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Examining the effects of comprehensive written corrective feedback on L2 EAP students' linguistic performance: A mixed-methods study

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ABSTRACT

Much research has been conducted on the effects of written corrective feedback (WCF) in L2 studies. Unfortunately, the effects of comprehensive WCF in Chinese EAP contexts have been insufficiently documented. Given the significance of WCF in developing EFL students' EAP skills, we employed a mixed-methods approach to bridge this gap. Adopting a quasi-experimental design, this study was implemented in two intact university English classes, with a treatment group receiving four rounds of comprehensive WCF, while no feedback was offered to a comparison group. The posttest and delayed posttest results revealed that such WCF helped the treatment group improve their writing accuracy and fluency statistically significantly and retain the positive effects in the delayed posttest, while it did not enhance their syntactic complexity. The comparison group did not statistically significantly improve their writing accuracy, syntactic complexity, or fluency. To elicit participants' perceptions of comprehensive WCF effects on their linguistic performance, we administered a follow-up open-ended questionnaire with all the treatment-group participants after the posttest. The qualitative findings generally echoed and shed light on the quantitative results. We conclude our study with a discussion of its implications.

1. Introduction

Compared with daily socialization with peers and family members, academic writing poses greater demands and has higher expectations for L2 learners in terms of language use (Cummins, 1984; Duff, 2010; Han & Hyland, 2019; Langum & Sullivan, 2017). Specifically, in EAP writing, L2 students need to use academic language to convey their ideas and establish their authorial identities, through which they can acquire content knowledge and advance academic literacy (Fang & Park, 2020; Hyland, 2017; Lancaster, 2014, 2016; Zhang & Zhang, 2021). To help students command a variety of linguistic resources and facilitate their language use in academic texts, teachers often provide them with written corrective feedback (WCF), especially comprehensive WCF, a crucial practice in EAP writing instruction (Cheng & Zhang, 2021a; Han & Hyland, 2019; Hyland & Hyland, 2019). In this study, WCF refers to teachers' written responses to errors in language use in their students' writing (Bitchener & Ferris, 2012; Storch, 2010).

In the field of WCF, many investigations have turned the spotlight onto how to improve the effectiveness of WCF (Karim & Nassaji, 2020; Suzuki, Nassaji, & Sato, 2019). These studies have examined the extent to which WCF should be provided. That is, they concern

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whether teachers should employ a focused (selective) or an unfocused (comprehensive) approach to WCF provision (Cheng & Zhang, 2021a). The former refers to feedback on a few pre-selected error types, whereas the latter is known as feedback targeting a wide array of linguistic features (Ellis, Sheen, Murakami, & Takashima, 2008). While copious research has evidenced the effectiveness of focused WCF on writing accuracy in specific linguistic target(s) (e.g., Bitchener & Knoch, 2009; Sheen, 2007; Shintani, Ellis, & Suzuki, 2014; Suzuki et al., 2019), such a practice has been called into question by some other researchers for not reflecting the reality of L2 writing classrooms (Hartshorn et al., 2010; Lee, 2020; Storch, 2010; Van Beuningen, De Jong, & Kuiken, 2012). When responding to students' writing, L2 teachers often correct all or most errors rather than focus on a limited number of linguistic errors (Alshahrani & Storch, 2014; Lee, 2017, 2020). Therefore, it is less common that teachers provide their students with focused WCF, particularly highly focused WCF (i.e., WCF on a sole linguistic feature) in real L2 writing contexts. However, in comparison with the proliferation of studies on focused WCF in recent years (e.g., Khezrlou, 2020), little attention has been paid to comprehensive WCF (Bitchener & Storch, 2016; Lee, 2017; Li & Vuono, 2019).

In addition, it should be acknowledged that quantitative approaches have been most prevalently adopted in WCF studies (Guo & Barrot, 2019; Liu & Brown, 2015; Van Beuningen, 2010). While such studies have been instrumental in investigating the effects of WCF by particular groups of students, they have not considered affective factors such as students' perceptions, which can provide powerful explanations for the quantitative results (Storch, 2010). To have a holistic understanding of WCF effects, a mixed-methods approach is needed to explore what effects WCF has on L2 learners' writing performance and how they perceive the effects (Nassaji, 2020). Considering the relative scarcity of studies on comprehensive WCF and its direct relevance to L2 EAP writing classrooms, this study intended to address the effects of comprehensive WCF in an EAP context of China by adopting a sequential explanatory mixed-methods design (Creswell, 2014). In doing so, we expected that the qualitative data could triangulate and add in-depth information to the quantitative results. This study aims to extend our current knowledge of this area and offer some useful implications for EAP writing pedagogy.

2. Literature review

2.1. Features and importance of language use in academic writing

To accomplish academic writing tasks, students need to employ academic language for constructing their texts, a kind of language essential to teaching, learning, and assessment in school settings (Fang & Park, 2020; Wei, Zhang, & Zhang, 2020; Yu, 2020; L.J. Zhang, 2021). Generally speaking, this language is very different from that used in daily social interactions (i.e., everyday language). Such a difference is demonstrated by Cummins' (1984) general distinction between "basic interpersonal communicative skills" (BICS) and "cognitive academic language proficiency" (CALP). The former refers to the linguistic resources used in spontaneous communication among close friends and family members, while the latter refers to the language that students use to express their thoughts and voice their attitudes in academic contexts (Cummins, 1984, 2000). Accordingly, comparisons between academic language and everyday language have been brought to the fore. Schleppegrell (2001) demonstrated that, as two different registers, everyday language and academic language are characterized by distinctive linguistic features. Specifically, in comparison with everyday language, academic language abounds with specialized vocabularies, noun phrases that are expanded by pre- and post-modifiers, and sentences containing embedded clauses. Similarly, Bailey (2007) reported that academic language features more technical vocabulary than does everyday language. Syntactically, it features longer noun phrases and greater use of relative and conditional clauses. Biber and Gray (2016) also investigated the features of academic language and everyday language. As they revealed, the former has greater phrasal complexity (e.g., dense noun phrases with pre- and post-modifiers), while the latter is featured by extensive uses of clausal structures. Thus, it has greater clausal complexity. What emerges clearly from these studies is that language in academic texts has a constellation of lexical and grammatical characteristics that can be challenging and demanding, especially for L2 learners (Bailey, 2007; Hyland, 2017).

Despite the relative difficulty in employing language effectively in academic texts, language use, which tends to be measured by complexity, accuracy, and fluency (CAF), is considered essential to the evaluation of students' academic writing progress and success in learning environments, especially in tertiary education (Biber, Gray, & Poonpon, 2011; Mazgutova & Kormos, 2015). With Wolfe-Quintero, Inagaki, and Kim's (1998) landmark publication, in which they analyzed and synthesized CAF thoroughly in academic writing, CAF has been established as an important issue in several research realms, including both EAP and SLA (Lan, Lucas, & Sun, 2019; Ong & Zhang, 2010; Xu, Zhang, & Gaffney, 2021). It is believed that these areas of language use have a direct influence on L2 students' academic writing performance (Bitchener & Ferris, 2012; Ellis, 2009; Tavakoli, 2018). For example, as a reliable indicator of academic writing proficiency, linguistic complexity defines the genre and communicative demands (Biber et al., 2011). That is, it enables L2 learners to satisfy genre, discourse, or other demands at the supra-sentential, macro level (Romano, 2019). Linguistic accuracy is also emphasized and valued in academia, since it constitutes a crucial criterion to assess EAP students' writing proficiency (Housen, Kuiken, & Vedder, 2012; Hyland, 2016, 2017), and lays a foundation for L2 learners' academic development and careers (Hyland & Hyland, 2019). Moreover, linguistic accuracy can contribute to clarity and idea development in writing, which in turn makes students' texts more appropriate for the requirements of the genres in which they are supposed to write. As such, language use is recognized as an important aspect of academic literacy development (Hyland, 2016; Romano, 2019; Storch & Tapper, 2009). For that reason, EAP researchers have paid considerable attention to students' language development in relation to the offering of EAP courses. For example, Shaw and Liu (1998) investigated the effects of an EAP writing course on L2 learners' language development, which was evaluated by a variety of linguistic measures and found that there were no significant changes in their writing accuracy and complexity. Storch and Tapper (2009) also examined such an issue, reporting that the EAP course enabled L2 postgraduate students to enhance their writing accuracy and use more academic vocabularies. More recently, McDonough, Uludag, and Neumann (2020)

probed into L2 EAP learners' morphological development and found that while the EAP class did not improve their global syntactic complexity or derivational accuracy, it benefited their inflectional accuracy and complexity.

