Investigating synchronous and asynchronous written corrective feedback in a computer-assisted environment: EFL learners' linguistic performance and perspectives

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ABSTRACT
While the existing literature contains a plethora of studies on written corrective feedback (WCF), little attention has been paid to the timing of such a practice. To fill this gap, this study adopted a quasi-experimental design to compare the effects of synchronous WCF (SWCF) and asynchronous WCF (AWCF) on Chinese tertiary EFL learners’ linguistic performance and perceptions. Three intact university English classes were recruited and assigned into three groups: SWCF group (n=30), AWCF group (n=30), and comparison group (n=32). The two treatment groups received nine rounds of mid-focused direct WCF in a computer-mediated setting, while the comparison group did not receive any feedback. The results indicated that the two treatment groups improved their linguistic accuracy significantly, although the treatment did not promote syntactic complexity and fluency. Furthermore, SWCF was more effective than AWCF in enhancing accuracy. The comparison group failed to improve any dimensions of their linguistic performance. To explore the EFL learners’ perspectives on SWCF and AWCF, we conducted semi-structured interviews with the two treatment groups, showing that learners generally had positive perceptions about the two types of WCF. Some important implications are discussed.

1. Introduction
As an essential pedagogical affordance, written corrective feedback (WCF), which refers to feedback on linguistic errors (Bitchener & Ferris, 2012; Cheng et al., 2023), is extensively utilized in L2 writing classrooms.
It has therefore been established as a crucial focus at the forefront of L2 writing research (Zhang, 2022). Over recent decades researchers have shown a good deal of interest in WCF efficacy, particularly since Truscott’s (1996) argument that WCF is ineffective in increasing L2 accuracy. Currently, scholars appear to have reached a consensus that WCF can improve L2 writing accuracy (see Bitchener & Storch, 2016; Kang & Han, 2015), and in order to maximize its effectiveness they have investigated different strategies to provide WCF (i.e. direct and indirect WCF) (Bitchener & Knoch, 2009, 2010; Karim & Nassaji, 2020; Nicolás-Conesa et al., 2019; Suzuki et al., 2019) and WCF scope (i.e. comprehensive and focused WCF) (Cheng & Zhang, 2021; Lee et al., 2021; Rahimi, 2021; Zhang, 2021).

Despite the proliferation of WCF research, one area that still merits further inquiry is the timing of feedback (Fu & Li, 2022; Kim et al., 2020). In L2 writing classrooms, WCF is mainly offered after students have completed their writing (i.e. asynchronous WCF, AWCF) in a paper-based form (Bitchener & Storch, 2016; Cheng & Zhang, 2021). However, with the advancement of educational technology and the popularity of technology-enhanced education, writing platforms and co-editing software programs have become more accessible to teachers and students which creates more opportunities for WCF. Specifically, teachers can now offer feedback while students are composing their writing—synchronous WCF (SWCF) (Kim et al., 2020; Shintani & Aubrey, 2016). The distinction between SWCF and AWCF lies in the ‘immediacy of application’ (Kim et al., 2020, p. 178). However, compared with AWCF, SWCF has far received little scholarly attention (Liu & Brown, 2015; Shintani & Aubrey, 2016). Consequently, we have little knowledge about the relative effects of SWCF and AWCF on L2 learners’ linguistic performance and perceptions.

To fill these gaps, this quasi-experimental study, anchored in a computer-mediated environment, set out to examine the effects of SWCF and AWCF on Chinese tertiary EFL learners’ linguistic performance by measuring accuracy, syntactic complexity, and fluency, and how the students perceived the usefulness of WCF in two different conditions.

2. Literature review

2.1. Theoretical arguments for the timing of feedback

There is a theoretical controversy regarding the ideal time to provide feedback, since immediate feedback and delayed feedback draw upon different theoretical underpinnings. According to behaviorism (Skinner, 1953), learning is seen as habit formation. In this sense, feedback should be provided immediately to correct errors, thereby contributing to
cultivating and developing good habits, whereas delayed feedback may give rise to the formation of bad habits (Fu & Li, 2022). Also, immediate feedback is supported by different theories in SLA. One of these is the Interaction Hypothesis (Long, 2007), which stresses the role of student-interlocutor interaction in learning development. According to Long’s (2015) argument, immediate feedback (e.g. recast) enables learners to map form and function, since it corrects students’ linguistic errors during communicative tasks and provides students with ‘information on target linguistic structure in context’ (Long, 2007, p.77). This means that such feedback is contextualized and does not separate feedback from errors. Although this discussion from the interactionist perspective was developed in the context of oral corrective feedback (CF), it is relevant to WCF, particularly SWCF (Bitchener & Ferris, 2012). SWCF is similar to oral CF, in that both are offered during the process of students working on their tasks (Shintani, 2016).

In addition, immediate feedback is also underpinned by Skill Acquisition Theory, which posits that declarative knowledge can be transformed into procedural/automatic knowledge through extensive practice (DeKeyser, 2007). Immediate feedback occurs as soon as errors appear, which helps learners steer away from proceduralizing and automatizing errors in subsequent tasks as practice (i.e. error fossilization). This particularly holds true for non-salient grammatical features; as DeKeyser (2007) noted, it is not ideal to postpone feedback.

However, delayed feedback is favored by scholars who follow other theoretical perspectives. According to Guidance Hypothesis, feedback should be postponed because immediate feedback can result in learners’ over-reliance on the clues from feedback, which may hinder their abilities to identify and correct errors autonomously or independently. Furthermore, compared with delayed feedback, immediate feedback requires more attentional resources and imposes a greater cognitive burden on students’ working memory. As a result, ‘limited working memory might interfere with simultaneous operations involved in writing’ (Shintani & Aubrey, 2016, p. 299). In this situation, it is very demanding for learners to deal with feedback effectively. Finally, considering that interlanguage is a dynamic system, errors are inevitable (Ellis, 2015). When students progress to a higher level, some errors will be eradicated due to their knowledge expansion. In this sense, it may be unnecessary for teachers to correct students’ errors immediately.

2.2. Empirical studies on AWCF and SWCF in L2 writing

Recent decades have witnessed a proliferation of investigations into WCF in L2 writing due to its theoretical and pedagogical significance, and the
majority of these studies are relevant to AWCF (Li & Vuono, 2019). To date, researchers have conducted ample studies to address the efficacy of AWCF in order to refute Truscott’s proposal that WCF is of little use in L2 development. The available investigations have shown that AWCF can not only facilitate L2 accuracy in revised texts, but also transfer the positive effects to new texts (e.g. Benson & DeKeyser, 2019; Bitchener & Knoch, 2010; Cheng & Zhang, 2021; Karim & Nassaji, 2020; Suzuki et al., 2019; Zhang, 2021; Zhang & Cheng, 2021).

