Modular Approaches in eLearning Design: Computer-Assisted Pronunciation Training Design and Evaluation (模塊化電子教學設計：電腦輔助發音訓練設計與評測)

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Abstract: Pronunciation is one of the more difficult aspects in teaching and learning Chinese and Cantonese as a second language. This paper suggests a modular approach in designing pronunciation training through eLearning. This paper discusses two models in computer-assisted pronunciation training (CAPT) modules, namely the accuracy model and the fluency mode. This paper also presents Pre-test-Intervention-Post-test experimental research, which is intended to evaluate these modules. This research uses experimental research to examine how the configurations of linguistic knowledge teaching and language skills practice affect the effectiveness of learning Cantonese as a second language.

摘要： 掌握正確發音一直是華語二語和粵語二語教學的教學重點。本文建議以電子教學模塊概念設計電腦輔助發音訓練模型。本次研究用了"前測-介入-後測實驗"去評估兩套電腦輔助發音訓練模型：發音準確度模型和流暢度模型的可用性。並且查考語言知識教學和語言技能練習的排列和佈局對粵語二語學習的影響。

Keywords: Modular approach, teaching Cantonese as a second language, computer-assisted pronunciation training (CAPT), eLearning design and evaluation

關鍵詞： 模塊概念設計，粵語二語學習，電腦輔助發音訓練，電子教學設計和評估

1. Introduction

Training for pronunciation accuracy is an important area in foreign language teaching (Chen, 1983; Macdonald, Yule, & Powers, 1994; He, 2011; Gilakjani & Sabouri, 2016; Huensch & Thompson, 2017). Pronunciation accuracy is also one of the targets set by Chinese as a second language (CSL) teachers and learners (Hsiao & Shicock, 2006;

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Wu & Miller, 2007) and for learners learning Cantonese as a second language (Ball, 1883). It has been pointed out that Cantonese pronunciation (Ball, 1883; Lee 2005) is one of the most difficult areas when learning the language. Research on studying methods to train pronunciation in the classroom (Tominaga, 2009; Foote, Trofimovich, Collins, & Urzúa, 2013) and by using educational technologies (Mushangwe, 2014; Hanna & Gao, 2016) has been conducted already. In literature on second language teaching and learning, many researchers believe that there is a multi-componential aspect to the construct of L2 proficiency and L2 performance. The principal dimensions can be captured by the notions of "complexity," "accuracy," and "fluency" (Skehan, 1998; Ellis, 2003, 2008; Housen & Kuiken, 2009; Larsen-Freeman 2009). These three notions, "complexity," "accuracy," and "fluency" became major research variables in applied linguistic research starting from the 1980s, and were also used as performance descriptors in L2 assessment as well as indicators for progress in language learning.

This project proposes two models in computer-assisted pronunciation training (CAPT) and uses experimental research to examine how the configuration of linguistic knowledge teaching and language skills practice in CAPT module designs affect the effectiveness of learning Cantonese as a second language. The eLearning design under investigation consists of two models, namely the "accuracy model" and the "fluency model." In my research, 12 non-Cantonese speaking international university undergraduate students were recruited to participate in a "Pre-test-Intervention-Post-test" experiment to investigate the effectiveness of the eLearning model designs. The "Pre-test-Intervention-Post-test" experiment focused on pronunciation accuracy and fluency. Preliminary findings provide evidence to support web-based computer-assisted pronunciation training (CAPT) and the hypothesis that CAPT should include both audio-visual feedback and annotated PowerPoint videos in order to enhance pronunciation accuracy.

2. Literature Review: Research on eLearning Design

Studies confirming that eLearning has an important role in higher education and has positive effects on students' motivation have been published (Kaewkiriya, 2013; Harandi, 2015). Researchers further investigated the content presented in eLearning (Boyle, 2003; Kanuka, 2006) or how content was presented (Alsadhan, Alhomod, & Shafi, 2014). Kanuka (2006) points out that the design of eLearning needs to connect content and pedagogy. Steen (2008) suggests that there is no "one-size-fits-all" eLearning software and that eLearning designers should take into account learning and/or training theories and should understand the knowledge or skills to be taught in order to achieve effective eLearning results. Some researchers suggest that eLearning design should be grounded on a core principle of learning theories (Sims, 2006; Pange & Pange, 2011), and should take into account learners' learning styles (Cooze and Barbour, 2007; Cercone, 2008; Sangsawang, 2015). eLearning practitioners have tried to build different eLearning models based on different theories and different learning needs (Koohang et al., 2009; Alonso et al., 2005). The similarities among these models were learner-centered and theoretically based.

