Analysing Lexical Density, Diversity, and Sophistication in Written and Spoken Telecollaborative Exchanges

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Abstract

In this article, we implement a Corpus Linguistics analysis to compare the differences in lexical density, lexical diversity, and lexical sophistication in the asynchronous written interactions and the synchronous spoken interactions of Japanese and Spanish University students during an English as a lingua franca telecollaborative exchange. A multidimensional analysis of lexical complexity was implemented using three programmes: *Text Analyzer*, TAALED 1.4.1, and TAALES 2.2. Our results show that although the word count in the written production of both cohorts was very similar, the Spanish learners scored higher for all three of the indices, and produced longer and, therefore, more complex sentences. Regarding oral production, the Spanish cohort used nearly four times as many words in the spoken interactions but the results for the lexical indices in the oral mode were not as unequivocal as in the written production. In this respect, the Spanish learners scored higher in lexical diversity and lexical sophistication but lower in lexical density than their Japanese counterparts. From a pedagogical point of view, our results show that lower proficiency learners can engage successfully in oral telecollaborative exchanges with more advanced students.

Keywords: telecollaboration, lexical density, lexical diversity, lexical sophistication

Introduction

Telecollaboration has become an important area of research and has given rise to a wide range of studies. The main themes explored in this field to date are, according to Kern et al. (2004), linguistic interaction, intercultural awareness, identity, and the development of new literacies. One topic of research that has received little attention is the application of lexical indices to the analysis of telecollaborative learner corpora. Such indices can provide teachers with objective assessments of learner proficiency and development (Ure, 1971; Halliday, 1985; Daller, van Hout & Treffers-Daller, 2003). Therefore, they should be the focus of further research (Schenker, 2016). Moreover, as all the studies on lexical indices have either been carried out on written or spoken tests, except Yu (2009), future research needs to include studies that compare both modes. Finally, researchers generally focus on one or two of the most common lexical indices, that is lexical density, lexical diversity and lexical sophistication, but not at all three.

To address these gaps in the research, the authors carried out an analysis of lexical density, lexical diversity, and lexical sophistication in email communications and eleven videoconference interactions between 25 Spanish EFL university students and 25 Japanese EFL university students[1]. Our results show that the Spanish learners, who have a higher level of proficiency in English than their Japanese counterparts, have higher rates in the three indices in their written production but only clearly outperform the Japanese learners in lexical sophistication in their oral production. This is an important finding in the field of telecollaboration through videoconferences as it demonstrates that less proficient learners are capable of achieving relatively high levels regarding lexical indices in spoken interaction.

Telecollaboration

CALL and Computer-Mediated Communication (CMC) are broad terms that have generally been employed to refer to technology-enhanced teaching methods. This is particularly the case when it comes to second language learning. CMC can be used in intracultural exchanges, where participants share the same language (Abrams, 2006), and intercultural CMC is also known as telecollaboration (Nguyen, 2008) where participants come from two different countries or communities. The importance of telecollaboration for language learning has been highlighted in several publications, especially since the beginning of the century (Hewitt & Brett, 2007; Su, Bonk, Magjuka, Liu & Lee, 2005). The most important definition of the term is offered by Belz (2003, p. 68):

> the use of Internet communication tools by internationally dispersed students of language in institutionalized settings in order to promote the development of (a) foreign language (FL) linguistic competence and (b) intercultural competence.

According to Lee (2001, p. 232), this type of interaction provides learners with "many opportunities to use the target language to negotiate both meaning and form in a social context that is crucial for second language acquisition (SLA)". The fundamental aim of telecollaboration is to facilitate collaborative conversations between geographically distant students that promote both the learning of a foreign language and the acquisition of intercultural communicative skills.

A lot of research focuses in telecollaboration on intercultural aspects of communication and the development of Intercultural Communicative Competence (Belz, 2003; O'Dowd, 2003, 2007, Ware & Kramsch, 2005). Other studies analyse participant interactions (Blake, 2000; Blake & Zyzik, 2003; Kötter, 2003; Smith, 2003, 2005; Sotillo, 2000). Less research has been done on language form (Ware & Cañado, 2007) or corrective feedback in telecollaboration (Iwasaki & Oliver, 2003; Lee, 2006; Sotillo, 2005; Ware & O'Dowd, 2008). Even less attention has been paid to the analysis of the acquisition of vocabulary in telecollaboration (Huang, 2018).

Lexical Density, Diversity and Sophistication

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Lexical density, lexical diversity and lexical sophistication (Daller, van Hout & Treffers-Daller, 2003) refer to statistical measures that gauge the lexical richness of texts. These indices may also be employed to assess a student's progress.

The lexical richness or diversity of a text accounts for how many distinct words are used in a text, whereas lexical density provides a measure of the proportion of lexical items (i.e., nouns, verbs, adjectives, and some adverbs) in the text (Johansson, 2008, p. 61) compared to non-content words. In general, texts with lower lexical density are easier to understand than those with higher lexical density. In this respect, spoken texts generally have lower lexical density levels than written texts (Ure, 1971; Halliday, 1985). Nevertheless, as Johansson (2008) points out, a text may have high lexical diversity, i.e., contain many different word types, but exhibit low lexical density, i.e., have a greater number of non-content words than content words.

