

Application of data-driven learning in EFL writing instructions for engineering students

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ABSTRACT: The present study is an examination as to whether data-driven learning (DDL) can be adopted effectively in English as a foreign language (EFL) writing instructions to solve students' writing problems. Forty-four Chinese engineering students, with lower English proficiency, participated in the pilot study. The results indicated that DDL in the pre-writing stage could better help engineering students, in terms of generating ideas and expressions, than would traditional activities, by presenting them with paper-based concordance lines. In addition, the application of the direct DDL approach in the revising stage was more helpful in restructuring students' errant knowledge about language use; although it did not show obvious advantages over on-line dictionaries in helping students revise essays. The findings of this study are, thus, interpreted as suggestive that the application of DDL in EFL writing is a feasible and effective practice that can be employed in pre-writing, as well as in the post-writing stage.

INTRODUCTION

English writing is an essential skill for English as a foreign language (EFL) learners, but it is a challenge for most Chinese EFL learners, especially, those majoring in engineering-related fields. Despite years of effort and exercises, the majority of the learners still have problems with their writing. They usually have little idea of what to write or are unable to convey what they want to say and accurately express it in English. In addition, they can rarely identify, by themselves, the errors in their writing and are usually unable to correctly rectify errors marked by teachers. These problems may be attributed mainly to the lack of use of the English language. Thus, language learners are usually advised to read more, so as to increase the lexicogrammatical (continuity between vocabulary and syntax), as well as the cultural, input about the target language. However, most engineering students are so busy with the courses directly relevant to their major, that they have no time to do enough reading for natural, multi-contextual language acquisition and the limited input in class can hardly guarantee high-quality output of a foreign language.

The data-driven learning (DDL) approach, proposed by Johns, can help students increase their ability to process language input efficiently by providing them with *concordance lines* (a line of text taken from a *corpus*, i.e. a collection of language texts organised and stored on a computer), from multiple contexts [1]. By reading concordance lines presented in *key word in context* (KWIC) format, students can get a large amount of information relevant to the specific topic in a limited time, which can help them to formulate their ideas in writing. In addition, introducing DDL activities in the writing process allows students to study the target language through a usage-based learning approach [2]. This type of learning can help learners to obtain and retain lexicogrammatical patterns, which are helpful for them in expressing themselves in writing. Furthermore, it has been shown by many studies that the DDL approach is useful in helping learners identify and correct lexicogrammatical errors. Thus, the present study applies the DDL approach to the teaching of EFL writing for engineering students, so as to help mitigate their problems with the writing.

LITERATURE REVIEW

The term, DDL, derives from computer science and it was Johns who first adopted it to describe the uses of *corpora* in language learning in 1991 [3]. There are multiple interpretations of DDL among researchers. Johns defines it as *...the use in the classroom of computer-generated concordances to get students to explore regularities of patterning in the target language, and the development of activities and exercises based on concordance output* [1]. Smart proposes two particular characteristics to define DDL; first, authentic language data are used as resources of language learning materials; second, learning activities are student-centred and focus on the discovery of language [4]. Although there is no consensus on definition, it can be found that the only aspect crucial in DDL is the use of corpus data, either directly or indirectly. The direct use of corpus data is usually called direct DDL or hands-on DDL, which means learners interact directly with corpora. The indirect use of corpus data is called indirect DDL, hands-off or paper-based DDL,

which means learners interact with the teacher-prepared paper-based concordance lines extracted from corpora. Direct DDL is used more widely by researchers, but the less autonomous, paper-based DDL also has its advantages, especially, for lower-level or novice learners. The author of the present study has adopted both types of DDL.

Some researchers have discussed the theoretical background of DDL. For instance, Chambers and Kelly [5] claim that the pedagogical context of DDL brings together constructivist theories of learning, the communicative approach to language teaching and developments within the area of learner autonomy [6]. Flowerdew discusses various language learning theories underpinning DDL, including the noticing hypothesis, constructivist learning and Vygotskian sociocultural theories [7]. These discussions have laid a solid foundation for the application of DDL in writing. Data-driven learning has been proved to have many advantages, including that of promoting learner autonomy, enhancing language awareness and noticing skills, through an inductive approach. In DDL, learners are actively involved in researching linguistic features. Yan proved that a research-oriented teaching mode is helpful to engineering students in improving their English learning [8]. Some researchers have discussed and described how to apply DDL in L2 (Language 2 - in this case English) writing [9][10]. This provides guidance for empirical studies about the application of DDL in L2 writing.

