A Cross-Cultural Study into the Utility of Diverse Written Corrective Feedback Strategies in Medicine Students' ESP Writing Courses

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Abstract This study strived to determine the utility of different written corrective feedback strategies for ameliorating medicine English for Specific Purposes (ESP) students' writing ability. Moreover, it endeavored to specify these students' perspectives on the pertinent strategies. To this end, the researchers used a mixed-methods design. First, we selected 183 intermediate-level medicine ESP students in six intact classes at two universities in Iran as the participants. Second, we assigned the classes to five experimental groups and one control group. Third, we used a writing pretest, written corrective feedback treatment sessions, and three writing posttests to collect the quantitative data. Finally, we gathered qualitative data on participants' perspectives on feedback strategies using a semi-structured interview protocol. One-way ANOVA and thematic analysis were used to analyze the data. The results indicated that, while meta-linguistic, electronic, direct, and reformulation-based strategies improved ESP students' writing ability in the short, medium, and long terms, the indirect strategy was only effective in the short term. Furthermore, the participants preferred explicit strategies to implicit ones.

Keywords: Education, Corrective feedback, ESP students, Language learning, Writing ability

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1. Introduction

A careful perusal of the pertinent literature indicates that researchers have been concerned with Corrective Feedback (CF) in language instruction in recent years (e.g., Bitchener, 2018; Chen & Nassaji, 2018; Dobakhti et al., 2023; Farrokhi et al., 2023; Karim & Nassaji, 2020a; Mao & Lee, 2020; Nassaji & Kartchava, 2017). The features of CF pertain to oral teacher corrections. Nonetheless, they also characterize the written form of CF as written corrective feedback (WCF, Ellis et al., 2008). The discussion of the main characteristics of WCF indicates that it can be used in both general English courses and ESP courses. Hutchinson and Waters (1987) stated that ESP courses encompass a host of English courses that directly address the occupation-related or education-oriented language learning needs of learners. They defined ESP courses as English courses that specify the learners' vocation-oriented language needs in terms of language aspects (e.g., vocabulary)

and skills (e.g., writing), determine the hierarchy of these needs, specify the appropriate methodological interventions for the instruction of the pertinent aspects and skills, and facilitate the learners' language acquisition using suitable educational materials. As Willey and Tanimoto (2012) pointed out, among the different ESP courses, medicine ESP courses have attracted considerable attention in recent years owing to the fact that medical specialists' writing ability plays a major role in the wide dissemination of medical information across the world.

Despite different studies on CF and WCF, researchers have disregarded certain lines of research. More specifically, a large number of the studies have focused on WCF in general English courses and have disregarded ESP courses, including medicine ESP courses. The use of WCF strategies in medicine ESP courses is likely to have a noticeable effect on medicine students' ability to provide information on their scientific experiments in research papers. Moreover, it can expedite the wide dissemination of scientific medicine-related information across the world. As a result, it constitutes a worthwhile lie of research in foreign language contexts, including the Iranian EFL context. Moreover, these studies have not compared the utility of all types of WCF strategies in writing courses over the course of time. Lastly, the related studies have not investigated the language learners' perspectives on different WCF strategies. The scrutiny of the role of different WCF strategies in medicine ESP courses is likely to provide ESP lecturer education courses with guidelines on ESP lecturers' optimal education process. Moreover, it can enable the ESP syllabus designers to improve the current ESP textbooks and lecturer manuals. Lastly, it can empower the ESL lecturers to expedite the ESP learners' writing skill development.

Considering this gap, we made an endevour to conduct our study in light of both *cogitive* or *computational* theory and *sociocultural* theory of langugae acquistion. Ellis (2009b) stated that computational theory of langugae acquistion expounds on language learning by focusing on *input* which constitutes provided oral or written second langugae information, language learners' internal *data processing mechanism* including attention, awareness, and noticing (e.g., Schmidt, 2001) among others, and *output* that involves learners' oral or written language production. Accordingly, in this study, we examined the extent to which WCF strategies attrcated or directed ESP learners' attention to formal aspects of the langugea and expedited their awareness and noticing of the relevant forms that constituted the prerequistes to their writing skill development.

In additon, Lantolf (2000) pointed out that sociocultural theory averes that language learning stems from the learners' *social intercation* that facilitates and expediates their *mediated* learning. As Lantolf (2000) explinaed, learners' mediated learning encompasses the proces in which they use material or abstract tools to exert concious conrol over their higher-order mental processes including attention among others. Moreover, Lantolf (2000) noted that, mediated learning empowers the learners to move from object-regulation (e.g., books) and other-regulation (e.g., teacher feedback) to self-regulation (i.e., langugae learning). In addition, Lantolf (2000) stated that, sociocultural theory underlines the link between scaffolding and Zone of Proximal Development (ZPD). Scaffolding refers to the diologic process in which an expert (e.g., language tecaher) assists a novice (e.g., langugae learner) to perform a task that is beyond his/her current ability level (Lantolf & Thorne, 2006). Moreover, ZPD refers to the gap between learners' current level and potential level of development that can be bridged by means of expert support and assistance (i.e., scaffolding). Considering these discussions, we made an effort to determine the degree to which ESP learners took advantge of scaffolded WCF strategies to mediate writing skill development, achieve self-regulaion in writing task peformance, and bridge the gap between their current and potential levels of second language writing ability. Accordingly, the present study strived to deal with these inadequacies of research in the EFL context of Iran. To this end, it attempted to answer the following research questions:

1. What are the efficacious WCF strategies in medicine ESP learners' writing skill development in the short term?
2. What are the efficacious WCF strategies in medicine ESP learners' writing skill development in the medium term?
3. What are the efficacious WCF strategies in medicine ESP learners' writing skill development in the long term?
4. What are medicine ESP learners' perspectives on different WCF strategies?