In contrast, lexical sophistication (Attali & Burstein, 2006; Crossley, Cobb & McNamara, 2013; Crossley & McNamara, 2013; Enright & Quinlan, 2010; Kyle & Crossley, 2016; Laufer & Nation, 1995) refers to the reference-corpus frequency of the words in a text, that is, words that occur less frequently are considered sophisticated, while frequent words are considered less so. More specifically, according to Kyle and Crossley (2015, p. 759) "the construct of lexical sophistication involves both the depth and breadth of lexical knowledge available to speakers, readers and writers (Meara, 1996, 2005; Read, 1998)". All in all, lexical sophistication is a significant indicator of overall writing proficiency (Bestgen, 2017).

Lexical Density, Diversity, and Sophistication in Computer-Mediated Communication (CMC) and in Telecollaboration

Most of the studies devoted to the analysis of lexical density, diversity, and/or sophistication have focused on written L2 production. Indeed, as Gregori-Signes and Clavel-Arroitia (2015, p. 548) argue, "students' written production has always been a central part in the assessment of their linguistic competence" and so "knowledge of lexical richness obtained through reliable quantitative and qualitative measures can provide teachers with a more accurate picture of lexical progress (Webb & Paribakht, 2015) and may help teachers to reflect on their teaching and the suitability of their teaching materials".

More recently, many studies on written L2 production have directed their attention to CMC. For instance, Sauro and Smith (2010) analysed the complexity and lexical diversity of overt and covert output produced by university learners of German during synchronous written CMC in the form of video-enhanced chat scripts. They provide evidence that online planning and monitoring leads to greater linguistic complexity and lexical diversity. For her part, Abrams (2003) investigated the claim that CMC can help learners improve their oral proficiency by analysing the performance of three groups of learners of German, a control group, a synchronous CMC group, and an asynchronous CMC group, in three oral discussion tasks. The dependent variables in her study were the number of idea units and words, lexical richness and diversity, and the syntactic complexity of learner language. She reported an increase in the quantity of learner output by the students in the synchronous CMC group. However, it was found

that the control group outperformed the asynchronous CMC group. Moreover, her analyses of the quality of the output showed no significant differences among the three groups either lexically or syntactically. Likewise, Hirotani (2009) also studied the effects of synchronous and asynchronous CMC on the development of certain linguistic features in the oral production of learners of Japanese. More particularly, she analysed the gain scores in terms of language output, linguistic complexity, accuracy, and cohesive devices. Although she did not find significant differences between the two groups, she did observe a relationship between CMC language use and the development of oral proficiency. Fitze (2006), on the other hand, compared the performance of students participating in face-to-face and written electronic conferences. According to his results, the discourse in the second setting displayed a greater lexical range, and students in these types of conferences produced more discourse. Stockwell's (2010) longitudinal study involved 24 Japanese learners of English who used synchronous CMC (text chat) and asynchronous CMC (discussion forum) to carry out a variety of tasks. He looked into lexical density and spelling, and syntactic complexity and accuracy of CMC discourse. His results suggest that students benefit from using both contexts to develop their language skills and that the use of multiple CMC modes allows learners to develop different aspects of their L2. Finally, Rabab'ah (2013) explored the discourse produced by EFL learners in an asynchronous CMC context, namely a virtual classroom (*NetOP*), with the aim of observing gender differences. The results showed that gender did play a role since the female participants produced more words, a more complex lexical range, and more output discourse functions than males.

To the best of our knowledge, very few studies dealing with lexical indices have concentrated their attention on telecollaboration and none have focused on the difference between oral and written production. Stockwell (2005), for example, investigated 24 non-native speakers of English involved in a five-week email exchange project in two different universities in Japan. He looked into lexical and syntactic development employing type/token ratio and T-unit analyses. He found that evidence of target language development in the NNS-NNS interactions that was similar to the kind found in NS-NNS interactions, although it was significantly less pronounced. Ritchie and Black (2012) examined the use of public Internet discussion forums by third-year students of French to ascertain if this helped them acquire a series of argumentative writing skills. The tool employed was Textalyser and the authors applied four criteria: the number of words, an indicator of fluency; the variety of words, an indicator of lexical density; the number of syllables per word, an indicator of the use of complex words; and the number of words per sentence, an indicator of sentence complexity. Their results showed no significant differences between the first and the last forum regarding these four aspects. The authors argue that the inconclusive results were due to the fact that a semester is not long enough to yield significant results. Finally, Akiyama and Saito (2016) examined a number of speech excerpts by 30 learners of Japanese in six universities in the USA, who had engaged in a semester-long video-based eTandem course with 30 native speakers of Japanese, to discover if they made gains in global language comprehensibility and what linguistic correlates (namely, lexical appropriateness, lexical richness, speech rate and morphological accuracy) contributed to these gains. Their results indicated that the group made significant gains in vocabulary and some in grammar. However, there was significant individual variability regarding improvement in overall comprehensibility. Their findings suggest that telecollaborative interaction may improve learners'

vocabulary and grammar, but that these gains may depend on longer interactional intervention.