Based on the above discussion, it is clear that academic writing features a range of lexicogrammatical properties that are different from those found in less formal written registers or in spoken registers. More importantly, language use plays a meaningful role in students' disciplinary learning, literacy development, and academic achievement (Fang & Park, 2020). As many L2 learners find it difficult to use academic language due to its lexical and grammatical characteristics, and language use is associated with students' writing proficiency and academic success, empowering students to develop control over linguistic resources and their language ability should be on EAP researchers' and teachers' agenda. To achieve the goals, instructors have adopted different instructional practices to scaffold students' language use. Of such practices, WCF, particularly comprehensive WCF, is a common intervention approach to L2 students' language development (Han & Hyland, 2019; Lee, 2020). This comes to a point where we think it is crucial that comprehensive WCF effectiveness should be well connected to the learning of EAP. Given the importance of language use and the role of comprehensive WCF in L2 EAP writing contexts, our study was set up to examine its effects on Chinese EAP students' linguistic performance quantitatively and qualitatively.

2.2. Effects of WCF

WCF has become a vibrant topic of contention in L2 writing research since Truscott's (1996, 2007) argument that WCF is not only ineffective, but also harmful to L2 writing (Lee, 2017). Among the burgeoning studies on WCF, researchers have examined the effects of WCF on text revision and new pieces of writing, finding that it was beneficial to L2 learners' writing accuracy in revision and/or beyond revision stage (e.g., Ashwell, 2000; Bitchener & Knoch, 2010a, 2010b; Frear & Chiu, 2015; Hartshorn et al., 2010; Kim and Emeliyanova, 2019; Truscott & Hsu, 2008). To date, a consensus appears to have been reached that WCF plays a beneficial role in L2 learners' writing (Kang & Han, 2015; Hyland and Hyland, 2019). To maximize its effectiveness, scholars currently have paid more attention to the strategies to deliver WCF and the scope of WCF that should be provided.

2.2.1. Effects of direct and indirect WCF

In practice, teachers need to consider what strategies should be employed to provide their students with WCF. According to a broad classification, there are two types of feedback according to the strategies: Direct and indirect WCF (Cheng & Zhang, 2021a, 2021b; Zheng and Yu, 2018). The former is defined as teachers' provision of correct answers to errors, while the latter refers to teachers only indicating errors without direct corrections (Bitchener & Ferris, 2012; Van Beuningen, 2010). For direct WCF, it can be realized by different forms: 1) presenting the correct forms directly; 2) deleting the redundant or erroneous items; 3) adding the omitted items (Lee, 2017).

In the current literature, the effectiveness of direct and indirect WCF has been widely discussed. However, the relative effectiveness of direct and indirect WCF remains inconclusive (e.g., Bonilla López, Van Steendam, Speelman, & Buyse, 2018; Chandler, 2003; Karim & Nassaji, 2020; Lalande, 1982; Van Beuningen et al., 2012). Those supporting indirect WCF state that it enables L2 learners to engage with the feedback more profoundly and have a deeper insight into the nature of their errors, which can contribute to their L2 development in the long run (Ferris, 1995; Lalande, 1982). In contrast, the researchers who advocate direct WCF argue that this type of feedback provides L2 learners with sufficient information to deal with linguistic errors, especially those complicated ones. Secondly, direct WCF offers L2 learners input, helping them avoid any misunderstanding and confusion in processing feedback. Furthermore, it contributes to L2 learners internalization of correct forms instantly and enables them to have explicit information to test the hypotheses that they have made on the target language (Bitchener & Knoch, 2010b; Chandler, 2003; Van Beuningen, 2010).

As for the present study, we used a direct strategy to provide the participants with WCF. The selection of such a particular WCF could be justified by the following rationales. First, as mentioned above, direct WCF has several advantages. Second, a large number of studies have shown that direct WCF is more effective in facilitating grammar acquisition than indirect WCF (e.g., Benson & DeKeyser, 2019; Bitchener & Knoch, 2009, 2010a; Chandler, 2003; Van Beuningen et al., 2012). As Kang and Han's (2015) meta-analysis showed, direct WCF has a larger effect size than indirect WCF in terms of promoting linguistic accuracy ($g = .60$ vs. .33). Finally, the case for direct feedback appears to be particularly strong if the feedback targets a wide range of errors. Understandably, comprehensive WCF requires much more attentional resources than focused WCF. If an indirect strategy is used, it may make students so overwhelmed that they would possibly fail to process WCF effectively. As argued by some researchers, it is probably better to provide comprehensive WCF directly (Bitchener & Storch, 2016; Bonilla López et al., 2018; Van Beuningen et al., 2012).

2.2.2. Effects of focused and comprehensive WCF

In addition to feedback strategies, many teachers are concerned with the extent to which they should provide WCF, which is termed feedback scope (T.F. Zhang, 2021). In general, WCF can be classified into two types in terms of the feedback scope: Focused and comprehensive WCF. As noted previously, the former is known as feedback on one/a limited number of errors, while the latter means feedback on all errors/a wide range of errors (Ellis, 2009; Ellis et al., 2008; Liu & Brown, 2015). In this sense, the distinction between focused and comprehensive WCF lies in the number of errors to which teachers should respond (Mao & Lee, 2020; Storch, 2010). In the extant literature, a number of researchers support and advocate focused WCF and they have offered theoretical as well as empirical rationales for it. Theoretically, focused WCF is friendlier to L2 learners, particularly low-achieving ones, since it does not overwhelm students' attention and they can have additional cognitive resources to process new input effectively (Bitchener & Storch, 2016; Sheen, 2007). Furthermore, researchers have provided ample empirical evidence that points to the efficacy of focused WCF on L2 writing performance (e.g., Bitchener & Knoch, 2009, 2010a, 2010b; Shintani & Aubrey, 2016; Shintani et al., 2014). These studies found that

recipients of focused WCF outperformed those who did not receive WCF with respect to the accuracy in target structure(s).

However, focused WCF has been questioned due to the lack of ecological value (Ferris, 2010; Hartshorn et al., 2010; Liu & Brown, 2015). In a natural L2 classroom setting where learners often make various linguistic errors in writing, responding to one or a few error types is far from sufficient, as teachers shoulder the responsibility to help their students "produce high-quality final products" (Bitchener & Ferris, 2012, p. 117) and the ultimate goal of WCF provision in L2 writing is to improve overall accuracy rather than accuracy in some specific linguistic features (Ferris, 2010; Van Beuningen, 2010). It is therefore argued that to generate more direct pedagogical implications, research on WCF should be in line with the reality of L2 writing classrooms (Karim & Nassaji, 2020). In light of this, comprehensive WCF, which corresponds to the actual WCF practices in many classroom settings, may deserve due attention. As Kim and Emeliyanova (2019) claimed, such research on comprehensive WCF is of importance, as it can enable L2 writing teachers to make the best pedagogical decisions.

