items of the protocol based on these themes. Finally, the researchers used member checking (Tanggaard, 2008) to ensure the instrument's content validity. Hence, they provided learners with the initial version of the protocol, asked them to evaluate its items for content, revised the items based on their comments, and developed the final version of the protocol.

Procedure

In the present study, the researchers first chose a quasi-experimental design to examine the effects of the independent variable, automated WCF, on the dependent variables, including ESP learners' writing ability, WSE, FLE, and SRL. They used this design because it allows researchers to conduct their studies with intact groups (Creswell & Creswell, 2017). Accordingly, they utilized automated WCF-informed ESP writing instruction as the study's treatment. Moreover, the researchers used a control group, standardization, and pretesting to control extraneous variables, minimize the effects of intact groups, and ensure internal and external validity (Creswell & Creswell, 2017). More specifically, they used a control group to isolate the independent variable's impact on the dependent variable. In addition, they standardized the study by keeping the experimental procedure, materials, and instruments consistent across all of the participants. Additionally, the researchers ensured the homogeneity of the groups in terms of writing ability, WSE, FLE, and SRL by conducting pretests prior to the beginning of the treatment sessions (Creswell & Creswell, 2017).

Second, they used convenience sampling to select 52 male and female intermediate nursing ESP learners from two intact classes at a university of medical sciences (i.e., 26 learners in each class) as participants, and obtained their informed consent. Third, they randomly assigned one of these classes to the experimental group or the Automated Feedback Group (AFG), and the other to the Control Group (CG). Fourth, they administered the writing, WSE, FLE, and SRLLE pretests to both AFG and CG to ensure homogeneity in the examined variables prior to the onset of the study.

Fifth, they provided AFG with the automated WCF treatment for 16 sessions in eight weeks. Before treatment began, the researchers organized a training session for ESP learners in AFG to use the Criterion AI system. During the treatment sessions, the learners in this group were provided with predetermined writing topics and asked to complete 500-word writing tasks based on them in 60 minutes using Criterion. Next, they were asked to submit their written work to Criterion, which provided them with immediate WCF on their errors. The examination of the WCF of this AI system showed that it used a combination of indirect and metalinguistic WCF (Ellis, 2009a). More specifically, this AI system highlighted the erroneous sections of learners' written work and provided metalinguistic explanations to help them self-correct their errors. After that, the learners were prompted to revise their written work based on the automated WCF and to submit it using the relevant system. Nonetheless, CG received teacher-provided WCF feedback. In this group, the researchers provided learners with the same writing topics, asked them to complete the writing tasks, and delivered combined indirect and metalinguistic WCF across the same number of sessions. Sixth, the researchers administered the writing, WSE, FLE, and SRLLE posttests to both of the groups to examine the efficacy of the treatment. Finally, the researchers randomly selected 10 learners in AFG and conducted 30-minute interviews using the study's interview protocol to examine their perspectives on automated WCF.

Data Analysis

Based on the aims, the researchers used descriptive statistics, including Mean (M), Standard Deviation (SD), and Standard Error of the Mean (SEM), and inferential statistics, including t-tests and MANOVA, to analyze the quantitative data. More specifically, they used independent-samples t-tests and paired-samples t-tests to examine the homogeneity of the experimental and control groups before treatment and to assess improvements in the experimental group's performance, respectively. Furthermore, they used MANOVA to examine the simultaneous effects of a single independent categorical variable with two levels (i.e., automated feedback & teacher-provided feedback) on four dependent interval variables: ESP learners' writing ability, WSE, FLE, and SRLLE (Pallant, 2020). In addition, the researchers used thematic analysis (Braun & Clarke, 2021) to determine the underlying codes and themes in the interview data.

Findings

Quantitative Results

The researchers examined the characteristics of the pretest and posttest data to specify the statistical tests to be used in the data analysis. The preliminary analysis results indicated that the data were compatible with the assumptions of parametric tests. More specifically, the data on the pretests and posttests were interval and were normally distributed based on the results of Shapiro–Wilk and Kolmogorov-Smirnov tests ($p>.05$). In addition, the data on the examined variables were collected independently. Consequently, the researchers used independent-samples t-tests, paired-samples t-tests, and MANOVA to analyze the data and answer the research questions.

Before data analysis, it was necessary to ensure that the AFG and CG were homogeneous in terms of writing ability, WSE, FLE, and SRL. To this end, the researchers used the independent-samples t-test. Table 2 presents descriptive statistics on the performance of AFG and CG.