To enhance the effectiveness of AWCF, researchers are interested in the use of different strategies to offer AWCF (i.e. direct and indirect). The former is defined as teachers’ provision of direct corrections, while the latter refers to teachers identifying and indicating students’ errors without providing the correct answers (Bitchener & Ferris, 2012). Currently, findings related to the relative effectiveness of direct and indirect WCF are inconsistent. With indirect WCF, L2 learners can develop a better understanding of their errors and engage in deeper feedback processing, which facilitates their long-term L2 development (Bitchener & Knoch, 2010). However, supporters of direct feedback claim that it provides learners with better input, enabling them to avoid misunderstanding and address linguistic errors successfully (Chandler, 2003; Storch, 2010). Despite some inconclusive results, however, Kang and Han’s (2015) meta-analysis suggested that direct WCF is more effective in enhancing L2 writing accuracy.

Apart from WCF strategies, researchers have also paid attention to the scope of WCF, i.e. the extent to which WCF should be offered. To be more precise, there are three types of WCF: Highly-focused (WCF on solely one linguistic error), mid-focused (WCF on five or six errors), and comprehensive (WCF on all errors) (Liu & Brown, 2015; Zhang, 2021). Compared with mid-focused and comprehensive WCF, highly-focused WCF is encouraged because of its theoretical and empirical justifications. Theoretically, it does not cognitively overload learners and empowers them to use extra attentional resources on processing new input (Sheen, 2007). Empirically, a number of studies have revealed that highly-focused WCF can improve accuracy of specific linguistic feature(s) (e.g. Guo & Barrot, 2019; Li & Roshan, 2019; Suzuki et al., 2019).

However, the utility of such WCF is questioned because it has little relevance to authentic L2 writing in classrooms, where teachers tend to provide WCF on various types of errors (Storch, 2010; Van Beuningen, 2010). Accordingly, some studies have examined the efficacy of comprehensive WCF on L2 writing, reporting that it can benefit L2 learners’ overall writing accuracy (Cheng & Zhang, 2021; Karim & Nassaji, 2020; Van Beuningen et al., 2012; Zhang & Cheng, 2021). Despite its ecological validity, comprehensive WCF requires greater cognitive resources and imposes more strain on L2 learners’ working memory (Ellis et al., 2008;
To resolve this dilemma, mid-focused WCF, which targets several linguistic structures, is highly recommended (Lee, 2020; Lee et al., 2021; Zhang, 2021).

As discussed above, most studies have concentrated on AWCF, but little attention has been given to SWCF. However, the few available studies offer interesting findings. For example, using a case study approach, Shintani (2016) examined how L2 learners responded to SWCF and AWCF respectively provided through Google Docs. Collecting data from stimulated recalls, she found that students were actively attentive to both AWCF and SWCF, which contributed to their metalinguistic understanding about target structures. However, SWCF enabled the participants to engage with feedback more profoundly due to the interactive process involved in SWCF. More recently, Kim et al. (2020) investigated the efficacy of direct and indirect SWCF on students’ writing outcomes and their perceptions in a collaborative writing context. Their analysis of data gathered from writing tests and semi-structured interviews showed that compared with indirect SWCF, direct SWCF was more effective in improving beginner-level Korean learners’ grammatical accuracy. Additionally, students reported similar perceptions regarding the two types of SWCF.

One study that is particularly relevant to our investigation was carried out by Shintani and Aubrey (2016); to our knowledge, this is the only study to address the comparative effectiveness of SWCF and AWCF on L2 learners’ grammatical accuracy in writing. Embedded in a computer-mediated setting, they provided participants with two sessions of direct WCF intervention using Google Docs. Analysis of the participants’ writing tests found that AWCF and SWCF recipients outperformed their peers in the comparison group in the use of hypothetical conditionals. However, SWCF was superior to AWCF in promoting the accuracy of the target structure. While the study adds to our knowledge, several research gaps remain. First, SWCF and AWCF were highly-focused and targeted only one grammatical structure in this study, which restricted the transferability of the results. Given the mediating effects of feedback scope, little is known about the differential effects of mid-focused/comprehensive SWCF and AWCF. Second, the study was only concerned with the effects of WCF on accuracy. Due to the potential trade-off, we think it is also necessary to take into consideration other dimensions of linguistic performance such as syntactic complexity and fluency in any examination of the effects of WCF (Nassaji, 2020; Van Beuningen et al., 2012; Zhang & Cheng, 2021). Finally, their study drew upon quantitative data to address its research questions with a lack of qualitative data related to how students felt about WCF. As a result, we do not know students’ perceptions of WCF. We think that such qualitative data can provide a more nuanced account and advance our understanding of WCF effects (Storch, 2010).
2.3. Trade-off Hypothesis

Informed by the theory of working memory, Skehan’s (1998, 2009) Trade-off Hypothesis is an important theory in SLA, since it can guide task implementation. Also, it makes it possible to predict how task implementation might affect L2 production (Rahimi & Zhang, 2019; Xu et al., 2022). Specifically, based on the Trade-off Hypothesis, L2 learners are probably able to engage with and enhance only one of three dimensions of language (complexity, accuracy, fluency, CAF) while completing a task as a result of their limited cognitive resources (Skehan, 1998, 2009). Thus, there is a trade-off among these dimensions.

Specific to WCF, regardless of whether it is SWCF or AWCF, the intention is to correct L2 learners’ linguistic errors in writing. If they receive WCF, learners may be able to place emphasis on accuracy and focus their attention on it, leaving fewer attentional resources available to devote to complexity and fluency (see e.g. Cheng & Zhang, 2021). Consequently, improvement and development in these two areas of L2 production may be impaired. In this sense, WCF may facilitate the enhancement of writing accuracy at the expense of complexity and fluency (Nassaji, 2020). Truscott (2007) also noted this challenge, positing that WCF might cause students to shorten and simplify their writing to enhance their accuracy.

Currently, the majority of studies regarding WCF have focused on accuracy, showing little interest in complexity and fluency (Rahimi, 2021; Van Beuningen et al., 2012). Based on the above discussion from the perspective of the Trade-off Hypothesis, L2 learners’ improvement in accuracy brought about by WCF possibly compromises the development of complexity and fluency in their writing. Accordingly, it is necessary to include measures of complexity and fluency as well as accuracy in research on the effects of WCF, in order to contextualize and gain a deeper insight into writing accuracy (Cheng & Zhang, 2021; Nassaji, 2020; Zhang & Cheng, 2021).

To fill these gaps, the present study addressed an overarching question: What are the similarities and differences between SWCF and AWCF in terms of their effects on Chinese EFL learners’ linguistic performance and perceptions? Specifically,

1. What are the effects of SWCF and AWCF on Chinese EFL learners’ linguistic performance?
   • What are the effects on accuracy?
   • What are the effects on syntactic complexity?
   • What are the effects on fluency?