Currently, several studies have examined the effects of comprehensive WCF. It is frequent in such studies that one group receives comprehensive WCF while the comparison groups receive no (or different) WCF (e.g., Ellis et al., 2008; Sheen, Wright, & Moldawa, 2009; Sun, 2013). However, these studies have not been systematic and have produced mixed findings. The reason is that studies in this line have failed to examine the effects of comprehensive WCF on overall writing accuracy. For instance, Ellis et al. (2008) compared the effects of focused and comprehensive WCF and they found that there was no significant difference between them in improving the accurate use of English articles. Likewise, Sheen et al. (2009) investigated the relative effectiveness of focused and comprehensive WCF. The target structure for focused WCF was English articles, while comprehensive WCF targeted errors in articles, copula "be", regular and irregular past tense, and preposition. The study revealed that focused WCF had an advantage over comprehensive WCF in enhancing students' accuracy in English articles. Unfortunately, neither of the two studies paid attention to the effects of comprehensive WCF on overall writing accuracy, with which L2 writing teachers are concerned.

Some early studies have exclusively focused on comprehensive WCF, examining its effects (e.g., Kepner, 1991; Robb, Ross, & Shortreed, 1986; Semke, 1984). However, their findings should be treated with caution due to the limitations in their research design such as the lack of a control group and inappropriate writing tasks (see Storch, 2010). Recently, several studies in this line have resolved the flaws, but the number of such studies is much smaller than that of focused WCF (e.g., Bonilla López et al., 2018; Karim & Nassaji, 2020; Truscott & Hsu, 2008; Van Beuningen, De Jong, & Kuiken, 2008, 2012). For example, in a study into the effects of comprehensive WCF on EFL learners' text revision and new pieces of writing in an EAP writing course, Truscott and Hsu (2008) recruited 47 participants and assigned them into either a treatment group (receiving comprehensive WCF) or a comparison group (receiving no WCF). The results showed that comprehensive WCF had favorable effects on overall accuracy in revision, but it did not bring about any accuracy gains when participants wrote new texts. Likewise, Karim and Nassaji (2020) addressed the revision and transfer effects of comprehensive WCF and the results showed that comprehensive WCF improved students' general writing accuracy in revised drafts significantly. As for the transfer effects, it enhanced students' general accuracy in new texts, yet the gains did not reach statistical significance. The results from such studies demonstrate that comprehensive WCF is an effective editing tool. Unlike the above two studies, Van Beuningen et al. (2008, 2012), who conducted studies in the Dutch as a foreign language (DFL) context, revealed that comprehensive WCF not only helped students improve writing accuracy in revision, but also carried over the beneficial effects to new texts. Their results indicate that comprehensive WCF is also a useful learning tool. Currently, the scope of research on comprehensive WCF is too small to draw an unequivocal conclusion concerning its effects on writing accuracy in new pieces of writing (Bitchener & Storch, 2016; Lee, 2017; Shintani & Aubrey, 2016). The inconsistent findings among the above-cited studies can probably be attributed to a range of factors such as the complex nature of WCF, and different research designs including research settings, the length of the intervention, feedback conditions, and participants' language proficiency (Kang & Han, 2015).

While the above reviewed studies are thought-provoking, there are still some research gaps. First, compared with the abundant research on focused WCF, recent studies focusing on comprehensive WCF are less common, and they have yielded inconsistent results about its effects on new pieces of writing (Bitchener & Storch, 2016; Karim & Nassaji, 2020; Lee, 2017). Therefore, more studies are needed to clarify the effects on new texts. Another concern is that prior studies tend to adopt accuracy as a single measure to evaluate WCF effects on L2 writers' language (Guo & Barrot, 2019). Such a practice does not tell the whole story because linguistic performance is a complicated construct that goes way beyond just accuracy and it also includes other fundamental features of language (Polio, 2017; Storch & Tapper, 2009). As recommended by some researchers (e.g., Hartshorn & Evans, 2015; Nassaji, 2020), studies on WCF should take linguistic complexity and fluency into consideration as well, which contributes to contextualizing accuracy. Moreover, almost all the studies reviewed above are based on one-shot intervention. Although such a design is easy to implement, it lacks ecological validity and yields limited implications for authentic L2 writing settings (Brown, 2012; Liu & Brown, 2015). In our view, multiple WCF treatment sessions are called for to enhance the reliability of research results and to gain more knowledge about the effects of sustained WCF. Finally, the reviewed studies tend to utilize quantitative data to investigate WCF effects. There is a lack of qualitative data to explore how students as the insiders perceive the effects produced by WCF (Liu & Brown, 2015). Specifically, the quantitative data assess the products of WCF but fail to look at the processes by which WCF influences students' linguistic output. To connect products and processes and to complement the quantitative insights (Storch, 2010), it is important to use a mixed-methods approach. The qualitative component of the investigation can offer rich information on "the various aspects of WCF as a pedagogical tool from students or teachers' perspectives" (Guénette, 2007, p. 50). In this sense, including L2 learners' perceptions not only renders a different perspective but deepens our insights into the effects of WCF.

3. The study

In our explanation of the background to the present study, we have highlighted the significance of language use and comprehensive

WCF in EAP writing classrooms. We also have summarized several research gaps based on our review of the current literature on WCF. To fill these gaps, our mixed-methods study addressed the following two questions with a refined design:

1) What are the effects of comprehensive WCF on Chinese EAP students' linguistic performance (i.e., accuracy, syntactic complexity, and fluency)?
2) How do Chinese EAP students perceive the effects on their linguistic performance?

3.1. Participants and research context

This study recruited 72 English major sophomores through a convenience sampling strategy (Dörnyei, 2007). The participants came from two parallel intact classes in a second-tier university in mainland China. Prior to the intervention, they were informed that they had rights to withdraw from the study at their own will during or after data collection, and they were assured that pseudonyms would be used to report the findings so as to protect their identities. The two parallel classes were randomly assigned into two groups: A treatment group ($n = 36$) and a comparison group ($n = 36$). The two groups used the same university syllabus and textbooks, attended the same in-and-after class writing activities, and had the same classroom instruction time. According to their examination scores in last semester and the discussion with the course teacher, the participants were considered as intermediate EFL learners.

Before data collection, all the participants completed a demographic questionnaire. Overall, the two groups were comparable with regard to age, gender proportion, English learning experience, and overseas learning experience (see Table 1).

During the data collection, participants were enrolled in an EAP course, named *English writing course*, which was a compulsory course for all the English major sophomores. It lasted one 16-week semester and used English as the medium of instruction. In such a course, students were expected to improve their knowledge in EAP writing, familiarize themselves with some basic writing genres (i.e., narrative, argumentation, and exposition), and produce English writing appropriate for academic study. The course was a general rather than discipline-specific EAP writing course, and had a syllabus including the teaching of how to structure the whole essay and each paragraph, make effective arguments, and develop ideas. The course for the two classes was delivered by the same teacher, who held a master's degree in applied linguistics and had eight years of experience in teaching EFL writing.

3.2. Instruments

In order to answer the research questions, this study employed writing tests and an open-ended questionnaire to collect quantitative and qualitative data respectively for data triangulation.