The past 20 years have seen a rapid increase in empirical studies concerning the application of DDL in L2 or foreign language writing. These studies generally can be classified into two categories. Some studies concentrate on learners' evaluations of the DDL approach in writing, while some others explore the learning outcomes of DDL [11-13]. Among these studies, some adopt DDL for error correction in revising essays [14][15]. Some studies, such as Kennedy, see DDL as an aid to learners' imagination and to their achieving accuracy [16]. Some others are focused on learning particular points in writing, such as linking adverbials [17], lexicogrammatical patterns [2]. Despite the positive findings related to student attitudes toward DDL and outcomes of corpus-based learning, a number of drawbacks are also reported, such as the time-consuming nature of DDL and the difficulty of interpreting the search results. As Tan et al claimed, teachers must play the role of co-ordinators to help engineering students to better use Internet applications [18]. Thus, while adopting DDL studies in writing, teachers' co-ordination or instruction is vital to learners. Other factors, such as types of corpus use, learners' language proficiency and types of task also should be considered.

Despite the increase in DDL studies in recent years, there are still limitations for these previous studies. First, empirical studies focusing on lower-level EFL learners in China are relatively few. In addition, most of the previous studies just focus on the application of DDL in the revising stage, without concern for the effects of DDL on the generation of ideas in a prewriting stage. The focus of the present study is on lower-level EFL learners majoring in engineering; the study also makes use of indirect, as well as direct, DDL in the students' writing process, aiming to examine whether the DDL approach is better than the traditional approach in helping students to generate ideas in the pre-writing stage and to restructure the errant knowledge about language use in the revising stage.

RESEARCH METHODOLOGY

Research questions

The following questions were addressed in this study. First, can DDL activities in the pre-writing stage help engineering students generate ideas and expressions for writing more efficiently than traditional activities? Second, can the DDL approach in the revising stage help engineering students perform better in revision in the given time? Third, is DDL or the traditional approach more effective in restructuring engineering students' errant knowledge about language use?

Participants

In total, 44 Chinese engineering students each with seven years' experience of learning English participated in the experiment. They were from two college English classes, which consisted of engineering students with lower English proficiency scores in College English Test Band 4 (CET 4). Their scores were all below 425 out of a maximum 710. The experimental group was composed of 20 students including 17 males and 3 females, mainly majoring in petroleum engineering and civil engineering. The control group was made up of 24 students including 21 males and 3 females, mainly majoring in material science and engineering. The average scores in the experimental group and control group were 386 and 385, respectively, with a range from 370 to 399. So, they were equivalent in overall language proficiency, and their writing scores in the final examination in the previous term also showed that no significant difference existed between the two groups in their writing competence.

Procedure

The research procedure was as follows:

Training

The teacher first directed some indirect DDL activities for the experimental group, to help them extract and analyse information from the paper-based concordance lines, so as to enrich the content and language of their essays. Then, they

were guided on becoming familiar with corpus consultation using CQPweb (Web-based corpus query processor). For EFL learners without any experience of corpus consultation, CQPweb is better than other corpus query systems in the following two respects: it is easier to use by less-competent learners since, with it, consulting corpora is just like browsing Web pages; also, it is capable of searching corpora and displaying results based on metadata, such as pre-defined genres and language proficiency [19]. Two CQP Web sites were introduced to the subjects of this study. One is CQPweb at Beijing Foreign Studies University (BFSU CQPweb for short), where students can conduct searches directly by entering the user ID and password *test*. The other is BNC Web (CQP edition), where students firstly must register for an account in the Web site.

Students were trained to be able to issue simple, as well as complex, queries by themselves and to generate ideas and expressions by analysing concordance data. For instance, when students were required to write an essay entitled *My view on pirated products*, they could consult the BNC Web by entering the word *pirated* in the pre-writing stage to retrieve the concordance lines, as shown in Figure 1. This can help the students to formulate ideas and expressions. In addition, students were also trained to consult corpora for correcting lexicogrammatical errors on their own in the post-writing stage and to restructure their errant writing. Finally, some direct DDL tasks including error-correction and rewriting were given as compulsory homework. This was intended to make the students skilled at solving writing problems by consulting corpora and analysing concordance output. There was no special training for the control group, who adopted the conventional approach in the pre-writing and revising stages.