2. Theoretical Framework

CF has proved to have an undeniable role in instruction. Karim and Nassaji (2020b) defined this type of feedback as language teachers' responses to learners' erroneous use of target language forms. Long (1991) stated that CF constitutes an offshoot of focus on form instruction, highlights the consequential role of learner errors in language acquisition, and builds on Schmidt's (1990) noticing hypothesis that ascribes language learning to learners' conscious attention to formal aspects of language. Moreover, as Long (1991) explained, CF is compatible with the notion of error treatment that was introduced by Chaudron (1988). According to Chaudron (1988), error treatment encompasses the process in which language teachers make the learners cognizant of the discrepancies between their performance and native speakers' uses of the language. As a result, CF constitutes a sub-category of error treatment that enables the learners to draw a cognitive comparison between their output and target language use by providing them with negative evidence that comprises information on the ungrammatical uses of the language (Bitchener, 2008, 2009).

WCF encompasses the feedback type that makes the learners aware of their writing errors (Truscott, 2007), ameliorates their writing performance (Sheen, 2007), enables them to use more complex grammatical structures (Ferris, 2010), and prompts them to cast aside their inhibitions that prevent them from using and learning diverse grammatical structures in their writing tasks (Storch & Wigglesworth, 2010). The interest in WCF partly stems from the existence of cross-cultural differences in writing styles (Sheen, 2007). Kaplan (1966) introduced contrastive rhetoric into the field of language instruction due to the underlying differences among the languages in terms of their discourse patterns. He stated that this area of investigation endeavors to determine the degree to which language learners' first language writing education and culture affect their second language writing performance. Moreover, he pointed out that it focuses on the diverse uses of the discourse patterns of a common language across various cultures. According to Kaplan (1966), learners' first language culture has a noticeable impact on their perspectives on the world and influences their uses of discourse patterns. Likewise, Kubota and Lehner (2004) stated that the main tenets of contrastive rhetoric encompass the uniqueness of the rhetorical convention of different languages and the interference of first language rhetorical conventions in second language writing performance. Lastly, Connor (1996) averred that contrastive rhetoric intends to itemize language learners' writing strategies and presuppositions in the process of second language writing task performance for specifying the similarities and discrepancies between the writing conventions of their first and second languages. As Bitchener and Ferris (2012) pointed out, WCF constitutes a favorable pedagogical intervention due mainly to the fact that it takes advantage of different strategies to adapt the process of error treatment to the learners' needs in light of the unique writing conventions of their first language and culture.

Notwithstanding, the utility of WCF has been a moot point. More specifically, a number of researchers (e.g., Khalili et al., 2024; Truscott, 2007; Truscott, 2010b; Truscott & Hsu, 2008; Zohrabi & Bimesl, 2022) have highlighted the role of positive evidence in the process of writing development and have averred that the learners' exposure to genuine language uses is the necessary condition for their effective writing performance. These discussions have mainly strived to downplay the utility of negative evidence due mainly to the fact that its effectiveness is limited to the corrected written output and does not empower the learners to take advantage of the pertinent corrections in their upcoming tasks (Truscott, 2010a). Furthermore, WCF has been criticized since it constitutes a laborious process that disrupts the learners' natural order and sequence of language acquisition (Truscott, 1996). On the other hand, the proponents of WCF (e.g., Bitchener & Ferris, 2012; Van Beuningen et al., 2012) have supported its use in writing courses owing to its purported positive impact on the learners' comprehension of second language writing intricacies. The disagreement among the supporters and critics of WCF has mainly arisen in general English courses. Notwithstanding, the researchers have disregarded the investigation of WCF strategy used in the other types of language courses that specifically prepare the learners for their future occupation or education.

The above-mentioned utility of WCF in the process of writing development has encouraged researchers to carry out empirical studies of this type of feedback in different contexts and settings. A number of these studies have examined the utility of direct and indirect WCF strategies for improving the learners'

writing accuracy. For instance, Almasi and Tabrizi (2016) examined the effect of direct and indirect WCF strategies on EFL learners' accuracy in writing tasks. Likewise, Abbaspour et al. (2020) made an effort to specify the extent to which scaffolded direct WCF influenced the learners' writing ability. Similarly, Ekiert and Di Gennaro (2021) investigated the role of direct focused WCF in ESL learners' writing skill development.

Moreover, some of these studies have compared the effectiveness of language teachers' WCF with the WCF that is provided by online editing services. Regarding this research line, Gharanjik and Ghoorchaei (2020) examined the degree to which teacher-provided and automated metalinguistic WCF affected learners' writing accuracy. Likewise, Fahmi and Cahyono (2021) strived to determine the role of teacher-provided and Grammarly-provided WCF in EFL learners' development of writing skills.

Furthermore, certain studies have examined the role of computer-provided WCF in the learners' writing performance. For instance, Hajebi (2018) and Jiang and Yu (2020) investigated the impact of computer-provided WCF on EFL learners' development of second language writing skills. Likewise, Koltovskaia (2020) strived to specify the effectiveness of computer-provided WCF in learners' writing accuracy in virtual language instruction.

In addition, a group of these studies has compared the effectiveness of coded and non-coded WCF in learners' writing skill development. In this regard, Rizkiani, et al. (2019) tried to determine the impact of coded and non-coded WCF on language learners' ability to write descriptive texts. Similarly, Sarré et al. (2019) investigated the effect of coded WCF on ESL learners' writing accuracy in blended language instruction.

Additionally, a few of the related studies have examined the degree to which focused and unfocused types of WCF affect the learners' writing ability. For example, Talatifard (2016) and Tang and Liu (2018) examined the effects of reactive focused WCF and indirect unfocused WCF on EFL learners' writing performance, respectively. Likewise, Valizadeh and Soltanpour (2021) investigated the efficacy of focused direct WCF on language learners' writing complexity.

Besides, a few studies have examined the utility of metalinguistic WCF strategy for improving writing skills. Regarding this line of research, Khalili, Kashef, and Khalili (2022) and Khalili, Kashef, and Yaghoubi-Notash (2022) examined the role of metalinguistic WCF in the writing skill development of university students from different academic majors. Other studies have focused on the impact of electronic and reformulation-based WCF strategies on learners' writing skill development. For instance, Milton (2006) investigated the role of resource-rich web-based WCF on language learners' writing independence. Moreover, Sachs and Polio (2007) examined the extent to which reformulation-based WCF influenced ESL learners' writing accuracy. Overall, it seems that many studies have focused on various WCF strategies used in different English courses but have disregarded specific courses, including medicine ESP courses.