3.2.1. Writing tests

Argumentation was selected as the genre for the writing tasks for the reason that argumentative writing is a genre that is widely used in the assessment of L2 learners' writing proficiency in academic contexts (Teng & Zhang, 2020; Zhang & Zhang, 2021). In the Chinese tertiary EFL context, students tend to be asked to write argumentative essays in a variety of large-scale standardized English proficiency tests such as the IELTS, the TOEFL, the College English Test - Bands 4 and 6 (CET-4 & 6) and the Test for English Majors - Bands 4 and Band 8 (TEM-4 & 8)[1] (Huang & Zhang, 2020).

All the participants were invited to attend the pretest, posttest, and delayed posttest sessions at the outset, the end, and three weeks after the intervention. These tests were used to measure what effects comprehensive WCF had on accuracy, syntactic complexity, and fluency. As Chinese EFL writing teachers' pedagogical practices tend to be examination-driven (Zhang, 2016), English major sophomores tend to be required to write essays based on the writing prompts from the past TEM-4 test battery. Additionally, as the TEM-4 is a national standardized test, the writing prompts are of high validity and reliability, which are drawn on students' daily life and considered familiar and fair to each student (Teng & Zhang, 2020). Accordingly, three different prompts for the pretest, posttest, and delayed posttest were chosen from the past TEM-4 papers based on the discussion with the course teacher (see Appendix 1). In accordance with the requirements by the TEM-4, the participants needed to complete writing tasks of at least 200 words within 40 min in each test. During the writing process, they were required to compose their writing independently and forbidden to use any external resources.

In terms of the pretest, posttest, and delayed posttest, we kept the writing genres, time allocation, and procedures constant. All the three tests were administered by one of the researchers of the present study.

3.2.2. Open-ended questionnaire

To understand students' perceptions, an open-ended questionnaire was administered to the participants in the treatment group. As a retrospective instrument, it can present an emic view on instructional interventions (Mackey & Gass, 2005). For this study, it sought an insider perspective, which can provide a detailed account of the quantitative results regarding the effects of comprehensive WCF. Adapted from Rastgou's (2016) study, the questionnaire included three items focusing on the effects on accuracy, syntactic complexity, and fluency respectively (see Appendix 2). In each item, the participants were asked to express their perceptions and

[1] The TEM-Bands 4 and 8 are two well-established national tests, used to evaluate English major students' English proficiency in mainland China.

Table 1
Demographic backgrounds of the treatment and comparison groups.

Groups	Gender	Age	English learning experience	Overseas learning experience
Treatment	Male (4) & Female (32)	19.4	9.5 years	None
Comparison	Male (5) & Female (31)	19.6	9.6 years	None

explain why they held such perceptions. To gather more information, they were allowed to use English or Chinese or a mixture of the two at will to complete the questionnaire.

3.3. Treatment

The students in the treatment group received four WCF intervention sessions (see Table 2), which targeted all the errors in their writing (e.g., singularity/plurality, voice, tense, part of speech, word choice and sentence structure, among other language-related errors). In the intervention, the feedback was provided by the second researcher of this study. Such a decision, for one thing, was expected to reduce the course teacher's workload of providing WCF. For another, it would enhance the reliability of the intervention. Specifically, in real situations, teachers tend to offer their students a wide range of WCF, but not necessarily correct each error in their students' drafts. Thus, if the teacher had provided the feedback, she would probably have left some errors intentionally or inadvertently.

In this study, we, as discussed earlier, chose to provide students with direct comprehensive WCF, which could be revealed by the following examples:

Example 1:

It is really an useful tool … *(a)*.

Example 2:

Otherwise, they will arouse our laziness, ˆ we will also never get rid of their influence. *(ˆand)*.

Example 3:

The intelligent machines can only take place the elementary work … *(perform)*.

During each treatment, the participants in the treatment group received their first draft of writing with WCF. They were allocated 10 min to look over the corrections of their writing. After they had studied the WCF, their texts were collected, and they were given another 30 min to revise their writing while looking at the original uncorrected texts. That is, the students made revision without access to WCF. We followed this revision procedure, which was used in many previous studies (e.g., Bonilla López et al., 2018; Ekanayaka & Ellis, 2020; Karim & Nassaji, 2020; Storch & Wigglesworth, 2010) and its purpose was to avoid the shallow processing of WCF resulted from direct feedback (i.e., merely copying corrections) (Ekanayaka & Ellis, 2020). During the revision process, they were not allowed to use any external assistance.

The participants in the comparison group did not receive any feedback and were just asked to write the same topic-given essays. After completing each writing task, they were also given 10 min to read through their compositions and then encouraged to self-revise their writing within 30 min. To avoid disadvantaging them, they were offered WCF after the intervention.

3.4. Measures

In our study, the dependent variables included syntactic complexity, fluency, and accuracy, which were evaluated by different measures. Syntactic complexity was gauged by the mean length of T-units and the ratio of clauses per T-unit, two measures widely used to appraise the global syntactic complexity (Wolfe-Quintero, Inagaki, & Kim, 1998). The syntactic complexity was processed by L2 Syntactic Complexity Analyzer (L2SCA) (Lu, 2010, 2011). Fluency was assessed by the total number of words produced within 40 min.

In our study, accuracy was evaluated by the index "the percentage of error-free clauses", which was calculated by dividing the error-free clauses by the total number of clauses. Since this index overlooks the number of errors in each clause, we used another

Table 2
Procedures of the study.

Week		Treatment group	Comparison group
1	Day 1	Pretest (text 1)	Pretest (text 1)
	Day 3	Studying WCF + revising text 1	Revising text 1
2	Day 1	Text 2	Text 2
	Day 3	Studying WCF + revising text 2	Revising text 2
3	Day 1	Text 3	Text 3
	Day 3	Studying WCF + revising text 3	Revising text 3
4	Day 1	Text 4	Text 4
	Day 3	Studying WCF + revising text 4	Revising text 4
5		Posttest	Posttest
6		Open-ended questionnaire	____
9		Delayed posttest	Delayed posttest

measure "the number of errors per 100 words", which was operationalized by dividing the total number of errors with the total number of words × 100. In this study, errors referred to any grammatical, lexical, and morphological inaccuracies in students' writing (Rahimi & Zhang, 2018, 2019). This study adhered to Geng's (2017) guidelines to code and count errors. During the practical coding, all errors were counted except misspelling and punctuation. The exclusion of these errors was due to two considerations. One was to avoid the possible over-estimation of errors resulting from some students' illegible handwriting (as in Rahimi & Zhang, 2018, 2019). Such a practice was also informed by our browsing of students' writing. It was found that the participants made few errors in spelling and punctuation. To ascertain the reliability of coding errors, a Chinese tertiary EFL teacher who earned her master's degree in applied linguistics and did not participate in our study was invited to be a co-coder. After of the authors completed all the work of coding, around 15% of the writing samples selected randomly was re-coded by her. The inter-coder reliability indicated by intraclass correlation coefficient (ICC) was .83. This exceeded the acceptable level of .7 (Fleiss & Cohen, 1973).

3.5. Data analysis

To address RQ1, three aspects including normality, missing values, and outliers were examined prior to statistical analysis. In this study, data were assumed to be normally distributed if the *z*-scores of skewness and kurtosis did not exceed 1.96 (Field, 2009). Since the dataset of our study satisfied the normal distribution requirement, *t*-tests and ANOVAs were employed. In addition, our study based on Cohen's (1992) criteria to interpret the magnitude of the effects. Specifically, *d* values of .20, .50 and .80 and partial η^2 values of .01, .06 and .14 were considered small, medium, and large, respectively.