2. How do Chinese EFL learners perceive the usefulness of SWCF and AWCF, respectively?
3. Methods

3.1. Operationalization of accuracy, syntactic complexity, and fluency

Since this study set out to compare the efficacy of SWCF and AWCF on accuracy, syntactic complexity, and fluency, this section presents how the three measures were operationalized in this study. Following Biber, Conrad, and Reppen’s (1998) recommendation, accuracy was evaluated by the division of the total error counts of the five target structures by the total number of words × 100. Syntactic complexity was measured by two indices: The mean length of T-units (MLT) and the ratio of clauses per T-unit (RCT). Fluency was defined as ‘the capacity to use language in real time’ (Skehan & Foster, 1999, p. 97), and was assessed by the total number of words produced in 30 min.

3.2. Context and participants

Employing a convenience sampling method (Dörnyei, 2007), we recruited three intact classes of second-year students (n=92) from a university in a central province in mainland China. The three classes were non-English majors, and they were randomly assigned to form the three groups: SWCF (n=30), AWCF (n=30), and comparison group (CG) (n=32). During data collection, all the participants attended a compulsory course, College English 3, which was taught by the same teacher and aimed to improve students’ comprehensive English ability as well as help them pass CET-6 (College English Test Band Six). The students attended the course in a classroom equipped with 40 computers, and they attempted the same English activities in and after class.

Prior to the intervention we administered a demographic questionnaire to all the participants, a total of 62 males and 30 females. Their ages ranged from 18 to 21, and all had around 10 years of English learning experience in mainland China. To determine the participants’ English proficiency, we consulted their CET-4 (College English Test Band Four) scores and the course teacher. According to the Common European Framework of Reference for Languages (CEFR) (Council of Europe, 2018), their proficiency was generally considered to be at B1 level, so they were classified as intermediate EFL learners.

3.3. Instruments

3.3.1. Writing tests

This study included three writing tests: A pretest (Week 1), a posttest (Week 9), and a delayed posttest (Week 11). The genre for the three tests was exposition, since this is a popular genre in evaluating L2 learners’
writing performance (Teng & Zhang, 2020). In addition, Chinese tertiary EFL learners are always required to write expository essays in both domestic and international standardized English-proficiency tests such as CET-4 & 6, IELTS, and TOEFL (Xu et al., 2023).

The writing topics for the three tests were selected from the previous CET-6 battery for two reasons. First, as the CET-6 is a large-scale examination with high validity and reliability for non-English majors in China, the difficulty of writing topics is largely consistent, which will help to eliminate the confounding variable of task difficulty. Additionally, the topics in CET-6 are designed to draw upon students’ general knowledge, so they were familiar to the participants. In our study, all the students needed to complete a writing task of around 150 words in length within 30 min in class, and they were not allowed to seek any external assistance during the tests.

3.3.2. Semi-structured interviews
To explore students’ perceptions of different feedback conditions, we conducted semi-structured interviews (see Appendix A) with some of the participants who received SWCF and AWCF respectively. A total of 16 participants (eight students from each group) were recruited to participate in this qualitative phase of data collection in order to generate in-depth information to complement our interpretation of the quantitative results regarding the effects of SWCF and AWCF.

Shortly after the posttest, the participants were interviewed individually using a semi-structured format. In this study, each interview lasted around 30 min and was conducted in Chinese to avoid any confusion and collect more information. With the participants’ permission, we audio-recorded the interviews for further analysis. We fully protected the identity of participants and used pseudonyms to report our findings.

3.4. Intervention
The whole study lasted 11 weeks, during which the participants in the treatment groups received nine intervention sessions (one per week) in a computer-assisted context. The contents of the intervention are described in Table 1.

3.4.1. WCF operationalization
Our study provided the two intervention groups with mid-focused direct WCF (see examples below). The use of direct feedback was justified according to three rationales. First, direct feedback strategy has several advantages, as discussed in the literature review. Second, previous studies (e.g. Bitchener & Storch, 2016; Kang & Han, 2015) have suggested that
direct WCF is more effective than indirect WCF in terms of improving L2 learners’ writing accuracy, particularly for low/intermediate L2 learners. As the meta-analysis by Kang and Han (2015) revealed, the effect size of direct WCF is larger than that of indirect WCF in enhancing L2 learners’ accuracy ($g=.60$ vs. .33). In addition, direct WCF was especially suitable for this study since the participants received WCF targeting five linguistic structures during the writing process in the SWCF condition, which would involve significant cognitive effort. If they were given indirect SWCF, they might have become cognitively overwhelmed.

Example 1: It is unwise for people to risk of their physical health for playing computers.
Example 2: The government should make a big effort to deal with this problem… (great)
Example 3: Computer has changed our society… (computers)

The decision to provide mid-focused WCF was based on the following reasons. As mentioned earlier, highly-focused WCF has been criticized for its lack of ecological validity, since it does not reflect what happens in real L2 writing classrooms where teachers often correct different types of errors. However, it is time-consuming and energy-intensive to provide comprehensive WCF, particularly in the SWCF condition. Accordingly, to achieve a balance between the ecological validity and the workload of WCF provision, mid-focused WCF appears to be an optimal approach.

3.4.2. Target structures
We targeted five types of errors in this study: Run-on sentences, subject-verb agreement, singular/plural forms, prepositions, and word/phrase choices. The selection of these structures was based on several reasons. First, according to Ferris (2010) classification, the first three are treatable errors, since they are rule-based, while the other two are untreatable, since they are idiosyncratic and cannot be explained by rules. The inclusion of both treatable and untreatable errors can yield a better

<table>
<thead>
<tr>
<th>Week</th>
<th>SWCF</th>
<th>AWCF</th>
<th>CG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pretest Writing task 1 receiving WCF while writing and revising</td>
<td>Pretest Writing task 1 receiving WCF and revising text 1</td>
<td>Pretest Writing task 1</td>
</tr>
<tr>
<td>2-8</td>
<td>Writing tasks 2-8 receiving WCF while writing and revising</td>
<td>Writing tasks 2-8 receiving WCF and revising texts 2-8</td>
<td>Writing tasks 2-8</td>
</tr>
<tr>
<td>9</td>
<td>Writing task 9 receiving WCF while writing and revising</td>
<td>Writing task 9 receiving WCF and revising text 9</td>
<td>Writing task 9</td>
</tr>
<tr>
<td>11</td>
<td>Delayed posttest</td>
<td>Delayed posttest</td>
<td>Delayed posttest</td>
</tr>
</tbody>
</table>
understanding of WCF effects (Guo & Barrot, 2019; Zhang, 2021). Second, such errors frequently cause problems for Chinese EFL learners. According to our pilot study where we collected Chinese tertiary EFL learners’ writing, we found that these errors were the most recurrent error types. This was also confirmed by the course teacher. Third, our participants had learnt and partially acquired these linguistic structures, and Ellis et al. (2008) has argued that WCF is more beneficial for structures that have begun to be acquired than for entirely new linguistic features.