3. Methodology

3.1. Participants

The study aimed to examine the utility of WCF strategies in the process of ESP learners' writing skill development. Consequently, the researchers used convenience sampling to select 162 (74 male and 88 female) intermediate-level learners of medicine at two universities of medical sciences in Iran as the participants. These participants were selected from among 183 medicine learners in six intact classes (three classes at University 1 and three classes at University 2) based on their results on a placement test. They ranged in age from 19 to 28 and were native speakers of Azeri, Persian, Kurdish, Balochi, Gilaki, or Arabic. The differences between these learners' native language backgrounds stemmed from the researchers' focus on intact classes that involved ESP learners with different first languages. In order to select the participants, the researchers first apprised the learners of the main objectives of the study and invited them to take part in it. At this stage, 16 learners (i.e., three learners in class 1, one learner in class 2, four learners in class 3, two learners in class 4, two learners in class 5, and four learners in class 6) stated that they did not intend to take part in the study due to various reasons such as their busy schedule. Second, the researchers administered the placement test to the learners to ensure

their homogeneity in terms of their language proficiency. Based on the results, five learners' proficiency levels in the above-mentioned classes fell below the intermediate level. To deal with this issue, the researchers decided to exclude these participants' data from the dataset. Consequently, 162 learners (i.e., 27 learners in each class) were considered to be the participants. Prior to the onset of data collection, the researchers obtained written informed consent from all of these learners.

3.2. Design

To develop a thorough understanding of the efficacy of WCF strategies and learners' views on them, the researchers opted to use the explanatory mixed-method design. Creswell and Creswell (2017) stated that, in this design, researchers collect data on pertinent variables in two major phases, the quantitative phase and the qualitative phase. As they noted, qualitative data are gathered to support and explain the quantitative results in detail. Accordingly, in this study, the researchers first took advantage of a writing pretest, WCF treatment, and writing posttests to collect quantitative data. Second, we gathered qualitative interview data using a researcher-developed protocol to delve more deeply into the participants' perspectives on WCF in their writing courses.

3.3. Instruments

The researchers employed the following materials and instruments to obtain the data:

3.3.1. Placement Test

To ensure the participants' homogeneity in language proficiency, the researchers used the Oxford Placement Test (Allan, 2004). This instrument encompassed 60 items. These items examined the test takers' reading comprehension, vocabulary knowledge, and grammatical competence by means of 20 cloze tests, 20 vocabulary, and 20 grammar items, respectively. Allan (2004) reported that the test enjoyed satisfactory reliability (.89) in a certain foreign language context. The Cronbach's alpha coefficient of this test (.81) in the Iranian EFL context confirmed Allan's (2004) reliability results.

3.3.2. Framework of Moves

The researchers strived to expound on the utility of WCF for ameliorating ESP learners' academic writing ability. To this end, we opted to focus on the Abstract section of research papers due to its consequential role in the process of paper publication (Willey & Tanimoto, 2012). Accordingly, we used Hyland's (2000) move framework to apprise the participants of the underlying structure of effective paper abstracts. Hyland (2000) defined moves as discourse pieces that are used by authors to indicate specific intentions and to perform diverse functions. Considering this definition, he itemized five main move categories including introduction, purpose, method, product, and conclusion. As he explained, the introduction and purpose moves justify the need for research and expound on research aims, respectively. Moreover, method and product moves, respectively delineate methodological considerations and demonstrate the obtained results. Lastly, the conclusion move discusses the probable reasons behind the results and draws the implications.

3.3.3. Framework for Scoring Writing

To objectively score writing pretest and posttests, the researchers used a shortened version of Brown and Bailey's (1984) writing scoring framework. This framework focused on three main aspects of writing including: a) structure, b) mechanics, and c) style. Each of these aspects comprised four sub-scales and guided the raters to assess the relevant writing aspect on a 20-point scale. Both of the researchers rated the writing pretest and posttests. Therefore, we used the inter-rater correlation coefficient as the measure of inter-rater reliability. The results indicated that this coefficient (.86) was satisfactory, and the pretest and posttest writing assessment results were reliable in the present study.

3.3.4. Pretest and Posttests

There was a need to assess the participants' ability to write genuine research paper abstracts that could be sent to real scientific journals. Consequently, first, the researchers selected 4 medicine papers (which were published in Elsevier's ISI-indexed medicine journals) as the basis for writing pretest, immediate,

and delayed posttests. Second, we removed their abstract section. Third, the researchers prompted the participants to write their 250-word abstract section in light of other paper sections in a 45-minute period of time. The participants' writing output on these tests was assessed using Brown and Bailey's (1984) framework.

3.3.5. Medicine Papers

In order to examine the participants' academic writing ability, the researchers used 21 Elsevier's ISI-indexed medicine papers (i.e., one paper as the sample and 20 papers as prompts for writing tasks) in treatment sessions. One of these papers was used as the instruction specimen in the first treatment session. That is, the moves of its abstract section were highlighted to apprise the participants of its move structure and move functions. Nonetheless, the researchers removed the abstract section of the remaining papers and used their other sections as the prompts for writing tasks in treatment sessions.

3.3.6. Framework of WCF

To provide the ESP learners of medicine with WCF, the researchers employed Ellis's (2009a) WCF framework. This framework has been developed based on the research methodology of multitudinous empirical studies of WCF in various contexts and settings (Ellis, 2009a). It itemizes two underlying WCF categories, focused and unfocused WCF. As Ellis (2009a) explained, while focused WCF intensely deals with specific learner error categories (e.g., use of inflectional morphemes), unfocused WCF extensively targets all of the learner error categories.

In addition to this general distinction, Ellis's (2009a) framework particularizes five major WCF strategies including direct, indirect, metalinguistic, electronic, and reformulation-based. As he explained, in direct WCF, the instructors furnish the correct form of the learners' erroneous output. Moreover, in indirect WCF, teachers may opt to either indicate the existence of an error in the margin of the task output or might both indicate and locate the pertinent errors using cursors that show the text omissions. Furthermore, in metalinguistic WCF, language instructors can either use specific error codes (e.g., WV= wrong verb) or may use short grammar-oriented explanations at the end of writing tasks to apprise the learners of their erroneous language use. In addition, in electronic WCF, language teachers indicate the learners' errors on a digital platform (e.g., electronic mail services) and provide them with hyperlinks to specific concordance files that indicate native language use in different situational contexts. Lastly, in reformulation-based WCF, the teacher asks native speakers to redress the learners' writing output to make them aware of their non-native uses of the target language.