has been the computer game Leisure Suit Larry, which was widely	pirated	and became infected. Pirated computer games are the most likely source
v decks. They sell everything from expired penicillin injections,	pirated	cassettes and old clothes to skin lightening creams — ‘As Used
in a particularly flagrant case (in which the Christmas Carol was	pirated	virtually wholesale) proved totally frustrating. HM 2. serjeant.
for a fund-raising gimmick. I hope the RSPCA takes action.	Pirated	music CLAIMS that the public is ‘being exploited’ by pirated
eremony in London. Blitz on sex video nasties A SCHOOL technician	pirated	anything from video nasties to computer games. Martin Ellis, 26
ing University attorney Lee Phillips and suggested that Jones had	pirated	ideas from his sight of the proposal that Fleischmann and Pons had
ready been fired in February with the accusations that Jones had	pirated	the Utah chemists’ work. Peterson began by pointing out how
a women in his hotel bedroom. On Cable TV, in	pirated	tapes in bars, you could watch him watching a buddy screw
from this disk. 8 Don’t let your kids bring home	pirated	games software to load onto your machine. Playgrounds are notorious so
selection of gory romances, full o fine cadence and corpses,	pirated	from the Italian; and it doesn’t take much to make
enjoy such fortune and was engulfed by the visitors’ defence who	pirated	possession to clear. The plaudits — which indubitably would have been
, shouldn’t do that Nearly everything on that hard disk is	pirated	No, no way dad oh I’m sorry Oh well I

Figure 1: Condordance lines for pirated, extracted from the BNC Web (CQP edition).

Pre-writing Tasks in Class

Listing is an unstructured pre-writing task that involves the unmonitored generation of words, phrases and ideas [20]. It can offer students concrete ideas for selecting a meaningful direction for their writing. Thus, students were required to list the key points about the positive and negative aspects of the Internet on the test paper (see Table 1) before writing the essay entitled *My view of the Internet*. To help generate ideas and expressions, the paper-based DDL material of about 1,200 words was delivered to the students in the experimental group. They were asked to finish reading the material and to try to write down as many key points as possible about the Internet within 20 minutes. For the control group, the teacher provided a long text of about 1,200 words relevant to the Internet. Students were also given 20 minutes to list all the possible key points that they could think of after reading the long text. All of the students had to hand in the test paper and the delivered materials to the teacher by the set time. Then, the teacher calculated the average number of key positive and negative points listed by each group. The points that already had been listed on the paper were not included and some expressions failing to convey specific meaning, such as *harmful to students*, *convenient*, were also excluded.

Table 1: Pre-writing task: list as many key points as possible.

Positive sides	Negative sides
Communicating with friends more conveniently	Misleading students’ ethical values
Shopping on-line more easily	Distracting students’ attention
1.	1.
2.	2.
3....	3....

Writing Task in Class and Follow-up Interview after Class

After handing in the written key points and the delivered materials, the students were required to write an essay on the topic within 25 minutes and were not allowed to refer to any relevant resources. To encourage them to produce longer essays, they were told *the longer the essay, the higher the score* and the essay should not be less than 120 words. The teacher collected all of the students’ essays when the time was up. Three students from the experimental group and three from the control group were randomly selected to be interviewed about where their ideas listed in the table or in writing came from.

Revision Test

The revision test consisted of two parts. The first part included 15 sentences with typical lexical or grammatical errors and the second part consisted of five sentences with some simple words or phrases that needed to be replaced. The latter aimed to help students expand their vocabulary by finding alternatives. All of these sentences were selected from the two groups' essays and the teacher underlined the parts that should be revised. One week after the writing task, the teacher required them to revise these 20 sentences within 35 minutes. Students in the experimental group could consult the on-line corpora, BFSU CQP Web and BNC Web (CQP edition), while those in the control group were asked to refer to the on-line dictionary. Since there were no Internet-connected computers for the students, they were told beforehand to bring their cell phone to the classroom and ensure they could be connected to the Internet. All did the revision work using their cell phones. After collecting the students' revision work, the teacher marked them. For the first part, they could get one point if they revised the sentence correctly. As for the second part, they could get 1 point if the alternative is grammatically correct and appropriate, but they got only 0.5, if the alternative was grammatically correct, but inappropriate.

The Delayed Revision Test

Two weeks after the revision test, the participants were required to revise the 20 sentences again without any reference resources and the parts to be revised were not underlined. The participants were supposed to underline the errors and, then, revise them within 25 minutes. Next, the test papers were collected and marked. There was one point for identifying and correcting an error and 0.5 points for identifying, but not correcting an error. The second part involved replacing words, as in the first revision test, and was marked in the same way.