As regards RQ2, each student's perceptions were firstly identified. Next, the reported reasons influencing their perceptions were analyzed with the following steps: Initially, the questionnaires completed in Chinese were translated into English. After translation, the responses in the questionnaires were read and re-read in order to have a general picture about the qualitative data. Then, open coding and axial coding were used to analyze them (Yin, 2011). By open coding, the meaningful segments were identified, coded, and categorized. Using axial coding, the recurrent themes were yielded to identify the reasons. Finally, the reasons were triangulated with the quantitative data and further adjustments were made.

4. Results

4.1. Effects of comprehensive WCF on linguistic performance

Table 3 records the descriptive data for accuracy, syntactic complexity, and fluency between the treatment and comparison groups across the three tests. To ensure the baseline conditions of the two groups at the beginning of the intervention, independent samples *t*-tests were computed (see Table 4). The results showed that no significant between-subjects differences were found in different indexes at the time of the pretest: Mean length of T-units: $p = .333$; the ratio of clauses per T-unit: $p = .103$; percentage of error-free clauses: $p = .849$; errors per 100 words: $p = .970$; fluency: $p = .475$.

4.1.1. Effects on mean length of T-units (MLT)

No significant differences were found between the treatment and comparison groups in MLT in the pretest and posttest ($t = .977$, $p = .333$; $t = .264$, $p = .793$ respectively), but the difference was significant in the delayed posttest, $p = .030$, with a medium effect size, $d = .64$.

According to one-way repeated measures ANOVAs, MLT changed differently across time in the treatment group ($F(2, 70) = 4.134$, $p = .022$, partial $\eta^2 = .147$), but it was not the case in the comparison group ($F(2, 70) = .267$, $p = .767$). To further explore the within-subjects differences in the treatment group, paired samples *t*-tests were employed and Bonferroni correction was performed ($p = .017$).

Table 3
Descriptive statistics for different measures across the three tests.

Measures	Group	Pretest		Posttest		Delayed posttest	
		Mean	SD	Mean	SD	Mean	SD
MLT	TG	14.582	2.294	14.173	2.353	15.561	2.253
	CG	13.923	2.442	14.000	2.043	14.266	1.772
RCT	TG	1.613	.194	1.521	.232	1.645	.292
	CG	1.501	.282	1.514	.235	1.591	.182
EFC/C	TG	52.345	10.192	62.751	11.662	64.303	11.834
	CG	51.772	13.613	44.646	18.175	52.742	10.734
EP100W	TG	7.961	2.223	5.272	1.653	4.794	1.823
	CG	7.982	2.635	9.534	2.774	8.411	2.352
Fluency	TG	213.243	32.474	237.683	39.412	240.724	31.363
	CG	220.252	35.683	218.714	39.683	217.752	32.734

Note. TG = treatment group; CG = comparison group; MLT = the mean length of T-units; RCT = ratio of clauses per T-unit; EFC/C = the percentage of error-free clauses; EP100W = the number of errors per 100 words; SD = standard deviation.

Table 4
Between-subjects comparisons of measures across tests.

Measures	Pretest		Posttest		Delayed posttest	
	T	P	t	p	T	p
MLT	.977	.333	.264	.793	2.232	.030*
RCT	1.622	.103	.216	.830	.703	.486
EFC/C	1.92	.849	4.169	.000**	3.578	.001*
EP100W	-.038	.970	−6.50	.000**	−6.05	.000**
Fluency	-.720	.475	1.679	.100	2.509	.016*

*$p < .05$; **$p < .001$.
Note. TG = treatment group; CG = comparison group; MLT = the mean length of T-units; RCT = ratio of clauses per T-unit; EFC/C = percentage of error-free clauses; EP100W = the number of errors per 100 words; SD = standard deviation.

The tests indicated that the treatment group improved MLT significantly from the posttest to delayed posttest ($p = .002$, $d = .72$). However, such significant improvement did not appear from the pretest to the posttest or from the pretest to the delayed posttest.

4.1.2. Effects on ratio of clauses per T-unit (RCT)

Results of independent samples t-tests showed that the treatment and comparison groups performed similarly with respect to RCT in the pretest ($t = 1.622$, $p = .103$) (see Table 4). Likewise, these two groups had similar performance in this index in the posttest and the delayed posttest ($t = .216$, $p = .830$; $t = .703$, $p = .486$ respectively). Within-subjects comparisons showed that RCT did not vary significantly over time in the treatment group ($F(2, 70) = 2.576$, $p = .087$) or the comparison group ($F(2, 70) = 1.596$, $p = .218$).

4.1.3. Effects on percentage of error-free clauses (EFC/C)

As shown in Table 4, EFC/C in the treatment and comparison groups was virtually identical in the pretest ($t = 1.92$, $p = .849$). At the time of the posttest, two-way repeated measures ANOVA revealed that there was a significant main effect of time, $F(2, 140) = 3.624$, $p = .035$, partial $\eta^2 = .072$, a significant main effect of group, $F(1, 70) = 18.700$, $p < .001$, partial $\eta^2 = .285$, and an interactive effect for time and group, $F(2, 140) = 6.306$, $p = .004$, partial $\eta^2 = .118$, suggesting that the two groups differed significantly in EFC/C over time. Between-subjects comparisons showed that the treatment group produced much more error-free clauses than the comparison group in the posttest, $p < .001$, $d = 1.19$, and the delayed posttest, $p = .001$, $d = 1.02$.

One-way repeated measures ANOVAs showed that the treatment group had significant differences in EFC/C across tests, $F(2, 70) = 12.207$, $p < .001$, partial $\eta^2 = .337$, but the comparison group did not, $F(2, 70) = 2.138$, $p = .141$. A further examination of within-subjects differences found that the treatment group made great progress in this measure from the pretest to the posttest ($p < .001$, $d = .92$) and such a beneficial effect was retained in the delayed posttest ($p < .001$, $d = .94$).

4.1.4. Effects on number of errors per 100 words (EP100W)

Results from two-way repeated measures ANOVA showed that time and group had main effects ($F(2, 140) = 5.787$, $p = .006$, partial $\eta^2 = .110$; $F(1, 70) = 34.292$, $p < .001$, partial $\eta^2 = .422$ respectively), and the interaction between time and group was significant ($F(2, 140) = 15.926$, $p < .001$, partial $\eta^2 = .253$). This indicated that the two groups varied significantly in this measure across tests. Although the two groups' pretest performance in EP100W did not differ greatly ($t = -.038$, $p = .970$), significantly fewer errors were found in the treatment group than in the comparison group in the posttest ($p < .001$) and the delayed posttest ($p < .001$) with large effect sizes ($d = 1.86$; $d = 1.73$ respectively).

One-way repeated measures ANOVAs were also run. Results showed that there were significant changes across tests in the treatment group ($F(2, 70) = 30.069$, $p < .001$, partial $\eta^2 = .556$), but such changes were not seen in the comparison group over time ($F(2, 70) = 2.707$, $p = .097$). The post hoc analyses revealed that the intervention helped the treatment group students reduce the number of errors significantly from the pretest to the posttest ($p < .001$, $d = 1.22$) and from the pretest to the delayed posttest ($p < .001$, $d = 1.37$).

4.1.5. Effects on fluency

As seen in Table 4, the two groups had similar performance in fluency in the pretest and the posttest ($t = -.720$, $p = .475$; $t = 1.679$, $p = .100$). However, the treatment group outperformed the comparison group in fluency in the delayed posttest, $p = .016$, with a medium effect size, $d = .72$. One-way repeated measures ANOVAs found that the differences in fluency were significant in the treatment group across tests ($F(2, 70) = 6.930$, $p = .002$, partial $\eta^2 = .224$), but the significant variations were not observed in the comparison group ($F(2, 70) = .037$, $p = .923$). The statistical analyses showed that the intervention enabled the treatment group to write much more words over time (pretest vs. posttest, $p = .008$, $d = .57$; pretest vs. delayed posttest, $p = .001$, $d = .79$).