The current study

The current study examines and compares lexical density, lexical diversity, and lexical sophistication in the written and spoken production of a group of 25 Spanish ELF university students and 25 Japanese ELF university students involved in a telecollaborative project between the Universitat de València and Kwansei Gakuin University. The exchange, which took place in spring 2020 (see table 1 below for a description of the activities carried out), lasted for six weeks and involved two lecturers in each university.

Table 1
Overall schedule of the telecollaborative project

Stages of the telecollaboration	**Participants**
Pre-task (videoconference in Spain and written instructions in Japan) (week 1)	N=50 (25 Japanese and 25 Spanish)
Main task (asynchronous email exchange (weeks 1, 2 & 3) and synchronous videoconferences in small groups of 4 or 5 students) (weeks 2 & 3)	N=50 (25 Japanese and 25 Spanish; the last videoconference could not be recorded so group 12 was not included: 23 Japanese and 23 Spanish)
Post-task (individual written composition in Spain (weeks 5 & 6) and small group oral presentations in Japan) (week 4)	N=50 (25 Japanese and 25 Spanish)
Post-survey (Spain and Japan) (week 6)	N=49 (25 Japanese and 24 Spanish)

As indicated in Table 1, the post-task and the post-survey involved all the members of the two cohorts in Spain and Japan whereas the pre-task and the main task were carried out by small groups of students. Finally, in the post-task, the lecturers in Spain and Japan chose different types of activities due to the difference in students' competence level and the characteristics of their modules. The students in Spain were enrolled in an English language class in a degree in English Studies and the aim of the module was to achieve a C2 level, whereas the Japanese learners were studying a degree in Business Studies and the course objective was to attain a B2 level. The majority of the Spanish participants were 21 or older, whereas most of the Japanese students were between 18 and 20 years of age.

The Japanese students reported a proficiency level equivalent to a B1 level (CEFR B1 level=TOEIC 550-780), whereas all but two of the Spanish students reported having a C1 to C2 level (CEFR C1 level=TOEIC 945-990).

Finally, as stated above, the students were organized in smaller groups for the two activities that they carried out in the main task phase: the email exchange and the videoconferences. They were distributed into twelve groups, ten groups consisted of two Spanish and two Japanese students, one group had two Spanish and three Japanese students and one group had three Spanish and two Japanese students.

For the current study, we analysed the written production of the 50 participants in the email exchange and their oral production in eleven videoconferences [2]. We hypothesized that the Spanish students would score higher on all the lexical indices due to their higher proficiency.

The tasks

Following Lee (2002), a task cycle was designed that was open-ended and communicative. The main task in the telecollaborative project consisted of two related and consecutive activities. The students were randomly assigned to groups made up of two or three members of each nationality. In the first place, students were asked to contact their counterparts via email and exchange general personal information about themselves. The students were given no specific instructions as to how long the text in the email should be or how many emails should be exchanged.

For the second main-task activity, the students were instructed to agree, by email, on a day and time for a Zoom videoconference meeting. They then carried out a task called "The unknown" (see Appendix). The topic of the task was chosen by the four lecturers as it was present in both syllabi and also because it was thought it might raise awareness about intercultural aspects, which is one of the main research objectives in the VELCOME project. The sessions were also designed to include both synchronous and asynchronous tasks to comply with the project. Students from both cohorts were instructed to carry out a pre-task in class where they were introduced to the topic of superstitions in the United Kingdom and they were asked to compare those superstitions and beliefs with the ones in their country. In the main task, the students were asked to share their results with their counterparts in the other country and compare or contrast any differences and similarities. Specific instructions were given at the beginning of the videoconference sessions on how to use the chat (if necessary) and how to share the pdf document containing the main task. Finally, they were instructed to contact the instructors when the interaction was over.

Procedure for data collection

Data collection was conducted by the participants' regular teachers who are also the researchers involved in this study. A specific email address was created for this purpose and students were asked to include it in all their exchanges. This allowed the researchers to collect and sort all the messages.

The videoconference interactions were recorded and the video excerpts were transcribed by the first author and then verified for accuracy by the second author[3]. The messages written on the chat in the form of text documents were also obtained.

The data collection resulted in approximately 7.336 words in the case of the email texts and nearly 15 hours (14:58:57) of videotaped discussions in the case of the 11 videoconferences.

[2] Due to a technical problem one videoconference was not recorded.

[3] The students at both universities were informed that the emails and the videoconferences were to be used as part of a study and they filled in a consent form.

Aims of the present study

This study employed a quasi-experimental, intact class design and addressed the following research questions:

1. Do the lexical indices reflect the difference in level between the cohorts (B1-B2 vs. C1-C2) and how does this affect their interaction?
2. Is there a difference between the lexical indices for asynchronous written online communication (e-mail exchange) and synchronous oral communication (videoconferences)?

To evaluate the lexical complexity of the students' written and oral output, an analysis of the complete corpus of emails and the transcriptions of the videoconferences was performed using a multidimensional analysis of lexical complexity, that is, looking into three different constructs: lexical density, lexical diversity, and lexical sophistication. These indices were employed here because they have been shown to be useful measures of linguistic complexity in previous research (see Daller, van Hout & Treffers-Daller, 2003; Abrams, 2003; Stockwell, 2005; Fitze, 2006; Sauro & Smith, 2010; Ritchie & Black, 2012; Gregori-Signes & Clavel-Arroitia, 2015; Akiyama & Saito, 2016).