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3. eLearning Mode: Design and Presentation

The computer-assisted pronunciation training (CAPT) designed in this study consists of two models, namely the "accuracy model" and the "fluency model." The concept of this dual-model design is based on the dichotomy of "accuracy and fluency" used by Brumfit (1984), who distinguished between "accuracy-oriented activities," which focus on linguistic forms, and "fluency-oriented activities," which foster spontaneous oral L2 production. "Accuracy-oriented activities," such as pronunciation drills and vocabulary drills, were used in the teaching of a new target item. "Fluency-oriented activities," such as extensive reading and question-and-answer (Q/A) exercises, are aimed at developing students' spontaneous application of what they have already learned. Table 1 below shows the purposes, content, and activities based on accuracy and fluency.

Table 1. The purposes and content of accuracy activities and fluency activities (adopted from Brumfit (1984)

Accuracy Activities	Fluency Activities
Purpose: the primary purpose is to help students achieve accurate perception and production of language forms.	**Purpose**: the primary purpose is to help students develop language fluency in using the language in spontaneous communication.
Content: the texts are usually composed of discrete items, such as sentences or words; the target items are usually practiced out of context.	**Content**: the texts are usually discursive length, such as conversations and stories; dialogues are spoken and articles and/or written stories are read; an effort is made to use authentic material from real life.
Activities: students' attention is focused on a particular target item; their output is usually predictable; student performance is assessed on how few language mistakes are made; students' errors are corrected; tasks do not usually simulate real-life situations.	**Activities**: students' attention is focused on communicating information and expressing ideas; their output may not always be predictable; their performance is assessed on how well ideas are expressed or understood; students' errors are not corrected when they interfere with communication; tasks often simulate real-life situations.

Other research has been undertaken which examines effective user interface design for eLearning software (Faghih, Azadehfar, & Katebi, 2013). Apart from addressing some of the issues discussed in previous studies, the eLearning interface design of the two models in this study has taken into account three major aspects discussed in the literature on eLearning design in foreign language teaching. The 3 aspects are: 1) Presentation of the speaker's face; 2) presentation of waveforms; 3) teaching of spectrographic analysis.

1) Presentation of the speaker's face

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Hardison's (2003) study presents experimental research on the effect of the presentation of the speaker's (teacher's) face in eLearning design for pronunciation training. He studied two experimental groups. The first group used an eLearning model with audio-visual presentation in which the speaker's (teacher's) face appeared visually, and the second group used an eLearning model with audio-only presentation. Hardison concluded that the audio-visual group showing the speaker's face outperformed the audio-only group when training Japanese and Korean learners to distinguish /r/ and /l/. Hardison (2006) further confirmed that students using eLearning models with faces familiar to the subjects enhanced their comprehension.

2) Presentation of waveforms

Okuno (2013) suggests that waveform display helps learners acquire Japanese geminates. Okuno and Hardison (2016) further elaborate that waveform display in eLearning pronunciation training models is useful to perceive and produce vowels with durational difference.

3) Teaching of spectrographic analysis

Researchers (Olson, 2014; Quntana-Lara, 2014) conclude that teaching students to analyze the spectrograms and to compare their own pronunciation with native speaker's pronunciation led to an improvement on consonant and vowel production. Olson's (2014) study focuses on L1 English speakers acquiring Spanish intervocalic stops. The results show that teaching students to analyze spectrographs in eLearning design improved students' consonant production. Quintana-Lara (2014) shows positive effects of spectrographic analysis toward the acquisition of Spanish pre-service English teachers' vowel production.

Based on studies of the presentation of a speaker's face, the presentation of waveforms, and the teaching of spectrographic analysis, the user interface for the accuracy model and fluency model were developed. Figure 1 shows the design and presentation of the "accuracy model" and Figure 2 shows the presentation of the "fluency model" used in this study.