4.2. Chinese EAP students' perceptions on the effects

4.2.1. Perceptions on accuracy

According to students' responses to the open-ended questionnaire, the majority of participants in the treatment group (32/36 students) agreed that their grammatical accuracy in English writing improved. They ascribed their improvement to comprehensive WCF, which benefited them in three dimensions. Firstly, they believed that their grammatical knowledge increased (12/32 students).

With the help of such WCF treatment, they felt that they were cognizant of some grammatical knowledge, which they had not mastered well beforehand and understood how to employ it proficiently in writing after the intervention. As Xin expressed in the questionnaire:

> After the WCF intervention, I had more knowledge about some grammatical points. For example, I used to be confused by attributive clauses and appositive clauses. However, after the comprehensive WCF sessions, I had a better understanding of the two different clauses. (Questionnaire, Xin)

Likewise, Yu commented that she particularly benefited from comprehensive WCF:

> I had had difficulties in employing articles in writing previously, but I was able to use them appropriately after the WCF treatment. (Questionnaire, Yu)

Based on students' reports, it appeared that comprehensive WCF contributed to their acquisition of grammatical knowledge and then improved their accuracy in grammar. Moreover, as some students expressed in the questionnaire, comprehensive WCF highlighted and corrected a variety of grammatical errors for them. They deemed that this enabled them to be aware of their weak areas and problems in grammar and they had opportunities to avoid them (25/32 students). For example, Wei explained: "Thanks to multiple comprehensive WCF sessions, I realized the recurring errors in my writing, one of which was run-on sentences. This prevented me from repeating them in the follow-up writing." In a similar vein, Tong noted that because of four rounds of comprehensive WCF, she understood the grammatical errors that she was prone to making in writing such as agreement, collocation, and article. As a result, she paid more attention to them while writing essays, which assisted her in ruling out such errors in the following tasks. In this sense, comprehensive WCF probably prompted the treatment group participants to diagnose their problematic areas in grammar and to keep themselves from making similar errors in the further writing.

The third merit of comprehensive WCF mentioned by students was that it helped them foster grammatical awareness (9/32 students), which made them put emphasis on grammatical knowledge and rules. With such an awareness, they reported that they valued and drew upon grammatical rules to compose sentences rather than wrote sentences arbitrarily, so that they could reduce grammatical errors. This is seen in the following except. Evidently, the intervention of comprehensive WCF drew Ran's attention to grammatical rules, which changed her habit of producing sentences from writing at will to writing based on rules.

> Previously, I wrote sentences by intuition, so there were many grammatical errors. After several WCF sessions, I adhered to grammatical rules. I took them into consideration while writing sentences and used them to check whether sentences I wrote were right, by which I could avoid many errors. (Questionnaire, Ran)

However, four treatment-group students did not share the same perceptions that their grammatical accuracy improved. The reason for their perceptions was their English proficiency. For example, in the questionnaire, Jin responded:

> My English was not very good, so I often did not know why my teacher corrected the errors like she did. I did not have sufficient grammatical knowledge to understand her corrections. (Questionnaire, Jin)

4.2.2. Perceptions on syntactic complexity

As for students' perceptions in terms of syntactic complexity, most WCF recipients (31/36 students) perceived no changes in syntactic complexity. The major reason for such a perception, retrieved from students' responses, was comprehensive WCF they received. As a cohort of students explained (28/31 students), it did not remove the ceiling imposed by their limited knowledge regarding syntactic complexity. Specifically, the intervention of comprehensive WCF played a crucial role in reducing linguistic errors, but it did not inform students of the strategies to produce long sentences. This reason was shown in Xin's response:

> The feedback that I received focused on accuracy but had nothing to do with how to write long sentences. Thus, I still had difficulties in this regard. (Questionnaire, Xin)

Like Xin, Qing stated that the WCF she received was beneficial to her writing accuracy greatly, but it did not extend her limited knowledge in expanding basic sentence structures. Without the repertoire of rich knowledge in expanding sentences, it was probably challenging for students to yield long sentences and improve syntactic complexity in writing. In addition, a few students (8/31 students) mentioned that during the intervention of comprehensive WCF, they prioritized linguistic accuracy and showed little concern with syntactic complexity. As Tian replied, with WCF, she placed emphasis on writing accuracy, so she did not give much importance to the production of long sentences and often used those familiar sentence structures to complete writing tasks.

As for the remaining five students, they perceived that the sentences in their writing changed longer. Surprisingly, when asked "why", they gave reasons for their perceptions, predominantly their preference for comprehensive WCF. For example, Bin stated: "After the WCF treatment, I improved grammatical knowledge, so I was able to understand what elements could be added to lengthen sentences." Furthermore, according to these students' comments, the treatment of comprehensive WCF appeared to boost their confidence, which contributed to their perceptions. As Le wrote in the questionnaire, after four WCF sessions, her writing accuracy improved, so her confidence in English writing increased; she said she felt confident in writing long sentences after the intervention.

4.2.3. Perceptions on fluency

When it comes to perceptions regarding fluency, the participants were optimistic about their performance in fluency. Specifically, over 90% of the respondents (33/36 students) felt that they could write faster after this intervention. When asked why they thought so, approximately 88% of the students (29/33 students) espousing such perceptions cited comprehensive WCF as a main reason. From these students' explanations, we can see that WCF enriched their knowledge related to language use (i.e., grammar). This, in turn, enhanced their writing speed. As Nan expressed, "due to the WCF sessions, I improved grammar a lot and did not need to spend much

time on grammar to check the accuracy during writing, which speeded up my writing." Similarly, Yuan commented in the questionnaire:

> My performance in grammar improved because of the multiple WCF sessions, so I was not troubled by grammar while writing, which enabled me to write faster. (Questionnaire, Yuan)

From the two extracts, as an instructional affordance, comprehensive WCF might consolidate students' grammar, thereby facilitating their writing fluency. Interestingly, another reason that some students provided for their perceptions was writing practice (13/33 students). In the open-ended questionnaire, few students failed to explain why writing practice benefited their writing fluency. For example, Han just noted that "practice makes perfect". However, other students elaborated how writing practice facilitated their writing fluency. For example, they said that it enabled them to be more familiar with the organization of writing. As Wen replied, she had a deeper insight into the global structure of writing after writing practice, so she could outline the whole essay promptly, which contributed to her faster speed of writing. In addition, it was believed to help students in terms of language use. Lu reported such a benefit of writing practice as follows:

> With several rounds of writing practice, I was able to produce the sentences that I would like to express more fluently. This promoted my writing speed. (Questionnaire, Lu)

Different from the majority of their peers, three respondents in the treatment group did not notice the changes in their writing speed and yet they unanimously agreed that their writing speed hinged on topics. As they commented, they could write fast if they had adequate information on a particular topic. In this sense, they believed that writing fluency varied with writing topics.