DATA ANALYSIS AND RESULTS

Average Number of Key Points Listed by Each Group

On average, students in the experimental group listed eight positive and six negative key points, while the control group listed six positive and four negative key points. The results show that DDL material could help engineering students better in the pre-writing stage since the two groups were given the equal number of words to read and explore.

Examining the key points listed by the experimental group, it was found that their points had a greater variety of content, such as finding out where celebrities lived, downloading material for free, watching inaugural events and reading numerous books for free. Negative key points from the experimental group included *spreading insults over the Internet*, *disclosing personal information* and *selling unhealthy things*. The follow-up interviews revealed that some of these points were selected directly from the DDL material and some were inspired by information in the material (see Figure 2). The expressions in the concordance lines provided an aid to imagination. For example, the expression *spreading insults over the Internet* reminded students of some other negative effects, such as spreading rumours or viruses over the net, and the idea *selling unhealthy things* occurred to them while reading *acquire the drugs on the Internet*. Some students said they obtained some useful collocations (particular combinations of words) from DDL material when they had an idea, but were unable to convey it in English. Students in the control group found that the texts were so long, they spent most of the time searching for information without carefully considering it. They almost had no time to give full play to their imagination and, thus, most of the key points listed were directly mentioned in the text. In addition, they usually had to finish one or more paragraphs to get just one point, so they listed fewer positive and negative key points. Therefore, DDL activities are better than the traditional activities in helping students to generate ideas and expressions in the pre-writing stage.

his show trial on Aug. 1 , have gone viral on the	Internet	. Mr. Abtahi testified that he no longer believed the country 's
warrant affidavit in the case stated the burglary crew would surf the	Internet	to find where the celebrities lived , survey the locations and devise
Food establishments often go uninspected , a fact highlighted by an	Internet	video showing rats roaming freely across produce in a Honolulu China
tapping on iPhones and gathering information from television sets , the	Internet	, and social networks such as Twitter and Facebook . University staff
prayer . " Many are honoring the prayer day on the	Internet	through tangle.com 's newest Prayer Wall . Over 100,000 prayers have
brilliant ones . Prepschool brings the electrified funk , and The Hood	Internet	flat-out rules . This is a tough one to call , but
nforced by an anonymous electronic culture that spreads insult over the	Internet	, egged on by " shock jocks " who require new shock
Newspapers do the digging upon which magazines , television , and the	Internet	largely rely . As watchdogs , the print media have a big
demands for cleaner , more efficient vehicles . Readers migrated to the	Internet	. But if change came too quickly to anticipate , why did
) . In a world of fake journalism by anyone with an	Internet	connection , the editors rightly chose to speak up on the issue
decades . He has by no means disavowed atonality , as an	Internet	hoax proposed . (It had convinced composers in China , 1
cause the automobile industry to shift to a horizontal structure . The	Internet	is already emerging as a key marketing medium ofr automobiles and is
on all sides reach millions worldwide by television , newspaper and the	Internet	but , perhaps more importantly , many of those so reached have
yourself . Yes , you can easily download G-Code projects from the	Internet	, but the only real way you 're going to become familiar
the place -- as many free versions exist for download on the	Internet	as there are commercial versions that will cost you anywhere from a
links for free and commercial CAD applications . Plan on doing some	Internet	searches to obtain reviews and comments from others who have used a

Figure 2: Concordance lines extracted from the BFSU CQPweb.

Results of the First Revision Test

As shown in Table 2, there were no significant differences between the two groups in the revision test. Hence, DDL did not confer an advantage in helping students to revise sentences, as compared with the traditional activities.

Table 2: Comparisons - the first revision test.

Category	Group	N	M	SD	Mean diff.	<i>t</i>	Sig. (2-tailed)
Error correction (15)	Experimental	20	11.150	1.843	-0.058	-0.112	0.911
	Control	24	11.208	1.615			
Finding alternatives (5)	Experimental	20	3.750	0.618	-0.042	-0.229	0.820
	Control	24	3.792	0.588			
Total (20)	Experimental	20	14.900	2.343	-0.100	-0.148	0.883
	Control	24	15.000	2.137			

The reasons for this result may be as follows. Students in the experimental group were not very skilled in conducting complex queries of corpora because the training period was not long enough. Sometimes they were not certain about the search word; thus, sometimes they had to conduct several searches to obtain what they wanted. If they entered the wrong search word, they may get the wrong results. In addition, they had to deduce a result from a long list of concordance lines. This may be a particular challenge for engineering students with low English proficiency.