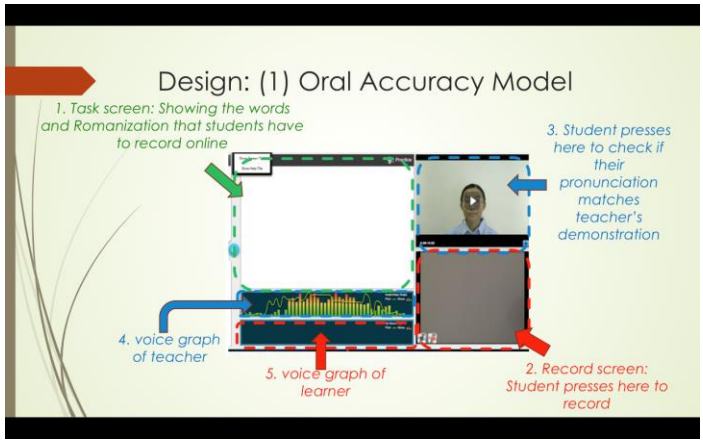

Figure 1 Design and presentation of the "accuracy model"

The design of the "accuracy model" contains five major parts, as shown in Figure 1 above. The first component (upper-left corner on the computer screen) contains a task screen, which shows the words (with Chinese characters and Cantonese romanization) that students are required to read out loud and record online. The second component (lower-right corner) shows a recording screen. The third component (upper-right corner) shows the teachers' face while pronouncing the word on the task screen. Students can watch the teachers' demonstration before recording themselves. The fourth and fifth components (lower-left corner) contain the voice graph of the teacher and the voice graph of the student. Students can compare their pronunciation with the teachers.' Students were trained to read voice graphs (spectrographs) when doing the tasks in this "accuracy model."

Figure 2 below shows the design and presentation of the "fluency model." The "fluency model" took the form of a simulation exercise. The first component (upper-left corner on the computer screen) shows visual prompts while the second component (upper-right corner) shows the face of the teacher who was asking questions. The third component (lower-left corner) shows the teacher's voice graph and the student's voice graph. The voice graphs indicate turn-taking timing and the flow of the conversations required by the task. The student's face is shown in the fourth component (lower-right corner) and the student's responses were recorded.

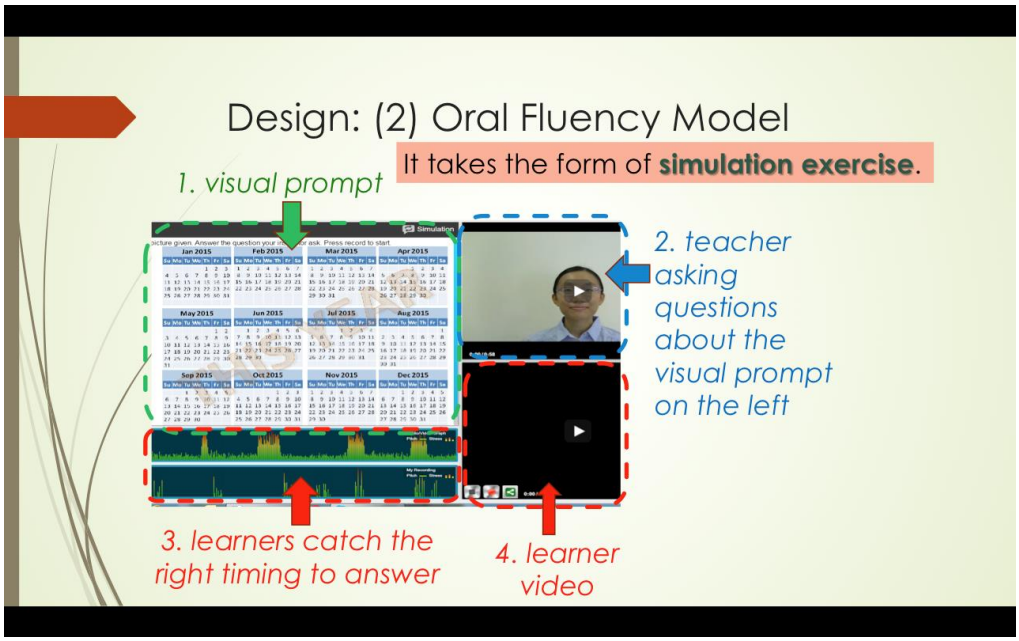

Figure 2 Design and presentation of the "fluency model"