5. Discussion

5.1. Effects on accuracy

Providing L2 EAP learners with direct comprehensive WCF facilitated their overall writing accuracy in new texts in the immediate and delayed posttests, no matter how the accuracy was measured (by the percentage of error-free clauses or the number of errors per 100 words). Such findings rebut Truscott's (1996, 2007) claim that error correction is ineffective and harmful to L2 writing. Furthermore, the results contradict the proposition by Sheen (2007) that comprehensive WCF is of little learning potential, as it is difficult and challenging for L2 learners to deal with WCF targeting various error types, which makes them have few attentional resources to process new information. However, our results that students made gains in overall accuracy in two posttests indicate that they did not seem to be cognitively overloaded. Instead, they probably were able to attend to comprehensive WCF, notice the gap between the input (what they should produce provided in the form of WCF) and what they have produced, process and internalize the input, and produce accurate and modified output in new texts.

Such Results align with the previous literature in fact (e.g., Bonilla López et al., 2018; Van Beuningen et al., 2008, 2012). All these studies investigated the effects of direct comprehensive WCF on accuracy and found that it helped improve students' accuracy over time in new texts. In this sense, our results of the positive effects on general accuracy are not surprising, which may be attributed to several factors.

Firstly, four comprehensive WCF sessions were provided in our study, which possibly prompted students to notice their linguistic errors. As such, they probably could avoid the similar errors in the follow-up writing tasks. This is supported by the qualitative findings from the open-ended questionnaire.

Secondly, the positive Results may be explained by the explicitness in feedback. In this study, we offered comprehensive WCF directly rather than indirectly. Compared with indirect WCF, direct WCF can alleviate L2 learners' confusion in attending to such a practice and may be less cognitively demanding due to its nature of explicitness and immediacy (Bitchener and Knoch, 2010b; Ellis et al., 2008). This is particularly true for the participants in our study. Given that they were intermediate EFL learners, they had limited English language proficiency, which may not contribute to their uptake and use of feedback (Lee, 2017; Zheng and Yu, 2018). If they had been provided with indirect WCF, it would have been more challenging and taxing for them to process the feedback. As some researchers have recommended, to enhance the effectiveness of WCF, L2 teachers need to take into account their students' proficiency when providing WCF (Kang & Han, 2015; Lee, 2017; Zhang et al., 2021). In many cases, they should consider offering direct WCF to learners with limited/low language proficiency and delivering indirect WCF to the higher-proficiency learners.

Finally, the favorable effects are probably associated with our research design. In our study, students reviewed direct WCF but did not have access to it while revising their texts. Such a design afforded L2 learners opportunities to reflect upon their errors and engage with direct WCF more profoundly than just copying corrections. This enabled them to reinforce what they had learnt from WCF. Our study may offer a useful alternative, in which teachers provide direct WCF along with students' self-reflections in doing the revision. Despite this, what should be pointed out is that such a design is not a common pedagogical practice in real L2 classrooms. In this sense, this design had an experimental flavor and compromised its ecological validity to some extent. However, as Karim and Nassaji (2020) argued, "ecological validity is a matter of degree, and any research, depending on the amount of control it has over its design, would be more or less ecologically valid" (p. 18).

Moreover, considering that the writing topics in testing and treatment sessions were different, it appeared that students might be able to generalize the WCF received in treatment to new contexts in the two posttests, as shown in other prior studies (e.g., Frear & Chiu, 2015). This indicates that with comprehensive WCF, learners probably not only noticed the inadequacies in their interlanguage system, but also pushed the noticing to the highest level—"noticing at the level of understanding" (Tang & Liu, 2018, p. 37).

As regards students' perceptions on accuracy, the majority of students (89%) believed in the improvement in accuracy. Gleaned

from the participants' responses to the open-ended questionnaire, comprehensive WCF was regarded as the reason for students' perceptions of the improvement in accuracy. As an empowering pedagogical tool, it was considered to generate three benefits for students. Firstly, some participants thought that it played a didactic role, adding knowledge in their current grammatical system. With more grammatical knowledge at their disposal, they were possibly able to employ grammar more skillfully in writing. Secondly, comprehensive WCF was reported to draw students' attention to their weak areas in language use. This might enable them to notice the recurrent linguistic errors and steer away from them in the following writing, which led to the gains in accuracy. Such an explanation aligns with Hyland's (2003) comment that WCF helped students notice their errors and then improved their writing accuracy. This also corresponds to the Noticing Hypothesis, which posits that noticing is essential for learning to occur (Schmidt, 1993). The last benefit demonstrated by the students was that such WCF cultivated their grammatical awareness, in which they gave importance to grammatical rules when writing sentences. Taken together, the three benefits, based on students' responses, reflect the potency of comprehensive WCF in providing students with linguistic scaffolding and also shed light on its facilitative effects on accuracy in both the immediate and delayed posttests. Despite this, we should exercise caution in interpreting these three strengths due to our research focus and design. As one reviewer rightfully pointed out, our study was designed with only one treatment group receiving comprehensive WCF and there was a lack of a comparison group receiving focused WCF. As such, it is highly probable that students who were provided with focused WCF would have the similar perceptions. This suggests that the perceptions the students reported might not be about comprehensive WCF exactly.

Unlike most students' perceptions, four participants perceived that the accuracy did not improve and they made reference to their limited English proficiency. This suggests that the usefulness of WCF may be offset by students' proficiency, which was viewed as a moderating variable (Kang & Han, 2015). More importantly, as these students responded, they did not understand the rationales for the corrections. This reflects a disadvantage of direct feedback that "students may not identify the rules or regularities underlying the corrections" (Ekanayaka & Ellis, 2020, p. 3).

5.2. *Effects on syntactic complexity*

In the present study, syntactic complexity was appraised by two measures: Mean length of T-units (MLT) and ratio of clauses per T-unit (RCT). As regards MLT, the treatment group outperformed the comparison group in the delayed posttest with a medium effect size. However, the two groups' mean scores in this index remained unaffected both from the pretest to the posttest and from the pretest to the delayed posttest. As to RCT, it did not vary across groups or tests. It appeared that comprehensive WCF had few effects on syntactic complexity.

The result that comprehensive WCF did not show any effects on L2 learners' syntactic complexity was also observed in previous studies (e.g., Hartshorn et al., 2010; Van Beuningen et al., 2012). It does not lend support to the argument that WCF has a negative influence on syntactic complexity, meaning that WCF probably makes L2 learners simplify their writing, as asserted in Truscott (1996, 2007). The finding may be attributable to two factors in our study. For one thing, the duration of the WCF intervention was short. Although our study provided multiple WCF sessions, the intervention spanned four weeks. It is not very possible for L2 learners to change syntactic complexity greatly in a short time period (Ortega, 2003; Storch & Tapper, 2009). Such a factor is corroborated in Rahimi's (2009) study, where L2 learners improved their syntactic complexity after a WCF intervention over a semester. For another, this finding may be related to our research design. Our study required the participants to complete their writing tasks with no less than 200 words within 40 min. In such an operationalization, students probably paid little attention to syntactic complexity or considered it to be relatively peripheral. They were very likely to employ those familiar sentence structures to complete writing tasks on time.

As for students' perceptions, 86% of the treatment-group participants perceived that there were no changes in their responses to the questionnaire. In our study, comprehensive WCF focused on the accurate use of language and benefited their accuracy significantly, yet it did not enable them to acquire knowledge about producing long sentences. It can be said that they still had limited knowledge in this respect. As Casal and Lee, 2019 argued, without external affordance, it is demanding and taxing for L2 learners to increase syntactic complexity. Viewed in an optimistic lens, the finding encourages L2 teachers to initiate some pedagogical strategies to help students expand basic sentence structures alongside WCF provision in L2 EAP writing classrooms so that students may make progress in their syntactic complexity and writing accuracy concurrently.