3.4.3. Intervention procedures
To reduce the course teacher’s workload, feedback in our study was provided by two EFL teachers who had earned Master’s degrees in TESOL and who had around eight years of EFL teaching experiences. Before the intervention, these two teachers were informed of the five target structures and trained in how to provide WCF. During the training, we described each structure and specified it through examples. To ensure the reliability of the WCF provision, after the training we invited 20 second-year EFL learners who did not participate in this study to complete two writing tasks, and then the two teachers provided WCF on the five target structures individually. In the SWCF condition, the agreement reached 0.96 while for AWCF the agreement was 0.98. Subsequently, the two teachers discussed to address any discrepancies.

In each treatment group, one EFL teacher provided the first 15 students with WCF, while the other EFL teacher gave WCF to the remaining 15 students according to the class roster. All the participants in the three groups completed their writing tasks on WPS (Word Processing System), a free and widely-used co-writing and co-editing software program in China with the function of uploading and cloud storage of documents.

**SWCF group.** As in Shintani and Aubrey (2016) study, prior to the intervention the students in the SWCF group were instructed that they should complete their revisions based on the SWCF they received during the task, and they were allowed to revise their texts at any time in the process of writing. Next, they logged into WPS via their individual accounts to write the essays and invited the two EFL teachers to offer WCF. In the process of WCF provision, the two teachers moved between and browsed students’ writing samples. As soon as any errors related to the target structures were detected, using the comment function within WPS the teachers highlighted the errors and then provided the students with correct answers directly (see Appendix B). In total, the participants were allocated 40 min to complete the tasks.
**AWCF group.** In this group, the participants were given 30 min to complete their writing tasks without interruption. After completion, they saved and uploaded their writing. Then, the two participating EFL teachers provided the students with direct WCF focusing on the target structures via comment boxes in WPS based on the students’ numbers. Two days later, the students received their feedback and were given 10 min in class to correct their texts.

**Comparison group.** The participants in CG were asked to complete the same tasks in 30 min, after which they were encouraged to revise their writing by themselves for an additional 10 min. Because of ethical considerations, they were offered WCF after the intervention.

### 3.5. Data analysis

#### 3.5.1. Analysis of students’ linguistic performance

Accuracy was calculated manually. Based on Geng's (2017) guidelines, we coded and quantified the errors related to the target features, since this scheme provided detailed explanations for coding such errors. To enhance the reliability of our error coding, a PhD candidate in applied linguistics was asked to be a co-coder. Approximately 10% of the writing samples in the three groups across the three tests were randomly selected, and coded separately by the first author and the PhD student. The inter-coder reliability was 0.93, which reached the threshold of 0.7 (Fleiss & Cohen, 1973). Discrepancies in coding were discussed until they were resolved.

For syntactic complexity and fluency, the data were generated automatically using L2 Syntactic Complexity Analyzer (Lu, 2011).

The measures of accuracy, syntactic complexity, and fluency were subjected to a series of statistical analyses. After confirming that the data were normally distributed, we used two-way repeated measures ANOVA to examine interaction effects, enabling us to understand whether different group conditions had significantly different effects on linguistic performance over time. The indices of the three dimensions were entered as the dependent variables and feedback conditions and time were the independent variables. Additionally, one-way repeated measures ANOVA was employed to explore the within-group differences (i.e. whether there were significant differences in accuracy, syntactic complexity, and fluency measures across tests within each group).

#### 3.5.2. Analysis of students’ perceptions

To address RQ2, all the audio-recordings of the semi-structured interviews were fully transcribed, after which the transcripts were sent back to the participants for member checking to make sure the transcripts aligned with the ideas they intended to convey. Then, the interview
transcripts were read and re-read in order to gain a general understanding of the qualitative data. Subsequently, the first author coded the data inductively using a recursive and iterative process. Specifically, he followed three steps in the practical analysis: Open coding, axial coding, and selective coding (Corbin & Strauss, 2008). First, each transcript was analyzed line by line manually and preliminary codes were generated. Then, the codes were compared and grouped into different categories (themes) based on similarities. Third, inter-case analyses were conducted to refine the themes.

Through this careful coding process, a set of themes emerged from the data such as students’ perceptions about SWCF/AWCF (their feelings and attitudes) (e.g. I felt happy to receive the feedback; I was grateful to the teacher’s time and energy to provide feedback), the specific advantages of SWCF (e.g. SWCF enabled me to understand and adopt correct forms instantly), and factors mediating the usefulness of WCF (e.g. it is difficult for low-proficiency L2 learners to understand WCF). To maintain the trustworthiness of the analysis, the same PhD candidate was invited to be the co-coder. Around 20% of the transcript data were selected randomly and coded independently by the first author and the co-coder. Any disagreements were discussed until they were resolved.

4. Results

4.1. The influences of SWCF and AWCF

Table 2 presents descriptive data related to syntactic complexity, accuracy, and fluency among the three groups in the pretest, posttest, and delayed posttest. To determine the comparability of the baseline conditions among the groups before intervention, we conducted one-way ANOVAs for all the measures. No significant differences in the three dimensions were found among the three groups in the pretest.

<table>
<thead>
<tr>
<th>Indices</th>
<th>Group</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Delayed posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>MLT</td>
<td>SWCF</td>
<td>13.53</td>
<td>3.101</td>
<td>13.552</td>
</tr>
<tr>
<td>RCT</td>
<td>SWCF</td>
<td>1.643</td>
<td>0.251</td>
<td>1.645</td>
</tr>
<tr>
<td></td>
<td>AWCF</td>
<td>1.638</td>
<td>0.221</td>
<td>1.640</td>
</tr>
<tr>
<td></td>
<td>CG</td>
<td>1.642</td>
<td>0.233</td>
<td>1.641</td>
</tr>
<tr>
<td>Accuracy</td>
<td>SWCF</td>
<td>6.464</td>
<td>1.912</td>
<td>4.208</td>
</tr>
<tr>
<td></td>
<td>AWCF</td>
<td>6.475</td>
<td>1.864</td>
<td>5.421</td>
</tr>
<tr>
<td></td>
<td>CG</td>
<td>6.631</td>
<td>1.973</td>
<td>6.589</td>
</tr>
<tr>
<td>Fluency</td>
<td>SWCF</td>
<td>149.320</td>
<td>28.477</td>
<td>151.231</td>
</tr>
<tr>
<td></td>
<td>AWCF</td>
<td>147.800</td>
<td>25.648</td>
<td>149.235</td>
</tr>
<tr>
<td></td>
<td>CG</td>
<td>148.145</td>
<td>25.332</td>
<td>148.672</td>
</tr>
</tbody>
</table>
In this study, two measures were adopted to gauge syntactic complexity: MLT and RCT. In terms of MLT, two-way repeated measures ANOVA generated no significant interaction between groups and time \((F(4, 178)=.235, p=.924)\), indicating that MLT for the three groups did not differ significantly over time. Tukey’s post hoc pairwise comparisons found that there were no significant differences between the SWCF and AWCF groups in the posttest \((p=.872)\) and delayed posttest \((p=.931)\). One-way repeated measures ANOVAs indicated that there were no significant changes across the three tests in the three groups (SWCF: \(F(2, 58)=.478, p=.788\); AWCF: \(F(2, 58)=.287, p=.835\); CG: \(F(2, 62)=.165, p=.892\)) (see Figure 1).