3.3.7. Concordance Website

To provide the participants of the electronic WCF group with appropriate feedback, the researchers used hyperlinks to American National Corpus (ANC). This text corpus was launched in 1990 and encompasses a very large word collection (i.e., 22 million) from diverse genres and is more advantageous than the other corpus resources (e.g., British National Corpus) since it involves modern text categories such as emails. Furthermore, it is more user-friendly due largely to its annotated content. That is, it encompasses a wide range of speech-part and named-entity annotations that provide users with rich information on native language use and diverse language aspects (e.g., vocabulary items and collocations).

In the present study, first, the researchers asked the participants of an electronic group to email their writing tasks to a pre-determined email address. Second, we used underlining to indicate the place of learners' writing errors. Finally, they provided the learners with multiple hyperlinks to ANC to make them aware of the native-speaker's use of their writing errors.

3.3.8. Native Speaker Editors

Reformulation-based WCF necessitated the use of native-speaker text reworking. Consequently, the researchers asked one of their previous learners (who is a Ph.D. candidate in TEFL at a state university in the USA) to hire five native speakers as the editors of the writing task output of the reformulation-

based group. The native speakers were Ph.D. candidates in TEFL. They came from England (i.e., 2), USA (i.e., 2), and Australia (i.e., 1).

The researchers asked the native speaker editors to join a Google Meet session and provided them with adequate information on their editing tasks prior to the onset of the study. Each of the native speakers agreed to edit 10-11 writing tasks weekly during the 10-week treatment of the study. Each week, the researchers emailed the participants' writing output in the reformulated-based group to these native speakers and received their reworked forms in a 24-hour period of time.

3.3.9. Interview Protocol

To determine the participants' perspectives on various WCF strategies, the researchers used a researcher-developed semi-structured interview protocol. The use of a semi-structured format stemmed from the researchers' desire to delve more deeply into the participants' views on the utility, drawbacks, and short-term and long-term effects of each strategy category on their writing performance. To ensure the content validity of this protocol, first, the researchers asked four of their colleagues (who were assistant professors in TEFL) to provide them with feedback on its items. Second, we made a number of modifications to protocol questions in terms of item wording and developed the final form of protocol. The protocol encompassed three items that focused on the advantages, disadvantages, and short-term/long-term efficacy of WCF strategies in ESP learners' writing courses. Third, the researchers pilot-tested the protocol by interviewing two ESP medicine learners whose characteristics were similar to the participants and made certain modifications to the wording of items and their order. Finally, we analyzed the obtained interview data using thematic analysis. Both of the researchers analyzed the data to determine their codes and themes. Therefore, it was necessary to determine the reliability of their code and theme extraction. To ensure inter-rater reliability, the researchers used Cohen's kappa measure. The obtained results showed that this measure (.82) was satisfactory and confirmed the reliability of coding and theme extraction.

3.4. Procedure

3.4.1. Data Collection

To conduct this study, the researchers collected and analyzed data on ESP learners' writing performance in a quantitative and a qualitative phase. More specifically, in the quantitative phase, we first selected 162 male and female learners of medicine in six intact classes of two universities of medical sciences in Iran as the participants. Second, we randomly assigned the classes to five experimental groups and one control group, including the Direct Feedback Group (DFG), Indirect Feedback Group (IFG), Metalinguistic Feedback Group (MFG), Electronic Feedback Group (EFG), Reformulation-based Feedback Group (RFG), and Control Group (CG). There were 27 ESP learners in each of these groups. Third, we administered the pretest to all of the groups to ensure their homogeneity in terms of writing ability.

Fourth, the researchers provided the experimental groups and CG with their treatment in twenty 90-minute sessions in a ten-week period of time (2 sessions per week). In the first session of all of the groups, the researchers used instruction and trial treatment phases. That is, at the beginning of the session, we provided the participants with adequate information on Hyland's (2000) move framework along with move categories and functions in about 45 minutes using a genuine medicine paper abstract as a model. Next, we prompted the participants to write a 250-word abstract for another medicine paper in 45 minutes based on the preparatory training that was provided for them in the first treatment session. In the remaining treatment sessions, the researchers focused on the trial phase in all of the groups and prompted the participants to perform abstract writing tasks in 45 minutes. Notwithstanding, each of these groups was provided with its pertinent WCF. More specifically, in DFG, the researchers provided the participants with the accurate form of their erroneously-used forms. Moreover, in IFG, the researchers underlined participants' errors and used cursors to make them cognizant of their location. Furthermore, in MFG, the researchers used short grammar-oriented explanations at the end of the learners' writing sheets to inform them about their errors. In addition, in EFG, the researchers asked the participants to write the abstract section of the relevant articles on their laptop computers and to email

their task output to the first author's email address. The learners in the experimental groups were not provided with the opportunity to revise their written abstract sections.

Next, we underlined the learners' errors and provided them with hyperlinks to ANC. Additionally, in RFG, the researchers prompted the participants to perform their abstract writing task on their laptop computers (using Microsoft Word documents) and to email them to the first author's email address. After that, we sent these outputs to native speaker editors, received their reworked versions in 24 hours, and provided the participants with the revised form of their output. Finally, in CG, the researchers adopted a product-oriented approach to writing instruction. Accordingly, we informed the participants about the move structure of the abstract section along with move functions and prompted them to write the abstract section of the relevant medicine papers in 45 minutes. Nonetheless, we did not provide the participants in this group with WCF. Lastly, the researchers administered the immediate posttest, delayed posttest 1, and delayed posttest 2 to all of the groups two days, one month, and two months after the termination of treatment sessions.

3.4.2. Data Analysis

In order to analyze the quantitative data, the researchers used descriptive statistics, including Mean (M) and Standard Deviation (SD) values, along with inferential statistics, including one-way ANOVA. On the other hand, we employed thematic analysis to extract the codes and themes in the interview data in the process of qualitative data analysis.