4. Research Questions and Methodology

This research uses a single group design with repeated measurements. The research design uses a one-group pre-test—post-test design. The pre-test—post-test design was adopted for evaluating the impact of computer-assisted pronunciation training (CAPT) used when students were learning Cantonese as a second language. In the

pre-test, students were given 25 Cantonese two-syllable words and 10 sentences to read. The 25 Cantonese words were terms appearing in beginners' textbooks. For example, "附近 fuhgahn (nearby)," or "瞓覺 fangaau (to sleep)." The 10 sentences including, "中文書，英文書，我都想買 jūngmàhnsyū, yīngmàhn syū, ngóh dōu séung máaih ('I want to buy both Chinese and English books')", were also selected from beginners' text books. Both Chinese characters and Cantonese romanization were given to students in the pre-test.

After finishing the pre-test, students were asked to undertake training sessions (intervention) using two eLearning pronunciation training models, namely the "accuracy model" and the "fluency model." There were 15 sessions using the "accuracy model" and 20 sessions using the "fluency model." The 15 "accuracy model" sessions included: 1 overview session; 6 sessions on Cantonese tones; 7 sessions on Cantonese finals, and; 1 review session. The 20 "fluency model" sessions included oral Q/A practice, where prompts (presented in English, Chinese characters, and Cantonese Romanization on screen) were given to students. 4 questions used in everyday life, such as, "What is your name?" and "What time is it?" were posed to students in each session. Students watched and observed the teacher's demonstration on screen after their trials and students could record themselves again and make corrections when they found that their output had deviated from the teacher's demonstration.

Table 2 below shows the interventions used in the training sessions in this research. Each training session lasts around 30 minutes. Subsections specified in the content last around 5-10 minutes. Pronunciation videos were used to complement the audio-visual feedback training in the two models.

Table 2 Interventions used in the training sessions

Training session	Content	Format
1.	1.1 Introduction to Cantonese pronunciation	PowerPoint video with narration
	1.2 General Cantonese pronunciation exercises	Web-based matching exercises
	1.3 High level tone	PowerPoint video with narration
	1.4 High level tone pronunciation exercises	Audio-visual feedback exercises
2.	2.1 Review of training 1	Oral response on explicit knowledge
	2.2 High rising tone	PowerPoint video with narration
	2.3 High rising tone pronunciation exercises	Audio-visual feedback exercises
	2.4 Long "e" and short "e"	PowerPoint video with narration
	2.5 Long "e" and short "e" pronunciation exercises	Audio-visual feedback exercises

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3.	3.1 Review of training 2	Oral response on explicit knowledge
	3.2 Mid level tone	PowerPoint video with narration
	3.3 Mid level tone pronunciation exercises	Audio-visual feedback exercises
	3.3 Long “u” and short “u”	PowerPoint video with narration
	3.4 Long “u” and short “u” pronunciation exercises	Audio-visual feedback exercises
4.	4.1 Review of training 3	Oral response on explicit knowledge
	4.2 Long “yu”	PowerPoint video with narration
	4.3 Long “yu” pronunciation exercises	Audio-visual feedback exercises
	4.4 Long “i” and short “i”	PowerPoint video with narration
	4.5 Long “i” and short “I” pronunciation exercises	Audio-visual feedback exercises
5.	5.1 Review of training 4	Oral response on explicit knowledge
	5.2 Low falling tone	PowerPoint video with narration
	5.3 Low falling tone pronunciation exercises	Audio-visual feedback exercises
	5.4 Long “o” and short “o”	PowerPoint video with narration
	5.5 Long “o” and short “o” pronunciation exercises	Audio-visual feedback exercises
6.	6.1 Review of training 5	Oral response on explicit knowledge
	6.2 Low rising tone	PowerPoint video with narration
	6.3 Low rising tone pronunciation exercises	Audio-visual feedback exercises
	6.4 Low level tone	PowerPoint video with narration
	6.5 Low level tone pronunciation exercises	Audio-visual feedback exercises
7.	7.1 Review of training 6	Oral response on explicit knowledge
	7.2 Long “eu” and short “eu”	PowerPoint video with narration
	7.3 Long “eu” and short “eu” pronunciation exercises	Audio-visual feedback exercises
	7.4 Long “a” and short “a”	PowerPoint video with narration
	7.5 Long “a” and short “a”	Audio-visual feedback exercises