Table2*Descriptive Statistics on Pretest Performances of AFG and CG*

Groups	Pretest	M	SD	SEM
AFG	Writing	25.77	2.422	.475
CG	Writing	26.04	2.306	.452
AFG	WSE	86.15	3.541	.694
CG	WSE	87.54	3.513	.689
AFG	FLE	26.23	1.904	.373
CG	FLE	27.19	3.487	.684
AFG	SRL	53.15	3.674	.720
CG	SRL	54.08	2.607	.511

The results of Levene’s test indicated that the variances of the groups were equal ($p>.05$). Therefore, the researchers examined the results of the independent-samples t-tests of the pretest performances of AFG and CG. Table 3 provides these results:

Table 3*The t-tests of Pretest Performances of AFG and CG*

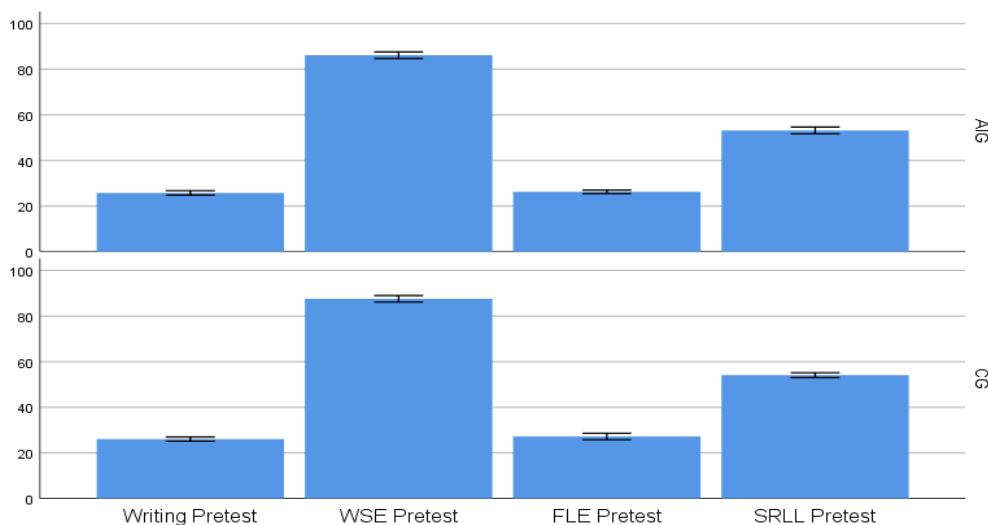
Pretest	F	t	df	Sig.
Writing	.269	-.411	50	.683
WSE	.012	- 1.416	50	.163
FLE	4.550	- 1.234	50	.225

SRL	6.083	-	50	.302
		1.045		

As shown in Table 3, there were not significant differences between AFG and CG in terms of their writing, WSE, FLE, and SRL pretest performances ($p>.05$). Figure 1 shows these results:

Figure 1

Pretest Performances of AFG and CG



Considering these results, the researchers proceeded to the data analysis to answer the research questions. The researchers ran four paired-samples t-tests to compare AFG's performance on the pretests and posttests. Table 4 provides the relevant descriptive statistics:

Table 4

Descriptive Statistics on the Pretest and Posttest Performances of AFG

	M	N	SD	SEM
Writing Pretest	25.77	26	2.422	.475
Writing Posttest	45.81	26	2.577	.505
WSE Pretest	86.15	26	3.541	.694
WSE Posttest	120.12	26	4.063	.797
FLE Pretest	26.23	26	1.904	.373
FLE Posttest	33.96	26	2.391	.469

SRLI Pretest	53.15	26	3.674	.720
SRLI Posttest	64.46	26	4.150	.814

In addition, Table 5 provides the results of the t-tests of AFG:

Table 5

The t-test of Pretest and Posttest Performances of AFG

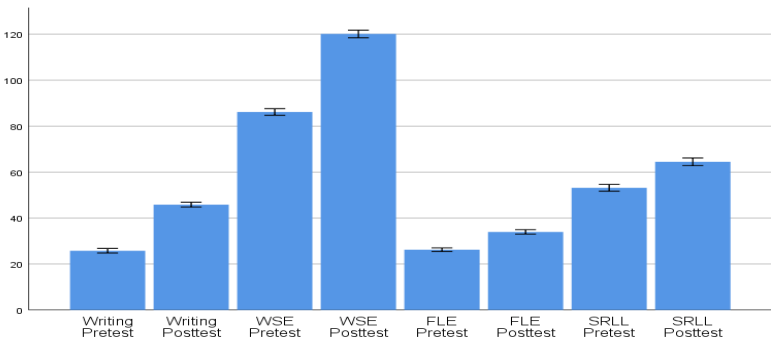
						95% Confidence Interval of the Difference				Sig. (2- tailed)
		M	SD	Mean	Lower bound	Upper bound	t	df		
Participant 1	Writing Pretest	-2	3	.6	-2	1	3	25	.0	
	Writing Posttest	0	1	2	1	8	2		0	
		.8	4		.3	.7	.1		0	
		0	1		3	7	1			
		3			2	5	2			
Participant 2	WSE Pretest	-3	4	.8	-3	3	4	25	.0	
	WSE Posttest	3	1	2	5	2	1		0	
		.9	8	0	.6	.2	.4		0	
		9	1		6	2	4			
		6			5	7	2			
Participant 3	FLE Pretest	-7	2	.5	-8	6	1	25	.0	
	FLE Posttest	.7	7	3	.8	.6	.4		0	
		7	5	9	4	2	3		0	
		3	0		2	0	3			
		1					2			

P	SRL	-	4	.	-	-	-	2	.
a	Pretest	-	1	.	9	1	9	1	5
i	SRL		1	6	1	3	.	2	0
r	Posttest		.	7	6	.	4	.	0
4			3	1		1	2	3	
			0			9	1	4	
			8			4		3	

As shown in Table 5, there were significant differences between the writing, WSE, FLE, and SRL pretest and posttest performances of AFG ($p<.05$). In other words, automated feedback had significant positive effects on ESP learners’ writing ability, WSE, FLE, and SRL. Figure 2 shows these results:

Figure 2

Pretest and Posttest Performances of AFG



Nonetheless, the researchers had to compare AFG and CG performances on the writing, WSE, FLE, and SRL posttests to ensure that the improvements in AFG’s posttest performance were not due to chance and stemmed from the automated WCF. To this end, the researchers used the MANOVA test. Table 6 provides the results of multivariate tests:

Table 6

Results of Multivariate Tests

					E
					r
		V			r
		a		Hyp	o
		l		othe	r
		u		sis	d
Effect		e	F	df	f
					.

G r o u p s	Pillai's Trace	.	14	4.00	4	.
		9	6.9	0	7	0
		2	28		.	0
		6			0	0
	Wilks' Lambda	.	14	4.00	4	.
		0	6.9	0	7	0
		7	28		.	0
		4			0	0
	Hotellin g's Trace	1	14	4.00	4	.
		2	6.9	0	7	0
		.	28		.	0
		5			0	0
		0			0	
	Roy's Largest Root	1	14	4.00	4	.
		2	6.9	0	7	0
		.	28		.	0
		5			0	0
		0			0	
		5			0	

As shown in Table 6, the p-value for the Wilks' Lambda test was smaller than .05. Consequently, the researchers examined the results of the tests of between-subject effects. Table 7 shows these results:

Table 7

Results of Tests of Between-Subject Effects

Source	Dependent Variable	Type III Sum of Squares		Mean Square	F	Sig.
			df			

Groups	Writing Posttest	147	1	14	2	.
		5.5		75.	0	0
		58		55	0	0
				8	.	0
					7	
	WSE Posttest				9	
					8	
		340		34	2	.
		8.4		08.	5	0
		81		48	9	0
	FLE Posttest			1	.	0
					5	
					9	
					5	
		637		63	1	.
	SRL Posttest	.00	1	7.0	6	0
		0		00	7	0
					.	0
					6	
					9	
	SRL Posttest				9	
		973		97	8	.
		.55		3.5	5	0
		8		58	.	0
					0	0
	SRL Posttest				2	
					7	

According to Table 7, there were significant differences between the performances of AFG and CG on the writing, WSE, FLE, and SRL posttests ($p<.05$). That is, AFG had a better performance on all of these posttests compared to CG.

Qualitative Findings

This section provides the qualitative findings of the study, in which the researchers analyzed the obtained interview data using thematic analysis. That is, they extracted the codes and themes in the data. Table 8 shows the codes along with their relevant themes:

Table 8

Codes and themes in the Data on AFG

Codes	Themes
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Noticing the corrections Comparing one's output with AI-corrected forms Using <i>Writer's Handbook</i> section to improve writing performance Remembering automated WCF for a long time Taking advantage of AI-provided grammatical explanations during treatment sessions	Long-lasting positive effect of automated WCF on writing ability
Being more confident about accuracy of written work Taking advantage of AI-provided model structures to improve writing performance	Self-efficacy-promoting nature of automated feedback
Focusing on various aspects of automated WCF Making an endeavor to understand automated WCF categories Being excited by the ability to integrate automated WCF into written work	Whole-person engagement in AI-mediated writing task performance
Casting aside writing inhibitions Establishing writing improvement goals Formulating and implementing writing strategies	Self-regulatory effect of automated feedback on writing performance