4. Results

4.1. Quantitative Results

The results of the Kolmogorov-Smirnov and the Shapiro-Wilk tests proved their normal distribution (p>.05). Consequently, one-way ANOVA was used to perform the data analysis. At the data analysis stage, first, the researchers tried to ensure the homogeneity of groups in terms of their writing ability. Examination of Levene's test results indicated the homogeneity of group variances (p=.36). Therefore, the researchers used a one-way ANOVA to compare the groups Table 1).

Table 1
ANOVA Test of Pretest Results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	59.037	5	11.807	.796	.55
Within Groups	2315.407	156	14.842		
Total	2374.444	161			

As shown in Table 1, pretest performances were not significantly different from each other (F (5, 156) = .796, p = .55). That is, the groups were homogeneous in terms of their writing ability.

Considering this result, the researchers analyzed the data on posttests to answer the research questions. The first question tried to specify the most effective WCF strategies in medicine learners' ESP writing courses in the short term. Levene's test results ensured that the researchers had the homogeneity of group variances (p=.65) on the immediate posttest. Consequently, we scrutinized the results of the ANOVA test of immediate posttest (Table 2).

Table 2
ANOVA Test of Immediate Posttest Results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6334.623	5	1266.925	128.011	.00
Within Groups	1543.926	156	9.897		
Total	7878.549	161			

According to Table 2, there were significant differences between immediate posttest performances (F (5, 156) = 128.011, p = .00). Therefore, we examined the results of the post-hoc test (Table 3).

Table 3
Post-hoc Tukey Test of Immediate Posttest Results

(I) Groups	(J) Groups	Mean Difference (I-J)	Sig.
DFG	IFG	7.444*	.000
	MFG	-8.296*	.000
	EFG	-2.963*	.009
	RFG	3.296*	.002
	CG	10.333*	.000
IFG	DFG	-7.444*	.000
	MFG	-15.741*	.000
	EFG	-10.407*	.000
	RFG	-4.148*	.000
	CG	2.889*	.012
MFG	DFG	8.296*	.000
	IFG	15.741*	.000
	EFG	5.333*	.000
	RFG	11.593*	.000
	CG	18.630*	.000
EFG	DFG	2.963*	.009
	IFG	10.407*	.000
	MFG	-5.333*	.000
	RFG	6.259*	.000
	CG	13.296*	.000
RFG	DFG	-3.296*	.002
	IFG	4.148*	.000
	MFG	-11.593*	.000
	EFG	-6.259*	.000
	CG	7.037*	.000
CG	DFG	-10.333*	.000
	IFG	-2.889*	.012
	MFG	-18.630*	.000
	EFG	-13.296*	.000
	RFG	-7.037*	.000

Post-hoc comparisons using the Tukey test showed that all of the experimental groups significantly outperformed CG (M=32.07; SD=3.47) on this test. Furthermore, there were significant differences between the performances of all of the experimental groups. That is, MFG (M= 50.70; SD= 2.12), EFG (M=45.43; SD=2.93), DFG (M=42.41; SD=2.77); RFG (39.11; SD= 4.29), and IFG (M=34.96; SD=2.83) had respectively the first to the fifth best performances on this test.

The second question strived to determine the most efficacious WCF strategies in medicine learners' ESP writing courses in the medium term. Levene's test results ensured the researchers of homogeneity of group variances (p=.57) on delayed posttest 1. Therefore, we examined the results of the ANOVA test of delayed posttest 1 (Table 4).

Table 4
ANOVA Test of Delayed Posttest 1 Results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6724.648	5	1344.930	129.275	.00
Within Groups	1622.963	156	10.404		
Total	8347.611	161			

As shown in Table 4, there was a significant difference between delayed posttest 1 performance (F (5, 156) = 129.275, p = .00). Consequently, we scrutinized the results of post-hoc test (Table 5).

Table 5
Post-hoc Tukey Test of Delayed Posttest 1 Results

(I) Groups	(J) Groups	Mean Difference (I-J)	Sig.
DFG	IFG	8.778*	.000
	MFG	-8.815*	.000
	EFG	-3.074*	.008
	RFG	2.519	.052
	CG	9.593*	.000
IFG	DFG	-8.778*	.000
	MFG	-17.593*	.000
	EFG	-11.852*	.000
	RFG	-6.259*	.000
	CG	.815	.939
MFG	DFG	8.815*	.000
	IFG	17.593*	.000
	EFG	5.741*	.000
	RFG	11.333*	.000
	CG	18.407*	.000
EFG	DFG	3.074*	.008
	IFG	11.852*	.000
	MFG	-5.741*	.000
	RFG	5.593*	.000
	CG	12.667*	.000
RFG	DFG	-2.519	.052
	IFG	6.259*	.000
	MFG	-11.333*	.000
	EFG	-5.593*	.000
	CG	7.074*	.000
CG	DFG	-9.593*	.000
	IFG	-.815	.939
	MFG	-18.407*	.000
	EFG	-12.667*	.000
	RFG	-7.074*	.000

Post-hoc comparisons using the Tukey test demonstrated that all of the experimental groups, except for IFG (M=31.48; SD=3.83), significantly outperformed CG (M=30.67; SD=3.38) on this test. Moreover, there were significant differences between the performances of all of the experimental groups. That is, MFG (M= 49.07; SD= 2.48), EFG (M=43.33; SD=2.73), DFG (M=40.26; SD=2.78), and RFG (37.74; SD= 3.85) had respectively the first to the fourth best performances on this test.

The third question attempted to specify the most effective WCF strategies in medicine learners' ESP writing courses in the long term. Levene's test results indicated group variance homogeneity (p=.64) on delayed posttest 2. Consequently, the researchers scrutinized the results of the ANOVA test of delayed posttest 2 (Table 6).

Table 6
ANOVA Test of Delayed Posttest 2 Results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6984.204	5	1396.841	177.534	.00
Within Groups	1227.407	156	7.868		
Total	8211.611	161			

According to Table 6, there was a significant difference between delayed posttest 2 performance (F (5, 156) = 177.534, p = .00). Therefore, we examined the results of the post-hoc test (Table 7).