Measures and Tools of Analysis

As mentioned above, the following linguistic indices were employed to analyse the participants' written and oral performance: a) amount of language output, b) lexical density, c) lexical diversity and d) lexical sophistication:

Table 2
Measurements and tools of the present study

Category	**Subcategory**	**Measure**	**Tool**
1. Language output	1.1. Word	The number of words	Microsoft word/ Text Analyzer (Online-Utility.org)
2. Linguistic complexity	2.1. Lexical density	Type of content words/ √token of content words	Text Analyzer (Online-Utility.org)
	2.2. Lexical diversity	Type/√2*token	TAALED: Tool for the Automatic analysis of Lexical Diversity
	2.3. Lexical sophistication	reference-corpus frequency of the words in a text	TAALES: Tool for the Automatic analysis of Lexical Sophistication

To determine the amount of language output produced by the participants, we used both *Microsoft word* and *Text Analyzer* (Online-Utility.org) to obtain the total number of words employed by the Japanese and the Spanish students in their written and oral production respectively. We also obtained results regarding the number of characters (with and without spaces), the number of sentences, and the number of syllables.

The online utility *Text Analyzer* was also used to establish lexical density. Then, we employed the TAALED 1.4.1 programme to look into the lexical diversity of both corpora. This programme has been used successfully to assess models of L2 speaking and writing proficiency (Kyle & Crossley, 2015; Kyle, Crossley & Berger, 2018). A series of indices was obtained (see tables 4, 7, and 10 below) that permitted the analysis of the learners' production in terms of lexical diversity.

Finally, to obtain results regarding lexical sophistication, the TAALES 2.2 programme, which has proven useful when analysing L2 production (Godwin-Jones, 2017, 2018), was employed. A series of indices related to lexical sophistication (see tables 11 and 22 below) allowed us to compare the written and oral production by both groups of students.

Analysis and Results

Lexical density, lexical diversity, and lexical sophistication in the written corpora

This section comprises the analysis and comparison of the Spanish and Japanese written production.

Lexical density in the written corpora

The results obtained through *Text Analyzer* regarding a number of characters, words, sentences, and syllables and the lexical density of both written corpora are shown in Table 3. As we can see, both written corpora are similar in size and that allows for comparison and reliability regarding the results obtained. However, although the size of both corpora is similar, the number of sentences in the Spanish production is considerably lower resulting in longer sentences than those found in the Japanese corpus. Normally, longer sentence length is linked to more elaborate grammar and syntactic complexity. This correlates to a certain extent with the evidence that the lexical density index is higher in Spanish production.

Table 3
Results for lexical density in the written corpus

	Japanese production	**Spanish production**	**Percentage difference**
Number of characters (including spaces)	21,109	20,650	-2.19%
Number of characters (without spaces)	15,872	15,899	+0.16%
Number of words	3,822	3,747	-1.98%
Number of sentences	460	299	-42.42%
Number of syllables	5,822	5,632	-3.31%
Lexical density	21.376%	25.273%	+16.70%

Lexical diversity in the written corpora

Regarding lexical diversity, the results are summarized in Table 4. In most of the indices, the Spanish corpus has higher levels than the Japanese corpus. These include tokens, types, lexical density types, simple TTR AW (the simple type-token ratio in all the words), simple TTR CW (the simple type-token ratio in content words), simple TTR FW (the simple type-token ratio in function words), root TTR AW (a mathematical transformation of the TTR (Guiraud, 1960) that indicates the root type-token ratio in all the words), root TTR CW (the same index in content words) and root TTR FW (the same index in function words). The only index where the Japanese corpus is slightly higher is in the case of lexical density tokens (marked in red). A possible explanation is that, as Johansson (2008: 61-61) explains, a text may have low lexical diversity because phrases are repeated but high lexical density because the words that are repeated are content words.

Table 4
Results for lexical diversity in the written corpora

	Japanese production	**Spanish production**	**Percentage difference**
Basic ntokens:	3,122	3,283	+5.02%
Basic ntypes:	508	636	+22.37%
Basic ncontent tokens:	1,324	1,325	+0.07%
Basic ncontent types:	390	499	+24.52%
Basic nfunction tokens:	1,798	1,958	+8.51%
Basic nfunction types:	118	137	+14.90%
Lexical density types:	0.767	0.784	+2.19%
Lexical density tokens:	0.424	0.403	-5.07%
Simple TTR AW:	0.162	0.193	+17.4%
Simple TTR CW:	0.294	0.376	+24.47%
Simple TTR FW:	0.065	0.069	+5.97%
Root TTR AW:	9.091	11.099	+19.89%
Root TTR CW:	10.718	13.708	+24.48%
Root TTR FW:	2.782	3.096	+10.75%

Lexical sophistication in the written corpora

Table 5 shows the types of indices employed to gauge the lexical sophistication in the production of the two cohorts. The programme allows for a choice of different sub-corpora in the COCA corpus when analysing the frequency and range of words and it was decided to compare our results with those belonging to the academic sub-corpus.