As shown in Table 8, the first theme in the data was the long-lasting positive effect of automated WCF on writing ability. Nine participants noted that automated WCF enabled them to address erroneous sections of their written work across various writing tasks. In this regard, participant 2 noted that:

“The system-provided feedback was beneficial. I understood everything. I mean, all of the explanations were very comprehensible”.

Likewise, participant 8 noted that:

“The positive aspect of the feedback was that it was clear and I remembered most of the corrections. I was able to use the relevant feedback to improve my performance in the other writing tasks”.

Similarly, participant 5 stated that:

“I used the Writer’s Handbook section to develop a better understanding of the causes of my errors. Some of the feedback instances provided information on common learner errors. I used these grammar rules to correct my errors. That is, I compared my written work with the example sentences and corrected its erroneous parts”.

Moreover, the second theme in the obtained data was the self-efficacy-promoting nature of automated feedback. Seven of the participants stated that automated feedback increased their confidence in their writing ability. Regarding this theme, participant 5 noted that:

“Becoming aware of your errors and correcting them is heartening. I was not afraid of the teachers’ comments and evaluation when I submitted my written work”.

Similarly, participant 10 highlighted the utility of automated feedback in error correction and pointed out that:

“I was more certain about the accuracy of my completed tasks since I compared my structures with the system-provided WCF and corrected their errors”.

In addition, the third theme in the data on AFG was *whole-person engagement in AI-mediated writing task performance*. Six participants noted that automated feedback effectively engaged them in the task performance process. For instance, participant 1 pointed out that:

“Correcting my own errors by myself felt great. I knew that I could rely on my own ability to improve my written work. I paid close attention to the explanations of the system and compared my sentences with them”.

Similarly, participant 6 noted that the automated WCF prompted her to reflect deeply on her errors and identify relevant grammar rules to improve her written work. She stated that:

“I worked hard to improve my written work. I knew it was possible to address my mistakes by using the system’s feedback. As a result, I made an effort to determine the rules in the provided WCF”.

Finally, according to Table 8, the last main theme in the data was the self-regulatory effect of automated feedback on writing performance. Nine of the participants noted that automated feedback empowered them to perform their tasks independently and helped them manage their negative feelings. In this regard, participant 7 pointed out that:

“Understanding the causes of my errors reduced my writing performance anxiety. I considered writing to be a formidable task in language classes. Nonetheless, the user-friendly nature of the AI system and the comprehensibility of its feedback helped me to deal with my writing fears effectively”.

Likewise, participant 7 noted that:

“The feedback that was provided by the AI system made me aware of the fact that developing and implementing writing strategies could extremely improve my performance. Therefore, I tried to use certain writing strategies to deal with my writing problems”.

Discussion

This section explains the results and describes the new information generated by the study. The first research question determined the effects of automated WCF on ESP learners' writing ability, WSE, FLE, and SRL. The results of the quantitative phase of the study indicated that this type of feedback significantly improved learners' writing ability, along with the aforementioned learner factors. These results corroborate the findings of several previous studies. In terms of writing ability, the results coincide with the results of Cheng's (2017) study and Chew et al.'s (2019) study. Cheng (2017) attributed the effectiveness of automated feedback to the fact that its Writer's Handbook section enabled learners to use WCF at any time and to practice writing effectively. Moreover, Chew et al. (2019) argued that the effectiveness of automated feedback in their study emanated from the fact that it allowed the learners to revise their written work before submitting it. Consequently, the utility of automated feedback in the present study may be attributed to its positive role in learners' unrestricted writing practice and their informed writing revision.

The results of this study contrast with those of Link et al. (2020) and Han and Sari (2022), reporting no significant difference in the effect of automated WCF compared with teacher-provided WCF. The discrepancy between this study's results and those of the above-mentioned studies may have stemmed from differences in their settings. More specifically, it is possible that the university student participants in the present study were more motivated to integrate automated WCF into their writing owing to its utility in their writing tasks, compared to the language institute student participants in these studies, who were mainly interested in developing speaking skills. However, the results of this study align with those of Grimes and Warschauer (2010) and Sherafati and Mahmoudi Largani (2022). Grimes and Warschauer (2010) attributed the positive effect of automated feedback on learners' WSE to its immediate nature, which increased their motivation to improve the quality of their written work. In addition, Sherafati and Mahmoudi Largani (2022) averred that the utility of this feedback type could be associated with learners' positive perceptions of its effectiveness. Consequently, in this study, the positive role of automated feedback in learners' WSE may be related to its immediacy and its correction-motivating nature.