Table 7
Post-hoc Tukey Test of Delayed Posttest 2 Results

(I) Groups	(J) Groups	Mean Difference (I-J)	Sig.
DFG	IFG	9.148*	.000
	MFG	-8.481*	.000
	EFG	-2.778*	.005
	RFG	2.963*	.002
	CG	10.370*	.000
IFG	DFG	-9.148*	.000
	MFG	-17.630*	.000
	EFG	-11.926*	.000
	RFG	-6.185*	.000
	CG	1.222	.599
MFG	DFG	8.481*	.000
	IFG	17.630*	.000
	EFG	5.704*	.000
	RFG	11.444*	.000
	CG	18.852*	.000
EFG	DFG	2.778*	.005
	IFG	11.926*	.000
	MFG	-5.704*	.000
	RFG	5.741*	.000
	CG	13.148*	.000
RFG	DFG	-2.963*	.002
	IFG	6.185*	.000
	MFG	-11.444*	.000
	EFG	-5.741*	.000
	CG	7.407*	.000
CG	DFG	-10.370*	.000
	IFG	-1.222	.599
	MFG	-18.852*	.000
	EFG	-13.148*	.000
	RFG	-7.407*	.000

Post-hoc comparisons using the Tukey test highlighted the fact that all of the experimental groups, except for IFG (M=29.48; SD=2.91), significantly outperformed CG (M=28.26; SD=2.33) on this test. Furthermore, there were significant differences between the performances of all of the experimental groups. That is, MFG (M= 47.11; SD= 2.95), EFG (M=41.41; SD=2.72), DFG (M=38.63; SD=2.54), and RFG (35.67; SD= 3.27) had respectively the first to the fourth best performances on this test.

3.2. Qualitative Findings

Considering the objectives, the researchers took advantage of thematic analysis to determine the underlying themes in the obtained interview data. Table 8 provides these themes along with their pertinent codes for DFG:

Table 8
Codes and Themes in Interview Data on DFG Participants' Perspectives on WCF

Codes	Themes
Paying close attention to corrections	Utility of corrections for ameliorating writing performance
Using corrections to determine errors and mistakes	
Trying to incorporate corrections into the writing process	
Forgetting corrections after a certain period of time	Short-term effectiveness of direct corrections
Being confused about the accurate use of corrected forms	

As shown in Table 8, the first theme in the data on the DFG group was the *utility of corrections for ameliorating the writing process.* In this regard, participant 2 stated that, *"I was aware of our*

professor's intention to highlight my non-native language uses. As a result, I carefully examined the corrections and tried to use the correct forms in my upcoming writing assignments".

Moreover, the second theme in the DFG interview data was the *short-term effectiveness of direct corrections*. Regarding this issue, participant 18 noted that, *"After a while, I was not certain about the accurate uses of the forms that were corrected by my professor. I want to say that, although I knew that I did not use the native-like form, I was not able to remember the required form in pertinent contexts".*

Table 9 shows the extracted codes and themes in the data on IFG.

Table 9
Codes and Themes in Interview Data on IFG Participants' Perspectives on WCF

Codes	Themes
Being confused by feedback	
Trying to locate the target of provided feedback	Obfuscating the nature of indirect feedback
Being exhausted due to feedback	
Not making an attempt to understand the feedback	Counter-productive impact of indirect feedback
Disregarding feedback	on writing performance

According to Table 9, the first theme in the IFG data was *obfuscating the nature of indirect feedback*. Regarding this issue, participant 14 noted that, *"I was not sure about the purpose of the feedback. How could I make changes to my writing task output when I did not know what to do?".*

In addition, the second theme in the data on IFG was the *counter-productive impact of indirect feedback on writing performance*. In this regard, participant 23 pointed out that, *"I could not understand the meaning of underlining. As a result, I ignored the underlined parts completely and tried to express my intentions using different words and grammatical structures".*

Table 10 shows the codes and themes that were extracted from the data on MFG.

Table 10
Codes and Themes in Interview Data on MFG Participants' Perspectives on WCF

Codes	Themes
Understanding the grammatical explanations	Effectiveness of metalinguistic feedback for
Determining the causes of errors	highlighting the gaps in second language
Using the explanations to prevent errors in writing tasks	competence
Remembering the explanations after a long time	The long-term positive effect of metalinguistic
Using model sentences based on explanations to improve writing ability	feedback on writing efficacy

As shown in Table 10, the first theme in the data on MFG was the *effectiveness of metalinguistic feedback for highlighting the gaps in second language competence*. Concerning this aspect of metalinguistic feedback, participant 10 stated that, *"The explanations were very brief and to the point. They provided me with adequate information on the relevant grammatical structures and helped me to deal with my errors in an independent way".*

Moreover, the second theme in the data on MFG was the *long-term positive effect of metalinguistic feedback on writing efficacy*. Regarding this aspect, participant 26 pointed out that, *"I used the explanations in an optimum way. That is, I developed model sentences based on the provided explanations and used them as criteria for evaluating the accuracy of my used sentences".*

Table 11 provides the codes and themes that were extracted from the data on EFG.

Table 11
Codes and Themes in Interview Data on EFG Participants' Perspectives on WCF

Codes	Themes
Understanding correct uses of structures by visiting ANC Using the model sentences of ANC to improve writing performance	Utility of electronic feedback for corpus-based grammar learning
Searching ANC to determine the correct uses of structures Checking ANC to ensure the accuracy of certain structures	Sustainable positive impact of electronic feedback on acquisition of language forms

As shown in Table 11, the first theme in the data on EFG was the *utility of electronic feedback for corpus-based grammar learning*. Concerning this point, participant 5 noted that, *"I used the hyperlinks to understand native speakers' uses of grammatical structures and collocations. I understood that I was not able to use different language forms in sentences appropriately. Therefore, I used the ANC sentences as guides to perform my writing tasks in an effective way"*.

Furthermore, the second theme of the EFG data was the *sustainable positive impact of electronic feedback on the acquisition of language forms*. Regarding this theme, participant 26 noted that, *"I got addicted to ANC. I want to say that it was a valuable source of information on the uses of words, grammatical structures, and collocations. I learned a lot of things by visiting the website"*.

Finally, Table 12 provides the codes and themes that were extracted from the data on RFG.