According to Kyle & Crossley (2015, pp. 766-767), TAALES offers a series of indices based on several frequency logarithms, namely, Kucera-Francis (KF) Logarithm, Thorndike-Lorge (TL) Logarithm, and Brown Logarithm. These can be combined in ways that show the frequency (Freq), the register range (Ncats), and the word range (Nsamp) of the vocabulary employed by the students when compared with well-known corpora. Frequency scores are calculated by dividing the sum of the frequency scores for the tokens in a text by the number of tokens in the text that received a frequency score. To do so, frequency lists are employed and scores for all words (AW), content words

(CW) and function words (FW) are calculated. In addition to this, as stated above, logarithmic transformations for each of those indices to control the Zipfian effects, which are common in word frequency lists, are provided. The following frequency lists are used:

- Thorndike-Lorge. The TL written frequency counts are based on Lorge's 4.5 million-word corpus of popular magazine articles (Thorndike & Lorge, 1944).
- Kucera-Francis written frequency. KF written frequencies are based on the Brown corpus (Kucera & Francis, 1967), which consists of approximately 1 million words of texts published in the United States in 1961.
- Brown verbal frequency. Brown verbal frequencies (Brown, 1984) are based on the 1 -million word London-Lund Corpus of English Conversation (Svartvik & Quirk, 1980).
- British National Corpus. The BNC, version 3 (BNC XML ed.) (BNC Consortium, 2007) comprises 100 million words of written (90 million words) and spoken (10 million words) English from Great Britain.

The Spanish cohort scores higher in 19 of the 24 indices. The Japanese cohort only achieves higher indices in the TL Frequency of content words, the Brown Frequency of content words, and the Brown Frequency Logarithm of content words (marked in red):

Table 5
Results for lexical sophistication in the written corpora

	Japanese production	**Spanish production**	**Percentage difference**
Word Count	3,630	3,706	+2.07%
KF_Freq_AW	5427.776	7058.222	+26.11%
KF_Freq_AW_Log	2.928	3.019	+3.06%
KF_Ncats_AW	13.887	13.977	+0.64%
KF_Nsamp_AW	272.902	290.478	+6.23%
TL_Freq_AW	26550.127	32569.556	+20.36%
TL_Freq_AW_Log	3.751	3.803	+1.37%
Brown_Freq_AW	1539.837	1674.243	+8.36%
Brown_Freq_AW_Log	2.452	2.481	+1.17%
KF_Freq_CW	1176.031	1130.193	-3.97%
KF_Freq_CW_Log	2.390	2.397	+0.29%
KF_Ncats_CW	13.212	13.234	+0.16%
KF_Nsamp_CW	178.564	185.090	+3.58%
TL_Freq_CW	6550.787	6157.872	-6.18%
TL_Freq_CW_Log	3.282	3.257	-0.76%
Brown_Freq_CW	359.825	343.130	-4.74%
Brown_Freq_CW_Log	1.869	1.834	-1.89%
KF_Freq_FW	12015.766	14747.009	+20.41%
KF_Freq_FW_Log	3.763	3.825	+1.63%
KF_Ncats_FW	14.934	14.941	+0.04%
KF_Nsamp_FW	419.078	427.169	+1.91%
BNC_Written_Freq_AW	15.214	16.223	+6.41%

BNC_Written_Freq_AW_Log	0.988	0.980	-0.81%
BNC_Written_Range_AW	97.380	95.064	-2.40%

Lexical density, lexical diversity and lexical sophistication in the oral production

In this section, we analyse and compare the oral production of the Spanish and Japanese cohorts.

Lexical density in the oral corpora

The general results for lexical density obtained with *Text Analyzer* are shown in table 6 below. The number of words in the Spanish corpus is considerably higher than in the Japanese corpus. Moreover, if we divide the number of words by the number of sentences in each corpus, we will see that the sentences produced by the Spanish learners contain an average of 10,46 words compared with the 5,5 words in the Japanese corpus. This higher mean sentence length in the Spanish corpus is an index of their complexity. The most striking result in table 6 is the fact that the lexical density of the Japanese oral production is higher than that of their Spanish counterparts (marked in red). The fact that the number of words produced by the Spanish cohort is almost four times greater than the Japanese cohort (12489 vs. 43441) might have affected this result.

Table 6
Results for lexical density in the oral corpus

	Japanese production	**Spanish production**	**Percentage difference**
Number of characters (including spaces)	69,840	228,542	+106.37%
Number of characters (without spaces)	48,163	167,903	+110.83%
Number of words	12,489	43,441	+110.68%
Number of sentences	2,247	4,153	+59.56%
Number of syllables	17,775	60,832	+109.55%
Lexical density	51.78%	41.76%	-21.42%

Lexical diversity in the oral corpora

Regarding the results concerning lexical diversity (table 7), what stands out most is that the Spanish learners show lower indices than their Japanese counterparts regarding lexical density tokens and others such as the simple TTR AW, simple TTR CW, simple TTR FW, root TTR AW and root TTR FW (marked in red). These results are not easy to explain given that the proficiency level of the Spanish students is higher than that of the Japanese cohorts. There are two possible reasons. The first is the nature of the frequently repeated words (Johansson, 2008) as seen in the written corpora. The second is that, as Veermer (2000: 79) points out, TTR measurements calculate lexical diversity without taking into account the presence of low-frequency words that are normally acquired at greater levels of proficiency –such as that attained by the Spanish cohort.