By comparison, students in the control group could find what they wanted more easily. For example, they just needed to enter a specific word and, then, they could quickly find out the synonyms and antonyms of this word. This would help them find out alternatives more quickly. The mean score of the revision test in the control group was a little higher than that in the experimental group. Nevertheless, both groups failed to revise some sentences appropriately with the help of on-line corpora or dictionaries, due to the lack of linguistic knowledge or consultative skills.

Results of the Delayed Revision Test

Table 3 shows that there was a significant difference between the two groups in the revision test taken two weeks after the first revision test. Students in the experimental group performed much better in both of the two types of the revision work, including error-correction and finding alternatives.

Table 3: Comparison - the second revision test.

Category	Group	N	M	SD	Mean diff.	<i>t</i>	Sig. (2-tailed)
Error correction (15)	Experimental	20	11.500	2.086	1.042	2.044	0.047*
	Control	24	10.458	2.201			
Finding alternatives (5)	Experimental	20	4.200	0.441	0.867	5.240	0.000**
	Control	24	3.333	0.620			
Total (20)	Experimental	20	15.700	2.086	1.908	2.932	0.005*
	Control	24	13.792	2.201			

*significance level $p < 0.05$, **significance level $p < 0.001$

The results reveal that the application of direct DDL was useful in helping students to restructure the errant knowledge of language use. They spent much time conducting searches in corpora, analysing concordance lines and deducing results and, thus, were more successful in error detection. For example, while revising the sentence *...despite he determined to change the habit, he could hardly resist the temptation of online games while surfing the net*, students in the experimental group could draw the conclusion about the usages of *despite* by analysing the numerous corpus examples. That is, *despite* cannot be followed directly by a complete sentence, but can be followed by *the fact that + sentence*. In this, students acted as researchers exploring the linguistic rules by themselves, which may help them retain the linguistic pattern and restructure their errant knowledge about language use. Thus, while doing the revision work, they could naturally recall the right linguistic patterns that occurred repeatedly in concordance lines.

The noticing hypothesis proposes that noticing is a condition that is necessary for converting input into uptake [21]. The abundant examples presented in KWIC format stimulated learners to notice that analysis of linguistic patterns was important in helping them to convert input into uptake. But, the limited examples in the on-line dictionaries were not sufficient to make learners in the control group notice the right linguistic form and they just received knowledge about language use passively. Such knowledge was not well retained for a long time. Some students referred to the dictionaries to finish the revision test, without careful analysis. Thus, after just two weeks, students in the control group forgot how to correct the same errors without the help of reference materials. Therefore, in the long run, the DDL approach is the more effective way to ensure students' long-term memory of lexical or grammatical patterns. However, it did not show obvious advantages in improving the accuracy rate of the revision work.

CONCLUSIONS

The present study focused on engineering students with lower English proficiency, exploring the effectiveness of DDL in their EFL writing. The application of indirect DDL in the pre-writing stage showed that DDL can help engineering students more efficiently to formulate ideas and accumulate linguistic patterns than do traditional activities, by presenting them with paper-based concordance lines. The application of direct DDL in the revising stage did not show any obvious advantages, over on-line dictionaries, on students' revision work. However, it was more helpful in enabling students to restructure errant knowledge about language use and more beneficial to their long-term memory of the lexical or grammatical patterns. This is vital to their future writing. Therefore, the application of DDL approach in engineering students' writing pedagogy is feasible and effective and can be employed in the pre-writing stage, as well as in the revising stage. It can not only help to solve engineering students' writing problems, but also promotes learner autonomy by engaging them in self-discovery and exploratory leaning. In the meantime, teachers also can benefit since they no longer need to spend as much time on correcting learners' lexicogrammatical errors. However, for students with lower language proficiency, there should be more detailed training about DDL.

The findings of this study show the need to conduct further research as to whether the DDL approach has long-term positive effects on the development of students' free writing. In addition, the results indicated only that the students performed better in the delayed revision test, which was just two weeks after the first revision test. It is still unknown whether learners would be able to use these acquired linguistic forms in their writing after a longer time interval. Therefore, it is also necessary to conduct a longitudinal research to explore the effects of DDL on improving engineering students' use of linguistic patterns in free writing.

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