5.3. *Effects on fluency*

As the quantitative results showed, the intervention of comprehensive WCF offered in our study prompted the treatment group to write significantly longer texts in the two posttests. In light of its effects on accuracy, comprehensive WCF contributed to students' gains in both accuracy and fluency. This also contradicts Truscott's (2007) claim that students may shorten their writing to achieve accuracy. The favorable effects on fluency rendered by comprehensive WCF align with the result found in Robb, Ross, and Shortreed's (1986) study, in which the students receiving such WCF lengthened their texts. Notably, other studies which evaluated accuracy alongside fluency found that comprehensive WCF did not generate any effects on fluency (e.g., Hartshorn et al., 2010; Hartshorn & Evans, 2015). The inconsistent results may be due to our research design. Specifically, our study explicitly stipulated that students should complete the writing tasks with no less than 200 words within 40 min, whereas the two Hartshorn studies did not. With this requirement, students in our study probably made meticulous endeavors to write as much as possible.

Based on the open-ended questionnaire, approximately 92% of students in the treatment group deemed that they wrote faster. More importantly, the respondents explained why they perceived so. An important reason that they presented was related to comprehensive WCF. Although it mainly concentrated on linguistic accuracy in students' writing, it was regarded as a salient factor by many students

with regard to accelerating their writing speed. In this study, students remarked that it contributed to their proficient use of grammar. Facilitated by comprehensive WCF, students felt that they could tackle the challenges and obstacles posed by grammar during writing, thereby enhancing the fluency. In this sense, the improvement in fluency may be viewed as an additional bonus brought about by comprehensive WCF. Writing practice was referred to as another factor. As some students emphasized in the questionnaire, this study provided them with multiple rounds of writing practice, which worked in different ways such as helping them in the overall structure of writing or language expression. However, students' perceived usefulness of writing practice in fluency is not justified by the comparison group's performance in fluency. Specifically, little improvement in writing fluency was seen in the comparison group across three tests, who was just engaged in writing practice. Taken together the comparison group's performance in CAF, writing practice *per se* does not seem to be enough to motivate students to enhance their linguistic performance, so the limited and short-term writing practice without WCF is of little value (see e.g., Frear & Chiu, 2015). This indicates that writing practice needs to be scaffolded by other assistance such as written/oral feedback and teachers' writing instructions (Bitchener & Ferris, 2012).

To summarize, conducted in a Chinese EAP context, our study generated some new insights and advanced the relevant previous studies in two meaningful ways. Firstly, since our study used complexity and fluency to appraise the effects of comprehensive WCF in addition to accuracy, it extends the prior studies which only focused on the effects on accuracy (e.g., Bonilla López et al., 2018; Karim & Nassaji, 2020; Truscott & Hsu, 2008), and it also enables us to paint a nuanced picture regarding the effects of such WCF on L2 development. More significantly, our study adopted a refined mixed-methods approach, gathering both quantitative and qualitative data. As aforementioned, previous studies predominantly depended on quantitative data from writing tests to explore WCF effects (Liu & Brown, 2015; Storch, 2010). We included students' qualitative perceptions of the WCF effects to triangulate and offer detailed explanations about the quantitative data, which helped us delve further into many of the previous quantitative studies (e.g., Bitchener & Knoch, 2010a, 2010b; Ellis et al., 2008; Karim & Nassaji, 2020; Shintani & Aubrey, 2016; Van Beuningen et al., 2008, 2012).

6. Conclusion, limitations, and implications

This study enriches the line of research on WCF by employing a sequential explanatory mixed-methods design to examine the effects of comprehensive WCF on accuracy, syntactic complexity, and fluency. It was revealed that the EAP students who received comprehensive WCF improved accuracy and fluency significantly; however, this practice did not produce effects on syntactic complexity. According to their responses to the open-ended questionnaire, students' perceptions, in general, concurred with the quantitative results and furthermore the qualitative responses provided insightful details to account for how comprehensive WCF affected the different dimensions of students' linguistic performance.

Understandably, this study is not without limitations. Firstly, we primarily concentrated on the effects of comprehensive WCF on EAP students' linguistic performance gauged by CAF, and did not engage with the effects of such a practice on macro-level EAP writing focuses such as students' genre knowledge and their idea development. Therefore, further studies in this line are needed to examine such issues. Moreover, as noted earlier, our study only included one treatment group who received comprehensive WCF, lacking a comparison group, where students were offered focused WCF. This is an obvious limitation in research design, as students' self-reported perceptions of comprehensive WCF cannot be ascertained with full confidence. Lastly, this study was conducted within a relatively short timeframe. Consequently, it is impossible for us to observe how L2 learners' CAF would develop in the long run. Considering this limitation, we strongly recommend that longitudinal, diachronic studies be conducted to examine the effects of comprehensive WCF on the dynamic development of L2 learners' CAF in the long term.

In spite of these limitations, our study might have something to offer, especially for EAP writing teachers. Since the results showed that comprehensive WCF enhanced students' general writing accuracy and fluency, its effectiveness is ascertained. Accordingly, it can be regarded as a valuable instructional resource that teachers might want to use as a pedagogical practice in EAP writing classes. However, it should be noted that the positive effects in our study appeared after several rounds of treatment. This indicates that in order to make it efficacious, teachers need to ensure that students receive sufficient sessions of comprehensive WCF. Although EAP teachers usually have other priorities aside from helping students' language development, EAP courses, as mentioned previously, attach great importance to language use, and it would be unrealistic to expect L2 students to improve their overall linguistic accuracy as well as maintain the improvement in a short period of time, let alone after one-off comprehensive WCF (Liu & Brown, 2015). As Karim and Nassaji (2020) posited, students' language development entails extensive exposure to WCF, as language development is a non-linear and recursive process. We therefore recommend that EAP writing teachers continue comprehensive WCF over a semester or an academic year, depending on their students' L2 proficiency. Moreover, as our study revealed, students' syntactic complexity remained unchanged after our treatment, and it seemed that comprehensive WCF did not enrich students' knowledge in this regard. Therefore, explicit instruction in constructing complex sentences should not be overlooked in the general EAP writing classroom. As a helpful approach to improving students' syntactic complexity, teachers could consider offering direct instruction using specific strategies for expanding basic clausal structures. We suggest that they adopt teaching practices such as sentence combination and sentence reformulation along with WCF provision as part of their usual pedagogical repertoire. Apart from explicit and targeted instruction, data-driven learning is considered as an effective way to teach morphosyntactic characteristics in L2 academic writing (Appel & Szeib, 2018). Utilizing available online corpora (e.g., British Academic Written English, among others) could be one of the strategies that EAP writing teachers find productive in realizing the aforementioned aim of increasing syntactic complexity. Teachers can choose and prepare concordance lines of a certain type of complex sentences from the corpora to raise students' awareness before practicing them in using these syntactic structures. Specifically, students could be asked to (1) observe the examples in the concordance lines; (2) independently explore and identify the features of these complex sentences and how they are formulated; (3) employ the corpora to extract more examples; and (4) construct syntactically complex sentences. Using these strategies might help L2 learners

gain a balanced development in CAF so that they can prepare themselves for writing academic texts more confidently.

Data availability statement

The datasets generated for this study are available from the second author upon request.

Ethics statement

The studies involving human participants were reviewed and approved by University of Auckland Human Participants Ethics Committee. All participants voluntarily took part in this study and provided their written informed consent to participate in this study before their participation.

Author contributions

Dr. X. Cheng and Prof. L. J. Zhang conceived and designed the study. Cheng collected the data and drafted the manuscript. Zhang revised the subsequent drafts of the manuscript and both authors agreed to the final version so that Zhang got it ready for submission as the corresponding author.

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Appendix A. Supplementary data

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