Table 7
Results for lexical diversity in the oral corpus

	Japanese production	**Spanish production**	**Percentage difference**
Basic ntokens	10,254	41,158	+120.22%
Basic ntypes	1,033	1,907	+59.45%
Basic ncontent tokens	4,246	14,161	+107.73%
Basic ncontent types	856	1,645	+63.09%
Basic nfunction tokens	6,008	26,997	+127.18%
Basic nfunction types	177	262	+38.72%
Lexical density types	0.828	0.862	+4.02%
Lexical density tokens	0.414	0.344	-18.46%
Simple TTR AW	0.100	0.046	-73.97%
Simple TTR CW	0.201	0.116	-53.62%
Simple TTR FW	0.029	0.009	-105.26%
Root TTR AW	10.201	9.399	-8.18%
Root TTR CW	13.136	13.823	+5.09%
Root TTR FW	2.283	1.594	-35.54%

Lexical sophistication in the oral corpora

In the case of lexical sophistication, the Spanish students outperformed their Japanese counterparts in 21 of the 24 all indices regarding oral production. The Japanese learners only had higher indices in the Brown Frequency index for content words, the Kucera-Francis mean range score, the BNC written frequency log for all words, and the BNC written range for all words (marked in red).

Table 8.
Results for lexical sophistication in the oral corpus

	Japanese oral production	**Spanish oral production**	**Percentage difference**
Word Count	12,489	43,441	+110.68%
KF_Freq_AW	4527.869	7082.872	+44.01%
KF_Freq_AW_Log	2.758	3.104	+11.80%
KF_Ncats_AW	13.296	14.126	+6.05%
KF_Nsamp_AW	250.208	313.414	+22.42%
TL_Freq_AW	21354.504	32193.757	+40.48%
TL_Freq_AW_Log	3.580	3.878	+7.99%
Brown_Freq_AW	1536.743	1832.364	+17.54%
Brown_Freq_AW_Log	2.474	2.670	+7.62%
KF_Freq_CW	931.185	1135.280	+19.75%
KF_Freq_CW_Log	2.232	2.455	+9.51%
KF_Ncats_CW	12.427	13.317	+6.91%
KF_Nsamp_CW	160.759	205.688	+24.52%
TL_Freq_CW	5122.079	6375.453	+21.80%
TL_Freq_CW_Log	3.155	3.311	+4.82%

Brown_Freq_CW	516.897	482.220	-6.94%
Brown_Freq_CW_Log	2.002	2.054	+2.56%
KF_Freq_FW	11524.976	13361.029	+14.75%
KF_Freq_FW_Log	3.780	3.789	+0.23%
KF_Ncats_FW	14.987	14.981	-0.04%
KF_Nsamp_FW	424.225	427.129	+0.68%
BNC_Written_Freq_AW	15.477	15.782	+1.95%
BNC_Written_Freq_AW_Log	1.027	1.014	-1.27%
BNC_Written_Range_AW	98.030	97.736	-0.30%

Comparison of lexical density, lexical diversity and lexical sophistication in the students' written and oral production

In this section we compare the results in both modes to answer the second research question, that is, "is there a difference between the lexical indices for asynchronous written online communication (e-mail exchange) and synchronous oral communication (videoconferences)?".

Lexical density in the written and spoken corpora

As seen in the last line of Table 9 below, in general, lexical density is a good deal higher in both the Japanese and Spanish learners' oral production than in their written output (marked in red). Results in the literature on lexical density (Ure, 1971; Halliday, 1985) have shown that lexical density is generally higher in written rather than oral production. However, Ure (1971: 445), who first coined the term, also points out that there is a certain degree of overlap between the written and spoken mode and some written texts actually have lower lexical density than written texts. Ure (1971) argues that the level of preparation that goes into either written or spoken texts has an impact on lexical density. O'Loughlin (1995) also highlights the importance of task types with regard to lexical density. With respect to the planning required for the written and oral tasks, the students were given straightforward instructions on what to do for the former whereas the preparation for the latter involved a whole lesson given by the instructors and autonomous work on the part of the students, that is, they had to learn specific vocabulary and prepare a series of questions on the topic for the exchange with their peers.

Table 9
Results for lexical density in both the written and the oral corpora

	Japanese written production	**Spanish written production**	**Japanese oral production**	**Spanish oral production**
Nº of characters (including spaces)	21,109	20,650	69,840	22,8542
Nº of characters	15,872	15,899	48,163	167,903

(without spaces)				
Nº of words	3,822	3,747	12,489	43,441
Nº of sentences	460	299	2,247	4,153
Nº of syllables	5,822	5,632	17,775	60,832
Lexical density	21.376%	25.273%	51.78%	41.76%

Lexical diversity in the written and spoken corpora

Unlike the lexical density result in table 9, the results for lexical diversity indicate that most of the important indices are lower (marked in blue) in the oral production of both cohorts than in the written production. As the task involved the peers asking each other questions, a smaller variety of words may have been used.