For RCT, there was no significant group × time interaction effect \((F(4, 178)=.005, p=.924)\). This suggested that RCT did not vary significantly across groups or tests. Tukey’s comparisons found that no significant differences were detected between the AWCF and SWCF groups in the posttest \((p=.991)\) and delayed posttest \((p=.995)\). One-way repeated measures ANOVAs indicated that the SWCF group \((F(2, 58)=.698, p=.856)\), AWCF group \((F(2, 58)=.294, p=.785)\), and CG \((F(2, 62)=.038, p=.884)\) failed to develop RCT significantly over the three tests (see Figure 2).

In terms of accuracy, two-way repeated measures ANOVA showed a significant interaction effect between group and time \((F(4, 178)=29.652, p=.000, \text{partial } \eta^2=.531)\), suggesting that the three groups developed accuracy for the five linguistic targets significantly differently. Post hoc pairwise tests showed that the SWCF and AWCF groups both significantly outperformed the CG in the posttest \((p=.000, d=1.31; p=.014, d=.64, \text{ respectively})\) and the delayed posttest \((p=.000, d=1.44; p=.018, d=.56, \text{ respectively})\). Furthermore, the SWCF group produced significantly fewer
errors in the target structures than the AWCF group in the posttest ($p=.012$, $d=.75$) and delayed posttest ($p=.016$, $d=.69$) (see Figure 3).

Regarding within-group differences, one-way repeated measures ANOVA found that the SWCF group had significant differences in accuracy across the tests ($F(2, 58)=31.856$, $p=.000$, partial $\eta^2=.823$). Further analysis showed that the SWCF group made progress in this index from the pretest to the posttest ($p=.000$, $d=1.95$) and retained the beneficial effects in the delayed posttest ($p=.000$, $d=2.12$). Likewise, significant differences were detected in the AWCF group ($F(2, 58)=26.781$, $p=.000$, partial $\eta^2=.584$). Post hoc analyses found that AWCF enabled these Chinese EFL learners to reduce the number of errors related to the five linguistic features significantly in the posttest ($p=.021$, $d=.54$) and the delayed posttest ($p=.014$, $d=.71$). However, no significant effect was returned for accuracy in the CG ($F(2, 62)=2.083$, $p=.547$).
To establish whether changes in fluency differed significantly across groups and tests, a two-way repeated measures ANOVA was performed. The results showed that the group × time interaction effect did not reach significance ($F(4, 178)=.486, p=.716$), suggesting that fluency for the three groups did not differ significantly over time. Tukey’s post hoc comparisons found that SWCF group did not differ significantly from the AWCF group with regard to fluency in the posttest ($p=.987$) and delayed posttest ($p=.993$). For within-group differences, one-way repeated measures ANOVAs indicated no significant variations in the three groups across the three tests (SWCF: $F(2, 58)=2.674, p=.267$; AWCF: $F(2, 58)=2.865, p=.186$; CG: $F(2, 62)=1.371, p=.256$) (see Figure 4).

4.2. Students’ perspectives

In this section, we report on the students’ perspectives according to the themes identified from the qualitative data.

4.2.1. Students’ perceptions about SWCF/AWCF

According to the interview data, the majority of the participants in the two treatment groups were in favor of SWCF and AWCF, respectively (SWCF: 6/8; AWCF: 5/8), acknowledging the usefulness of the feedback they received. Their supportive perceptions were evident in excerpts such as ‘I felt happy to receive the teacher’s feedback’ (Qin, AWCF; Xiao, SWCF); ‘I was grateful for the teacher’s time and energy to provide feedback’ (Lin, AWCF; Qi, SWCF); ‘It was a good teaching practice to provide feedback during the writing process’ (Yan and Fan, SWCF).

Moreover, they gave two reasons for their positive perceptions. First, SWCF/AWCF made them put more emphasis on the quality of their
writing. In addition, the two types of WCF made them aware of their errors and the problems in their writing and provided them with future directions for more efforts. As Yan (SWCF) noted in the interview, after several rounds of teacher feedback, he realized that the recurring errors in his writing related to run-on sentences and inappropriate word choices, and recognized that he should pay more attention to these errors in follow-up writing tasks. This was also true for Lin (AWCF), who said: ‘I tended to commit errors in prepositions and run-on sentences, so I needed to spare more efforts to these aspects, which could benefit the writing performance.’

Interestingly, a few participants did not fully enjoy the process of the different types of WCF they experienced (SWCF: 2/8; AWCF: 3/8) because of their respective disadvantages. Xun received AWCF, which was provided two days later after the writing task, so it was difficult for him to recall and figure out why he had made particular errors during the tasks. Consequently, he just copied out some feedback without engagement. As for SWCF, the participants also pointed out its limitations.

Actually, I was not very used to receiving feedback during the writing process, since this type of feedback distracted my attention. (Ming)

My English was not very good, so it was demanding for me to receive feedback and revise my writing while completing the writing tasks, which imposed a heavy burden on me. (Hong)

Based on the interviews, SWCF may challenge L2 learners, because they have to attend to feedback and revision while they are still drafting their writing. In this sense, the participants appeared to suffer from a cognitive burden in the SWCF condition.

4.2.2. Specific advantages of SWCF

Encouragingly, although two participants experienced challenges during the SWCF intervention, the other six students pointed out three advantages specific to SWCF, which contributed to their positive perceptions about it. First, all six students noted that this kind of WCF prompted them to identify and correct their errors immediately. This point was illustrated by Jia:

In the SWCF condition, I was able to understand and adopt the correct forms instantly, which enabled me to enhance the quality of writing. (Jia)

This advantage was a consequence of the synchronous nature of SWCF. Given that SWCF was administered during the students’ writing process, they had opportunities to recognize their errors and understand the correct forms immediately.
In addition students reported another advantage, namely that SWCF facilitated their use of grammar to complete writing tasks. As Fan expressed, ‘Since the teacher offered feedback during the task, I could refer to the previous feedback provided while employing the same grammatical points to voice my ideas in the same text, which helped me avoid the similar errors and improve the accuracy.’ Yan made similar comments: ‘I utilized the previous SWCF to identify and correct other similar errors by myself while composing new sentences before the teacher pointed out them.’ These explanations suggested that the students seemed to deploy cognitive and metacognitive operations (e.g. connection and monitoring) to engage with SWCF and their writing process, which helped them make good use of the feedback, acquire the knowledge conveyed by the feedback, and improve their use of grammar to complete the writing tasks.