Table 12
Codes and Themes in Interview Data on RFG Participants' Perspectives on WCF

Codes	Themes
Not understanding complicated sentences and unfamiliar vocabulary items Being puzzled by the convoluted discourse of reworked writing output	Complex nature of native speaker feedback
Losing interest in corrections Being disgruntled by the changes in the intended meanings	The annoying nature of reworked learner texts

According to Table 12, the first theme in the data on RFG was the *complex nature of native speaker feedback*. Concerning this issue, participant 26 stated that, *"What did they do to my texts? I was shocked by the corrections that were made to my writing output. I was able to understand certain sections of the texts. Nonetheless, the texts looked like scientific texts and were barely comprehensible"*.

Moreover, the second theme in the data on this group was the *annoying nature of reworked learner texts*. Regarding this point, participant 22 pointed out that, *"I had a feeling that the modified texts were not my texts. They changed my opinions. I want to say that the people who changed them imposed their intended meanings on my opinions. This issue irritated me and gave the impression that I was not competent enough to articulate my own opinions"*.

5. Discussion

The present study strived to determine the efficacy of diverse WCF strategies in medicine learners' ESP writing courses. Moreover, it intended to determine these learners' perspectives on the above-mentioned WCF strategies. Accordingly, research question one intended to examine the efficacious WCF strategies in medicine learners' ESP writing courses in the short term. The obtained results indicated that all of the examined WCF strategies significantly ameliorated the participants' writing ability immediately after the termination of WCF treatment. Furthermore, metalinguistic, electronic, direct, reformulation-based, and indirect strategies were, respectively, the first to the fifth most efficacious WCF strategies. In general, these results corroborate the results of the studies that were conducted by Almasi and Tabrizi (2016), Khanlarzadeh and Nemati (2016), Khodareza and Delvand (2016), Rahimi (2019), Gharanjik and Ghoorchaei (2020), Karim and Nassaji (2020), and Ekiert and Di Gennaro (2021). These studies

reported that different WCF strategies would have advantageous impacts on language learners' language skill development, including writing development.

Ellis (2009b) stated that the proponents of WCF have mainly taken advantage of the cognitive view of language learning to support their claims. As he explained, this view ascribes language learning to the cognitive processing of information that is facilitated by internal resources, including attention. Concerning this view, it is possible to use Schmidt's (2001) noticing hypothesis, which is one of the most consequential cognitive hypotheses, to justify the effectiveness of the above-mentioned feedback strategies. That is, the utility of the examined WCF strategies for improving ESP learners' writing ability could stem from the fact that they directed these learners' conscious attention to the formal aspects of the target language and expedited the transformation of their input to intake that constitutes the basis of language acquisition.

In addition to the cognitive view, it may be possible to explicate the results using the sociocultural view of language learning (Lantolf, 2000). Lantolf and Thorne (2006) stated that this view of language acquisition ascribes the learning of different aspects of the language to the support that is provided by experts (e.g., language teachers and native speakers) to novices (e.g., ESP learners) to develop an emergent language development boundary that is called ZPD. Therefore, ZPD specifies the difference between learners' actual language ability and their ability when they are supported by experts, and it is modified as the learners hone their language skills (Nassaji & Swain, 2000). Based on this discussion, the effectiveness of the WCF strategies in the present study can be attributed to the fact that they empowered the ESP learners to bridge the gap between their actual and potential levels of development and expedited the development of their subsequent ZPDs.

Research questions two and three, respectively examined the impacts of the different WCF strategies on medicine learners' ESP writing ability in the medium term and the long term. Based on the results, all of the examined strategies, except for the indirect strategy, ameliorated ESP learners' writing ability in their academic setting. Moreover, metalinguistic, electronic, direct, and reformulation-based strategies constituted the first to the fourth efficacious WCS strategies. In other words, while metalinguistic, electronic, and direct strategies were very effective in improving the participants' writing ability, the reformulation-based strategy was relatively useful. Furthermore, the indirect strategy lost its effectiveness over the course of time. In general, these results are in line with the results of the studies that were carried out by Santos et al. (2010), Storch and Wigglesworth (2010), Saadi and Saadat (2015), Yu and Lee (2015), Talatifard (2016), Yu and Hu (2017), Hajebi (2018), Merkel (2018), Tang and Liu (2018), Mak (2019), Rizkiani et al. (2019), Sarré et al. (2019), Tayebipour (2019), Abbaspour et al. (2020), Valizadeh and Soltanpour (2021), and Wang and Han (2022). These studies reported that explicit WCF strategies were more effective than implicit WCF strategies (including indirect WCF) in improving learners' language skills.

Concerning the cognitive view, these results can be ascribed to Tomlin and Villa's (1994) notion of detection. These researchers differentiated language learners' awareness of language forms from their detection of them. As they explained, the learners' awareness of the accurate use of formal aspects of the language does not ensure their detection of them. Therefore, although the less explicit WCF strategies, such as indirect and reformulation-based strategies, result in the learners' formal awareness, they do not help them detect their use in different contexts. On the other hand, as Tomlin and Villa (1994) pointed out, the more explicit WCF strategies, including the metalinguistic, electronic, and direct strategies, ensure the learners' detection of the corrections and result in the cognitive registration of the pertinent forms in their long-term memory. Moreover, as Ellis et al. (2005) pointed out, the WCF strategies that facilitate the learners' cognitive comparisons are likely to be more effective than the other WCF strategies over the course of time. According to him, these strategies help the learners to determine the discrepancies between their own output and the corrections and to integrate the corrections into their language use. Consequently, the effectiveness of metalinguistic, electronic, and direct strategies in the present study can be attributed to their positive impact on the learners' ability to draw comparisons between their writing performance and target language texts.

In addition, regarding the sociocultural view, the results may be related to the mediating role of WCF strategies that act as artifacts in the process of language learning (Lantolf & Thorne, 2006). Lantolf

(2000) stated that mediation encompasses the process in which language learners take advantage of artifacts in order to facilitate the process of their language learning. As he noted, artifacts comprise the concrete and symbolic tools that empower language learners to exert control over their thoughts. Considering these discussions, it can be stated that in this study, the effectiveness of the WCF strategies stemmed from the fact that they were used as symbolic artifacts by the learners and mediated their process of language learning.