Table 10
Results for lexical diversity in both the written and the oral corpora

	Japanese written production	**Spanish written production**	**Japanese oral production**	**Spanish oral production**
Basic ntokens:	3,122	3,283	10,254	41,158
Basic ntypes:	508	636	1,033	1,907
Basic ncontent tokens:	1,324	1,325	4,246	14,161
Basic ncontent types:	390	499	856	1,645
Basic nfunction tokens:	1,798	1,958	6,008	26,997
Basic nfunction types:	118	137	177	262
Lexical density types:	0.767	0.784	0.828	0.862
Lexical density tokens:	0.424	0.403	0.414	0.344
Simple TTR AW:	0.162	0.193	0.100	0.046
Simple TTR CW:	0.294	0.376	0.201	0.116
Simple TTR FW:	0.065	0.069	0.029	0.009
Root TTR AW:	9.091	11.099	10.201	9.399
Root TTR CW:	10.718	13.708	13.136	13.823
Root TTR FW:	2.782	3.096	2.283	1.594

Lexical sophistication in the written and spoken corpora

There is a stark difference between the written and oral production between the two cohorts regarding lexical sophistication. Most of the indices (higher indices marked in red) are higher for the Spanish cohort for the oral corpora while under half of the indices for Japanese oral production are lower than the written production. Unlike lexical diversity which is higher when there is a great variety of distinct words, lexical sophistication involves the use of low-frequency words –the kind used to talk about

superstitions, for example. This may explain the higher indices for the oral versus written production for the Spanish cohort.

Table 11
Results for lexical sophistication in both the written and the oral corpora

	Japanese written production	**Spanish written production**	**Japanese oral production**	**Spanish oral production**
Word Count	3,630	3,706	12,489	43,441
KF_Freq_AW	5427.776	7058.222	4527.869	7082.872
KF_Freq_AW_Log	2.928	3.019	2.758	3.104
KF_Ncats_AW	13.887	13.977	13.296	14.126
KF_Nsamp_AW	272.902	290.478	250.208	313.414
TL_Freq_AW	26550.127	32569.556	21354.504	32193.757
TL_Freq_AW_Log	3.751	3.803	3.580	3.878
Brown_Freq_AW	1539.837	1674.243	1536.743	1832.364
Brown_Freq_AW_Log	2.452	2.481	2.474	2.670
KF_Freq_CW	1176.031	1130.193	931.185	1135.280
KF_Freq_CW_Log	2.390	2.397	2.232	2.455
KF_Ncats_CW	13.212	13.234	12.427	13.317
KF_Nsamp_CW	178.564	185.090	160.759	205.688
TL_Freq_CW	6550.787	6157.872	5122.079	6375.453
TL_Freq_CW_Log	3.282	3.257	3.155	3.311
Brown_Freq_CW	359.825	343.130	516.897	482.220
Brown_Freq_CW_Log	1.869	1.834	2.002	2.054
KF_Freq_FW	12015.766	14747.009	11524.976	13361.029
KF_Freq_FW_Log	3.763	3.825	3.780	3.789
KF_Ncats_FW	14.934	14.941	14.987	14.981
KF_Nsamp_FW	419.078	427.169	424.225	427.129
BNC_Written_Freq_AW	15.214	16.223	15.477	15.782
BNC_Written_Freq_AW_Log	0.988	0.980	1.027	1.014
BNC_Written_Range_AW	97.380	95.064	98.030	97.736

Discussion

One of the first conclusions that can be drawn from the results is the difference in the quantity of language produced in the two settings. In the written production, the numbers are quite similar whereas, in the case of the oral context, the Spanish participants produced a much greater number of words. This may be because asynchronous written tasks give the participants much more time to express what they want to say without any pressure from other participants (O'Dowd, 2006, p.106). In contrast, lack of proficiency in a spoken context, where there is very little time to think, lead to frequent silences on the part of the Japanese cohort (for similar results see Akiyama, 2017, p.192) and what could be called hyperexplanation from the more proficient partner, borne out by the fact that the Spanish students produce almost four times as many words as their Japanese

counterparts. A look at both sets of results shows that the sentences are longer in the case of the Spanish participants in both contexts: an average of 10.4 words per sentence in the oral context and 9.7 in the written context for the Spanish learners and 5.5 words per sentence in the oral context and 7.06 in the written context for the Japanese students.

In what follows, we will detail our answers to the two research questions, that is,

1. Do the lexical indices reflect the difference in level between the cohorts (B1-B2 vs. C1-C2) and how does this affect their interaction?
2. Is there a difference between the lexical indices for asynchronous written online communication (e-mail exchange) and synchronous oral communication (videoconferences)?

We can state that, as hypothesized in question one, in most cases, because of the higher linguistic competence of the Spanish students, their lexical density, lexical diversity, and lexical sophistication levels are, generally, all higher. Despite this difference between the cohorts, the flow of the interaction was not affected adversely since communication breakdowns and other related problems were not observed in the exchanges. In both asynchronous written communication and synchronous oral communication, all the students seemed to interact with their peers effectively and the tasks were carried out satisfactorily.