Third, three out of these six SWCF receivers suggested that they were able to engage with WCF more profoundly. Both Xiao and Xin elaborated on this advantage:

With SWCF, we attended to the teacher feedback deeply and corrected errors actively in that the whole writing process was supervised by the teachers. In contrast, we tend to disregard some feedback points if they are provided after writing tasks.

SWCF involves an online interaction between teachers and students (Shintani, 2016), in which teachers monitor their students’ writing and revision processes. With this supervision, the participants explained that they were able to respond to the feedback more actively.

4.2.3. Factors mediating the usefulness of WCF

The qualitative data show that participants in both the SWCF and AWCF groups (SWCF: 7/8; AWCF: 6/8) stated that the effectiveness of WCF was not only related to feedback timing, but also was influenced by other factors, including L2 proficiency, motivation, and personal proactive thinking and action, namely agency.

L2 proficiency played a crucial role in how the participants processed feedback. As the participants confirmed in the interviews (SWCF: 6/7; AWCF: 6/6), low-proficiency L2 learners were more likely to find it difficult to understand the rationales underlying WCF, which created obstacles for them taking up and internalizing feedback (e.g. Xun, AWCF; Qi, SWCF).

Another factor was the students’ motivation in relation to L2 writing (SWCF: 5/7; AWCF: 4/6). According to Fan’s (SWCF) response in the interview, students, who lacked motivation tended to give little importance to WCF and engaged with it superficially, which impaired the
usefulness of the feedback. Similarly, the AWCF recipient Chen said that demotivation in L2 writing may not permit students to recognize the value of teacher feedback leading them to underplay its importance.

Finally, students’ agency mediated the helpfulness of WCF. According to the participants’ responses (SWCF: 4/7; AWCF: 3/6), the efficacy of WCF was dependent on whether students were willing to engage with it. For example, Yan in the SWCF group remarked that it was challenging for L2 learners to exercise agency to process WCF continuously, which might have a negative impact on the value of feedback. Similar comments were observed in Wang’s words (AWCF receiver):

I felt very frustrated if I received a lot of WCF on my writing although I was grateful for the teachers’ hard work. In this situation, I did not want to engage with the feedback proactively, which impaired the usefulness of the feedback. (Wang)

According to their replies, it was apparent that students, irrespective of what type of WCF they received, shared the idea that agency was an important factor influencing the degree of engagement with feedback, and thereby mediating feedback efficacy.

5. Discussion

5.1. The effects of SWCF and AWCF on linguistic performance

In our study, linguistic performance was assessed by measuring accuracy, syntactic complexity, and fluency. In terms of accuracy, both treatment groups improved their overall accuracy in relation to the five structures significantly more than the comparison group. Furthermore, SWCF and AWCF also contributed significantly to the L2 learners’ accuracy in both the posttest and delayed posttest. The favorable effects of AWCF on accuracy have been observed frequently in previous literature regarding focused WCF (e.g. Benson & DeKeyser, 2019; Bitchener & Knoch, 2010; Li & Roshan, 2019) and unfocused WCF (e.g. Cheng & Zhang, 2021; Karim & Nassaji, 2020; Van Beuningen et al., 2012). Additionally, the positive effects produced by SWCF agree with the findings of Kim et al. (2020) and Shintani and Aubrey (2016). Moreover, our results have extended such studies because we examined the efficacy of mid-focused SWCF on accuracy, an insufficiently-explored area in the field of L2 writing research in the existing literature.

Our study further revealed that SWCF was more effective than AWCF in promoting writing accuracy in the posttest and the delayed posttest. In this sense, SWCF appears to have a greater and more durable effect than AWCF. Unlike AWCF, which is offered after the writing process,
SWCF is provided in situ so it has the feature of immediacy (Kim et al., 2020). This results in several characteristics of SWCF, which may account for its more favorable effects. First, due to the immediacy of SWCF, the students in this group were able to correct their errors immediately, while the participants in the AWCF group did not receive feedback until two days later. From the Skill Acquisition Theory perspective, SWCF provides learners with the opportunity to identify and correct their errors instantly, allowing them to reconstruct their interlanguage system and then reinforce and proceduralize their revised system during the subsequent practices (Shintani & Aubrey, 2016), which may prompt students to acquire and develop linguistic structures more effectively. In contrast, the students in the AWCF group received delayed feedback, which may have resulted in their incorrect knowledge about linguistic structures being strengthened and automatized through repeated utilization of the target structures to compose new sentences. As Fu and Li (2022) have argued, errors can be internalized and proceduralized if not corrected in a timely manner.

In addition, the immediacy of SWCF allowed a creation of a context, where receiving feedback was contiguous to performing writing tasks. Within this context, students received direct WCF immediately, which may have helped them notice their errors and internalize correct forms (internalization). Then, they rectified their errors immediately (modification), and had opportunities to employ the same linguistic structures while writing new sentences in the same text (consolidation). This means that SWCF, as contextualized feedback, enabled learners to experience these three stages of acquisition recursively (Williams, 2012). In contrast, AWCF was decontextualized, detaching the receipt of feedback from the production of new texts. In this situation, internalization, modification, and consolidation were separated and did not occur cynically, which was less conducive to students’ acquisition of linguistic structures (Shintani, 2016). In this sense, contextualized WCF in the SWCF condition was more helpful than decontextualized WCF in the AWCF condition.

Regarding syntactic complexity, two measures (i.e. MLT and RCT) were employed to evaluate syntactic this aspect, but they did not vary significantly across groups or tests. Thus, it appears that direct mid-focused SWCF and AWCF had few influences on syntactic complexity, as reported in the previous studies (e.g. Cheng & Zhang, 2021; Van Beuningen et al., 2012; Zhang & Cheng, 2021). Taking accuracy and syntactic complexity together, our study suggests that while SWCF and AWCF receivers promoted accuracy, syntactic complexity remained unaffected. The result does not support the Trade-off Hypothesis, which predicts a compromise between accuracy and syntactic complexity because of L2 learners’ limited cognitive capacity (Skehan, 1998). Furthermore, this result suggests
that WCF did not cause students to simplify sentences in order to avoid/reduce grammatical errors. Therefore, it refutes Truscott's (2007) claim that providing WCF may lead to the simplification of writing to improve accuracy, undermining L2 learners’ development in syntactic complexity.