Lastly, the fourth research question examined the ESP learners' perspectives on different WCF strategies. The findings showed that, in general, the learners considered metalinguistic, electronic, and direct WCF strategies as the strategies that facilitated their language processing, made them aware of their errors by expediting their cognitive comparisons, improved their short-term and long-term acquisition of language forms, and ameliorated their writing performance. On the other hand, the participants stated that indirect and reformulation-based strategies obfuscated them, constituted barriers to their effective noticing of the accurate uses of formal aspects of the target language, and did not positively influence their writing development. In general, these findings support the results of certain studies, including the studies that were conducted by Jiang and Yu (2020), Koltovskaia (2020), Wang and Li (2020), Woodworth and Barkaoui (2020), Fahmi and Cahyono (2021), and Guo et al. (2021).

These findings make sense in light if the contrastive rhetoric discussions the and cross-cultural differences among the language learners' writing styles and their writing strategy and feedback strategy preferences. Kaplan (2005) stated that language learners' first language writing instruction greatly influences their effective writing presuppositions. As he explained, this writing education affects the learners' tendency to favor certain writing and feedback strategies over others during the performance of both first language and second language writing tasks. For instance, the provision of direct and explicit feedback to the learners on their writing performance is likely to cause them to disregard or disapprove of the indirect strategies.

Moreover, in terms of the cognitive view, the findings can be explained by considering the negative-evidence-inducing nature of metalinguistic, electronic, direct, and reformulation-based WCF strategies (Luquin & García Mayo, 2021; Sheen, 2007). Long (1996) noted that negative evidence comprises the input categories that make the learners aware of the ungrammatical aspects of the target language and help them to distinguish the possible uses of the forms from their impossible uses. Therefore, it can be stated that metalinguistic, electronic, direct, and reformulation-based WCF strategies were effective in ameliorating the ESP learners' writing ability since they helped the learners to determine their ungrammatical language uses and prompted them to substitute these forms with accurate language forms. Lastly, in view of the sociocultural approach to language acquisition, the findings may be ascribed to the notion of self-regulation. Ohta (2001) defined self-regulation as the process in which language learners use other-regulation tools to gain control and manage their thought processes. As he pointed out, achieving self-regulation enables the learners to internalize second language knowledge and to use it as the basis for further language acquisition. Consequently, it can be argued that, in this study, metalinguistic, electronic, direct, and reformulation-based WCF strategies improved the ESP learners' writing ability since these learners' first language writing education mainly depended on them instead of the other feedback strategies and resulted in their disregard for the implicit and indirect WCF strategies. Moreover, these strategies were used by the learners as other-regulation tools that facilitated their self-regulation and subsequent language learning.

Overall, this study strived to determine the degree to which direct, indirect, metalinguistic, electronic, and reformulation-based WCF strategies affected ESP medicine learners' writing ability in the university settings in the short-term, medium-term, and long-term. In addition, it scrutinized these learners' perspectives on each of these WCF strategy categories. The results of the study highlighted the utility of all of these strategies in the short term. Moreover, they underlined the fact that all of these strategies, except for the indirect strategy, positively affected these learners' writing performance in the medium term and the long term. Lastly, ESP learners preferred to receive explicit WCF instead of implicit WCF.

These results may have certain implications in foreign language contexts, including the Iranian EFL context. First, they indicate that the current ESP lecturer education courses have to be thoroughly

redressed. The overhaul procedure of the pertinent courses has to focus on their content and educators. More specifically, the close perusal of these courses shows that they mainly focus on the preparation of ESP lecturers for the instruction of the technical vocabulary of the relevant ESP courses and disregard the other language aspects and skills such as writing skill. Moreover, these courses do not apprise the lecturers of the different WCF strategies that can ameliorate the learners' skill development. Therefore, it is necessary to include a specific module in these courses that informs prospective lecturers about the necessity of writing skill development in medicine ESP courses and empowers them to use the WCF strategies in their courses effectively. Moreover, there is a need to re-educate the educators of these courses to provide them with adequate information on WCF strategies, mainly because most of these educators lack knowledge of these strategies.

Second, it is essential to develop informative manuals for ESP lecturers, including the lecturers who teach medicine ESP courses. Most of the ESP lecturers are not provided with manuals and teach their courses haphazardly. Therefore, syllabus designers have to furnish these lectures with manuals that provide them with sufficient information on the WCF strategies and empower them to put the theory of these strategies into practice for ameliorating the medicine ESP learners' writing ability.

Lastly, ESP lecturers need to develop a thorough understanding of effective language teaching interventions, including the use of WCF strategies to help the ESP learners to hone their writing skills in the relevant courses. For instance, they can take advantage of the results of recent empirical studies (such as the present study) to determine the utility of the WCF strategies in medicine ESP courses. Furthermore, they can form and join peer groups on social media applications to receive peer feedback on the use of effective WCF strategies for improving ESP learners' writing ability. In addition, ESP lecturers should strive to make optimum use of various WCF strategies in their classes. Accordingly, they need to provide their learners with explicit WCF, including metalinguistic and direct WCF, to improve both their short-term and long-term writing skill development. For instance, they can combine metalinguistic WCF with direct WCF to resolve the learners' uncertainties about the accurate uses of the target language in writing tasks. Moreover, they can use metalinguistic and direct WCF strategies along with electronic WCF to make the learners cognizant of their erroneous language uses and to ameliorate their writing accuracy and complicity by means of native speaker corpora. Lastly, these lecturers can make sporadic use of indirect WCF to prompt the learners to reflect on their writing performance and to improve it over the course of time.

The present study suffered from certain limitations and delimitations since it was not able to use random sampling and random assignment. Moreover, it did not control the impact of the participants' gender, age, and language background on the obtained results. Future studies need to deal with these issues. Furthermore, they should examine the effectiveness of the WCF strategies in the other ESP courses, such as engineering ESP courses in both second and foreign language contexts, to determine the generalizability of the results of this study to similar and different courses and contexts. In addition, these studies must use introspective data collection methods such as think-aloud protocols to delve more deeply into the role of WCF strategies in the process of writing. Moreover, future research studies need to expand the qualitative data collection to explore the learners' cultural perspectives and the influence of their cultural identities on their responses to different WCF strategies. Additionally, the pertinent studies have to investigate the cultural adaptation feedback strategies in different language learning contexts. Finally, future studies should determine the utility of WCF strategies for improving ESP learners' ability to write their occupation-related reports, such as memos, among others.

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