Specifically, regarding the written production of both cohorts, the Spanish cohort's higher proficiency is borne out by the results for the three lexical indices. In this respect, their lexical density count is higher, and lexical diversity levels are also higher in 13 of 14 indices and in 19 of the 24 indices in the results for lexical sophistication. The results for the two cohorts' oral production are more complex. The lexical density of the Japanese learners was higher. In this respect, Failasofah & Dayij Alkhrisheh (2018: 106) state that sometimes learners with a lower level of proficiency can score higher in lexical indices than students with higher proficiency levels. In contrast, in the case of lexical diversity, the Spanish cohort scored higher rates in eight of the fourteen indices. The six indices where the Japanese cohort gets higher results may be due to them repeating content words more often than the Spanish cohort (Johansson, 2008) and the fact that TTR scores (5 of the indices) do not account for the presence or absence of words that are acquired later by learners (Veermer, 2000). Finally, the Spanish learners performed better in 21 of the 24 indices of lexical sophistication probably due to them using low-frequency words to talk about superstitions.

Regarding research question number 2, our results contradict most research into lexical density as it is higher for both cohorts with regard to oral production. We believe that this is due to the nature of the tasks and the preparation needed to carry them out (Ure, 1971). In this respect, the written task was a straightforward message in which students introduced each other and arranged to meet whereas the oral task involved learning specific vocabulary and idioms on superstitions and followed a class given by the learners' instructors on this topic. Regarding lexical diversity, both cohorts scored lower for the oral rather than written task. This might be because the students had to repeat structures when asking and answering questions. As stated above lexical diversity does not take into account if there is a high presence of low-frequency, late acquired words, which are found in advanced learners' vocabulary. In any case, this finding is interesting and worth analysing in future research.

The results for lexical sophistication show that the Spanish cohort scores higher in their oral production than in the written production. Although there are no comparative studies of lexical sophistication in written and spoken texts, we expected the written texts to have higher levels of lexical sophistication. However, seventeen of the twenty-three indices are higher in the oral production of the Spanish students. This might reflect the use of more unusual words –connected to superstition– in the Spanish students' oral production. In contrast, the Japanese cohort scored lower in the oral task in spite of the need to use specific, low-frequency vocabulary.

Apart from ours, there is only one study, (Yu, 2009), that compares written and spoken production. However, the corpus used is quite different from ours as it consists of written and spoken tests. Moreover, although Yu's (2009) study finds a positive correlation between both modes, that is, if a cohort scores high in the written mode, good results will be be produced in the oral mode. However, as we have seen, our results are more mixed showing, for example, that the Spanish cohort score better results for lexical density in oral production but do worse regarding lexical diversity in the same mode.

Conclusions and Pedagogical Implications

In view of our results, we would argue that lexical indices can shed light on the performance of learners carrying out written and spoken tasks. They can also serve to diagnose a learner's general linguistic competence at a given point in time regarding lexis. According to Yu, (2009: 236) lexical diversity is an especially useful indicator of general language proficiency. Our results for lexical diversity and lexical sophistication, for example, seem to indicate that the Japanese students belong to a B2 level. The results for oral communication for the Japanese cohort seem to back up Yu's (2009: 236) claim that different topics can help improve lexical diversity. Our study seems to prove, given the Japanese cohort's results in the oral telecollaborative task, that learners with lower proficiency can increase their lexical diversity. Moreover, the lower-proficiency Japanese learners are able to hold their own, which supports González-Lloret's (2016: 307) claim that such learners are able to engage in elaborate interactions. This is an important result as telecollaborative exchanges often occur between cohorts of different proficiency levels. However, we must add that some of the Spanish participants in the post-task and post-survey commented that they felt almost like teachers as they had to elicit answers from their Japanese peers, explain the meaning of words, ask for comprehension checks, and offer feedback, etc.

Regarding the limitations of the research presented here, it mainly focuses on written and oral production at a given point in time. We concur with Ritchie and Black (2012), Akiyama and Saito (2016), and Hirotani (2009) that there is a need for longer interactional interventions as these would offer more insights into the development of lexical competence over time. Another limitation is that we only analyse the two cohorts' performance in one written task and one oral task. O'Loughlin (1995) suggests that different task types or topics can affect performance and therefore lexical indices. It would, therefore, be useful to find how the same individuals would perform doing different task types and topics.

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Appendix: The task

The Unknown

What do you think about the following? How widespread is the belief in these phenomena in your society?

Ghosts

Reincarnation

Déjà vu

Telepathy

Psychics

Hypnosis?

Predicting the future

UFOs

The Unknown

Do you believe in *ghosts*? Do you think peoeple's spirits can live on in some form?	
What do you feel about **reincarnation**? Do you believe in it?	
Have you experienced the feeling of *déjà vu*? How do you explain this strange feeling?	
Telepathy is communication directly from one mind to another. Is it possible to communicate this way?	
Sometimes, the police use *psychics* to help them. What do you think about this?	
Do you believe in *hypnosis*? What happens when a person is hypnotized?	
Can people *predict the future*? Have you ever had a feeling about the future that turned out to be true?	
What is your opinion about *fortune tellers*?	
What do you think about *UFO* sightings?