Regarding FLE, the results of this study align with those of Ranalli (2021) and Yan and Zhang (2024). Ranalli (2021) noted that the utility of automated feedback in improving learners' FLE stemmed from learners' trust in this type of feedback and their perception of it as a true reflection of native-speaker language use. Moreover, Yan and Zhang (2024) noted that the improvement to the participants' FLE in their study was related to the beneficial effect of automated feedback on their cognitive processing of language information. As a result, in this study, the beneficial impact of automated feedback on participants' FLE may be attributed to

participants' trust in it as a genuine source of second-language data and its use to expedite their language data processing.

Additionally, regarding SRLL, this study's results corroborate those of Rahimi and Fathi (2021) and Sherafati and Mahmoudi Largani (2022). Rahimi and Fathi (2021) argued that the positive role of automated feedback in language learners' SRLL stemmed from its prompting learners to use effective writing strategies. In addition, Sherafati and Mahmoudi Largani (2022) noted that automated feedback was effective in improving learners' SRLL, as it helped them set writing goals and monitor their performance in line with their objectives. As a result, in the present study, the positive effect of automated feedback on ESP learners' SRLL may be linked to its role in learners' use of writing strategies and goal-setting for writing development.

The second research question examined the ESP learners' perspectives on the effects of automated WCF on their writing ability, WSE, FLE, and SRLL, showing that the participants had positive attitudes towards the use of automated WCF in their course, as it improved their writing, increased their confidence in their writing ability, engaged them in writing tasks, and helped them overcome their writing inhibitions. In general, these findings are in line with the results of Alberth's (2019) study and Sari and Han's (2024) study. Alberth (2019) attributed learners' positive attitudes towards the use of automated WCF in their classes to its personalized nature and to its empowering learners to integrate corrections into their written work effectively. Moreover, Sari and Han (2024) noted that learners in their study preferred automated feedback to teacher feedback, as it was available at any time and helped them make cognitive comparisons between their own output and the correct use of the language reflected in automated feedback. Consequently, it may be argued that, in the present study, ESP learners' favorable views of automated feedback stemmed from its personalized nature and its role in promoting learners' cognitive comparisons.

Conclusion

The present study investigated the extent to which automated feedback ameliorated nursing ESP learners' writing ability, WSE, FLE, and SRLL. Moreover, it scrutinized these learners' perspectives on the efficacy of automated feedback in their classes. The results indicated that the WCF furnished by the AI significantly improved both learners' performance on writing tasks and their affective factors. In addition, the participants had positive attitudes towards integrating this feedback type into their ESP courses and preferred it to teacher-provided WCF.

These results have specific implications for various stakeholders. First, ESP lecturer educators and syllabus designers should prepare lecturers for AI-mediated language instruction and encourage them to integrate automated feedback into their classes. This approach can empower learners to leverage automated WCF to address their sentence-level errors. Moreover, it can help lecturers provide their learners with WCF on the organization of their completed writing tasks, alongside the content of their written work.

Second, ESP lecturers need to use automated feedback in their classes to facilitate ESP learners' cognitive comparisons, help learners learn from their errors, and enable them to hone their ESP writing skills. Likewise, ESP lecturers should use a type of feedback to increase learners' motivation to correct errors, enhance learners' confidence in their writing ability, and make learners aware of self-regulatory writing strategies. Lastly, these lecturers have to integrate automated WCF into language instruction to create and maintain a more learner-centered environment, to focus on the learners' macro-level writing performance, including the content of their written work, and to adapt writing instruction to ESP learners' evolving language acquisition needs in the modern era of AI-mediated education.

The present study suffered from certain limitations that may affect the generalizability of its results. First, the researchers were unable to determine the effects of learners' personal attributes — such as age, gender, and language background — on the results. Second, they could not use random participant assignment and utilized intact groups. Moreover, the researchers delimited the study to intermediate-level nursing ESP students in university settings. Future studies need to address these issues. In addition, these studies should replicate the present study using other AI-powered systems, such as ChatGPT, to determine their efficacy in WCF provision. Finally, future studies should be conducted in both second- and foreign-language contexts better to understand the efficacy of automated WCF in ESP courses.

Bio-data

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