Our result regarding syntactic complexity is interesting but not surprising, with two possible factors helping explain why. First, both SWCF and AWCF focused on errors in the target linguistic structures, and did not provide students with information on how to diversify and lengthen sentences in their writing. Therefore, the feedback may not have enriched their knowledge in this respect. Without an expanded knowledge repertoire in this area, it is difficult for students to improve syntactic complexity. Moreover, the result may be related to the participants’ L2 proficiency. In this study, the participants were characterized as intermediate L2 learners. As Xu et al. (2023) argued, it is often the case that L2 students’ syntactic complexity development is delayed until these students progress to become advanced learners.

As to fluency, between-subject and within-subject comparisons showed that no significant differences were discernable among the three groups over time, suggesting that WCF, irrespective of its timing, showed few effects on writing fluency. In light of the students’ performance in terms of accuracy and fluency, our study demonstrated that the enhancement in accuracy facilitated by WCF did not shorten students’ written texts or cause their writing fluency to deteriorate. Again, this result contradicts Trade-off Hypothesis, in which a competition is anticipated between accuracy and fluency (Skehan, 1998). Furthermore, the result also disputes the argument that with WCF L2 learners may produce writing samples with significantly fewer words to ensure accuracy (Truscott, 2007).

The finding that L2 learners’ writing fluency seemed to be unaffected by WCF is consistent with the results of some prior studies (e.g. Hartshorn & Evans, 2015). However, it does not align with findings from Zhang and Cheng (2021), where WCF was found to have contributed to Chinese EFL learners’ writing fluency significantly. The inconsistency between these results may be ascribed to the participants’ different English proficiency levels. In this study, the participants were second-year non-English majors, whose English proficiency was lower than that of the English majors in their study. The result from our study is understandable in this light and may also be associated with our instruction about the total number of words to be produced. Specifically, the participants were asked to write approximately 150 words according to the CET-6 requirement. Given that writing too much incurs a loss of marks in the CET-6, the students in our study, who were preparing for this examination, were very likely to focus on satisfying this word requirement.
To sum up, this study investigated the relative effects of SWCF and AWCF on Chinese EFL learners’ linguistic performance. The results showed that both SWCF and AWCF benefited accuracy, while the former was more effective than the latter in improving accuracy. Despite their improvement in accuracy, our L2 learners’ performance in syntactic complexity and fluency was not compromised by the provision of SWCF and AWCF. In this sense, the promotion in accuracy resulting from WCF did not come at the cost of syntactic complexity and fluency. This rebuts the Trade-off Hypothesis, and dismisses Skehan’s (1998) concern that emphasis on accuracy may influence complexity and fluency negatively.

5.2. Students’ perspectives

In our study, SWCF receivers in general showed positive perceptions about this type of WCF, recognizing its value and importance. This finding corroborates the findings from the previous studies (e.g. Kim et al., 2020; Shintani, 2016), where L2 learners realized the usefulness of SWCF. Meanwhile, our AWCF recipients had the similar perceptions towards AWCF. L2 learners’ favorable attitudes towards AWCF are widely reported in the existing literature (e.g. Han & Hyland, 2015; Zheng & Yu, 2018), where L2 learners expected to receive AWCF and spoke highly of it.

In spite of their generally positive perceptions, a few participants also reflected on SWCF and AWCF critically, identifying their individual deficiencies. This corresponds to the theoretical debate on these two types of WCF as discussed in literature review, which pointed out their potential problems. Specifically, SWCF may cause a cognitive burden for L2 learners. According to the writing model proposed by Hayes and Flower (1980), the L1/L2 writing process comprises three phases: Planning, translating, and text revision. In the AWCF condition, since WCF was administered after the writing tasks, the students mainly focused on text revision and did not have to deal with planning and translating. However, SWCF complicates the cognitive process of writing. Specifically, SWCF receivers not only engaged with SWCF to perform their revisions, but also needed to attend to other aspects (planning and translating) simultaneously (Shintani & Aubrey, 2016). Thus, it is not surprising that SWCF consumes more cognitive resources than AWCF, which may result in increased cognitive load for the L2 learners. This may be particularly true for low-proficiency L2 learners, who have fewer cognitive and metacognitive strategies at their disposal.

As for AWCF, three participants complained the time gap between the submission of their writing and their receipt of WCF. This problem is reported in the previous studies (e.g. Cheng, Zhang, & Yan, 2021; Lee, 2017). In L2 classrooms, teachers are challenged by different contextual
constraints such as heavy workload, large-size classes, and students with heterogeneous L2 proficiency. Faced with these challenges, L2 teachers tend to find it time- and energy-consuming to offer feedback (Lee, 2017).

In our study, the students further identified three distinctive advantages unique to SWCF. These advantages also lend empirical support to the possible superiority of SWCF that was postulated by Shintani and Aubrey (2016). First, it enabled students to spot and correct errors immediately. This is associated with the immediacy of SWCF and supports the foregoing theoretical discussion regarding the effectiveness of SWCF. From a theoretical perspective, this benefit of SWCF facilitates SLA, since L2 learners can avoid the fossilization of errors and strengthen their internalization of target structures, which contributes to their effective acquisition of linguistic structures.

In addition, SWCF improved L2 learners’ utilization of grammar to facilitate their writing process. Considering that students have access to SWCF at any time during their writing task, they are able to consult it in the process of writing. As the two participants elaborated, they referred to the previously provided SWCF to write new sentences in the same task as well as to identify and correct errors before the teacher indicated them. It therefore appears that SWCF encouraged the students to invest cognitive effort into enhancing their writing. That is, they employed cognitive and metacognitive strategies (e.g. connecting and monitoring), suggesting that they exerted agency to regulate their mental efforts in order to process feedback and promote revisions (Yang & Zhang, 2023). Using such strategies, they went a step beyond merely focusing on the feedback per se, potentially internalizing the conceptual information delivered by SWCF, enriching their repertoire of grammatical knowledge, and transferring the feedback to their subsequent writing process. Thus, SWCF appeared to scaffold L2 learners in terms of shifting from other-regulation to self-regulation (Kim et al., 2020).

Finally, SWCF prompted L2 learners to engage with WCF more deeply. The synchronous affordance of SWCF provided online communication between teachers and students, which made such WCF interactive (Shintani, 2016). Teachers were able to monitor students’ uptake of WCF and their revisions, and students were highly attentive to the WCF, which benefited their internalization and agentic use of linguistic structures. In contrast, AWCF as an offline feedback was provided after writing tasks had been completed, and lacked teachers’ monitoring of students’ revisions. Consequently, they tended not to take AWCF seriously and sometimes did not even engage with it (Arroyo & Yimaz, 2018). The finding that SWCF was better at enhancing L2 learners’ engagement is very inspiring, since it is more likely for students to capitalize on feedback in
later writing after they spare efforts to understand it (Fan & Xu, 2020; Sachs & Polio, 2007).

In addition, regardless of whether they had received SWCF or AWCF, L2 learners in our study believed that WCF efficacy was mediated by other factors apart from feedback timing such as L2 proficiency, motivation, and students’ agency. Such a finding echoes the claim that WCF is a complex pedagogical practice, the usefulness of which is influenced by a range of individual difference factors (Lee, 2017; Li & Roshan, 2019). Of these factors, we would like to emphasize agency because of its importance. In the interviews, students in both AWCF and SWCF groups acknowledged that it was difficult for them to exert agency to process WCF continuously. This is really understandable, since responding to WCF is a demanding and taxing task, which requires great efforts and appropriate strategies (Zhang & Cheng, 2021). However, to benefit from feedback and improve learning of writing, students need to engage with feedback proactively. That is, they should exert agency to analyze, interpret, use feedback to improve their texts and further their learning (Yang & Zhang, 2023). In other words, without students’ agency to deal with feedback, feedback would be in vain even if it was provided timely and in an appropriate way (Cheng & Liu, 2022). As a result, it is necessary and worthwhile for teachers to formulate strategies to improve students’ agency to approach feedback in order to maximize the value of this teaching practice.

In our study, students’ perceptions as qualitative data offered in-depth accounts for the quantitative results. That is, the qualitative data provide us with powerful explanations to justify the effectiveness of WCF rendered in the writing tests. In this sense, our study made a contribution to the methodology of research on WCF. As many previous studies recommended (e.g. Liu & Brown, 2015; Storch, 2010; Zhang & Cheng, 2021), more mixed-methods studies are needed to explore how students as insiders perceive WCF effects in order to have a better understanding of WCF mechanism.

While the quantitative and qualitative data reveal the potentially favorable role of SWCF, there is an important pedagogical concern regarding this practice. Understandably, it is taxing and challenging for teachers to offer SWCF, since they need to read their students’ writing as quickly as possible in order to detect and correct errors on site. In this sense, offering SWCF involves a significant workload and time pressure (Kim et al., 2020). However, the workload of employing SWCF is affected by various factors including L2 proficiency, the extent of the errors targeted by SWCF, and classroom size. To reduce their workload, L2 writing teachers may need to modify the traditional approach to providing WCF (i.e. comprehensive WCF, WCF on all or most errors). Instead, they could adopt mid-focused WCF, focusing on a few different types of errors
while implementing SWCF. In addition, for large-size classrooms, as Shintani and Aubrey (2016) suggested, teachers could ask students to write collaboratively in groups to reduce the number of writing samples that teachers need to monitor and alleviate time pressure accordingly. These options are expected to address the teachers’ challenges and make SWCF as a viable alternative to AWCF in real classroom contexts.

6. Conclusions

Our study examined and compared the effects of SWCF and AWCF on the linguistic performance of Chinese university EFL learners and their perceptions of the two types of WCF in a computer-enhanced environment. We found that SWCF was more efficacious than AWCF in enhancing the overall accuracy of five linguistic targets. We also found that WCF had neutral effects on syntactic complexity and fluency, regardless of the timing of feedback. Additionally, we noticed that students generally had positive perceptions regarding the usefulness of SWCF and AWCF.

This study brings several important pedagogical implications. First, our study provides strong evidence for the beneficial effects of SWCF on L2 learners’ writing accuracy. In this sense, as a new mode of WCF, SWCF should be given more attention and emphasis. L2 writing teachers should be encouraged to employ SWCF extensively in their classroom pedagogy. Another implication relates to how to utilize SWCF effectively. Considering the workload involved in providing SWCF, this practice may be questioned in terms of its feasibility. To resolve such an issue, teachers could consider mid-focused SWCF in practice as our study did. This may contribute to achieving a balance between workload and the use of SWCF. In addition, our study found neither SWCF nor AWCF had a discernible effect on L2 learners’ performance in syntactic complexity, since the WCF our study provided did not target this aspect. This suggests that explicit instruction in producing complex sentences needs to be included in L2 writing course syllabus design. It is therefore worthwhile and necessary for teachers to adopt several strategies to encourage students to expand basic sentence structures such as sentence combination and sentence reformulation alongside the provision of WCF. In this situation, L2 learners may make progress in both accuracy and syntactic complexity. Finally, the participants confirmed that WCF efficacy was mediated by L2 proficiency, motivation, and agency. Thus, L2 teachers should not focus merely on WCF itself (i.e. different types of WCF). Importantly, they also need to take individual differences into consideration while implementing WCF, since one size does not fit all, and feedback needs to be customized and cater to individual students’ needs, which contributes to improving WCF effectiveness.
Unsurprisingly, we think that the results of our study should be interpreted with caution due to several limitations. First, although we rationalized the use of mid-focused WCF, this study only focused on five linguistic structures. Thus, the beneficial effects of SWCF and AWCF on accuracy may have been due to the narrow scope of errors that we considered. Considering that target linguistic features mediate the effects of WCF on accuracy (Bitchener & Storch, 2016; Shintani, 2016), future studies need to compare the effects of SWCF and AWCF targeting other linguistic structures so as to yield a more persuasive conclusion about the effectiveness on accuracy. Additionally, in this study we employed two popular measures to gauge syntactic complexity, namely MLT and RCT (Wolfe-Quintero et al., 1998). However, according to systematic functional linguistics, T-units may be more sensitive to spoken language than written language, particularly in the academic genre, since clauses tend to be nominalized in these genres. In this sense, we should be cautious about the effects of SWCF and AWCF on syntactic complexity, as measured by MLT and RCT.

In this study, we focused on a comparatively innovative mode of WCF, i.e. SWCF and examined the differential effects of SWCF and AWCF on L2 learners’ linguistic performance in a computer-mediated context. Our study lends empirical support to the value and usefulness of SWCF, and advances the current body of literature, which has predominantly addressed the effects of AWCF. As a product of technology-enhanced education, SWCF is an innovative approach to feedback provision, giving students more supportive and engaging WCF.

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**References**


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**Appendix A. Guiding interview questions**

1. Can you share your English learning experiences with me?
2. Can you tell me your experiences of learning English writing and receiving feedback?
3. What do you think of the feedback you received in this study?
4. Do you want to receive the feedback? Why?
5. Can you understand the feedback you received?
6. What are your feelings when you received the feedback?
7. How do you process the feedback you received?
8. How do you employ the feedback you received to complete revision and writing tasks?
9. What factors do you think influence the effectiveness of feedback?
10. What are the strategies that you employed to revise your texts?
Appendix B. Examples of SWCF

With the development of technology, computer (computers) has changed our society in many different ways. In (From) my perspective, it exerts a great influence on our study. In today’s society, many university students are fond of playing computer games; (and) they pay little attention to their study. Therefore, universities and government should...