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	pronunciation exercises	
8.	8.1 Review of training 7	Oral response on explicit knowledge
	8.2 Overall review - Cantonese tones	PowerPoint video with narration
	8.3 Six tones pronunciation exercises	Audio-visual feedback exercises
	8.4 Overall review – final lengthening	PowerPoint video with narration
	8.5 Final lengthening pronunciation exercises	Audio-visual feedback exercises

After students completed the training sessions, they were given a post-test, which required them to read 10 bi-syllabic Cantonese words and 5 Cantonese sentences.

12 full-time university undergraduates participated in this research. The subjects were recruited through social media and all the subjects were asked to fill out a language background form. None of them had any Cantonese background at all at the time the research was conducted. All the subjects filled out a research consent form (required by the university's Research Ethics Committee) and the students' biographic data was not disclosed in the research. All 12 participants finished the pre-test. 2 students dropped out during the training sessions. Eventually 10 students completed the entire research process and completed the post-test.

5. Data Analysis and Discussion

This research examines whether the combination of the accuracy model and the fluency model improved second language learners' Cantonese pronunciation. In what ways may the models be useful? The research also looks at whether the models are useful in improving vowel accuracy, consonant accuracy, or rhyme duration and what the representational disfluency types may be among elementary Cantonese learners.

This study employed a one-group Pre-test—Intervention—Post-test design to study the effect of audio-visual training on second language learning, with a focus on pronunciation training in teaching Cantonese as a second language.

For the "accuracy model," 200 test tokens in the pre-test and post-test were extracted through PRAAT, with rhyme duration changing between pre-test and post-test. Instead of formant values and trajectories, these changes are the focus. The results of this study are in line with the plausibility of previous computer-assisted pronunciation training (CAPT) studies (Neri et al, 2008; Luo, 2014).

Based on the analysis, there are several findings on the subjects' accuracy.

1. The duration of the second syllable of the learners was lengthened significantly with a medium effect size.
2. The ratio of Rhyme2/Rhyme1 was closer to the native speaker norm after

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training.

3. There is less variance in bi-syllabic word ratio after intervention.
4. The results of two-way ANOVA show that both token-type (Tone1, Tone3, Tone6) and previous Mandarin level of participants (intermediate level or above versus beginning level) do not moderate statistically the effects of training.

Rhyme duration gains as shown in Figure 3 were different (ranked from Tone6, Tone1 and Tone3). However, the interaction effect was not significant, indicating that the gains were not statistically different. Partial eta squared is 0.55, indicating a medium effect size.

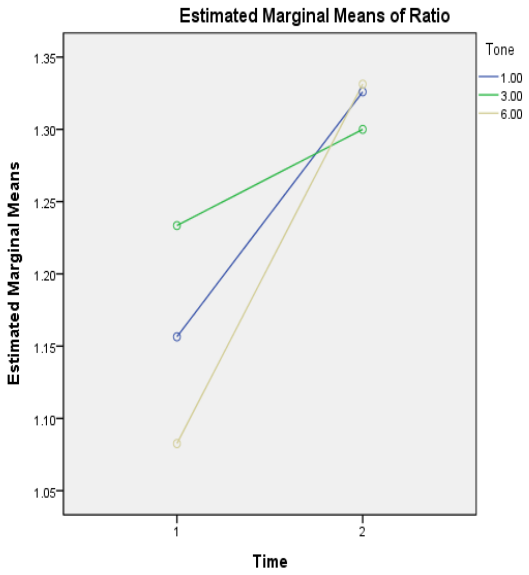

Figure 3 Rhyme duration gains of Cantonese tone

Rhyme duration gains, as shown in Figure 4, were different among subjects. Subjects with lower Mandarin level (M2) benefited more than subjects with higher Mandarin level (M1). However, the interaction effect was not statistically insignificant. Partial eta squared is 0.6, indicating a medium effect size.

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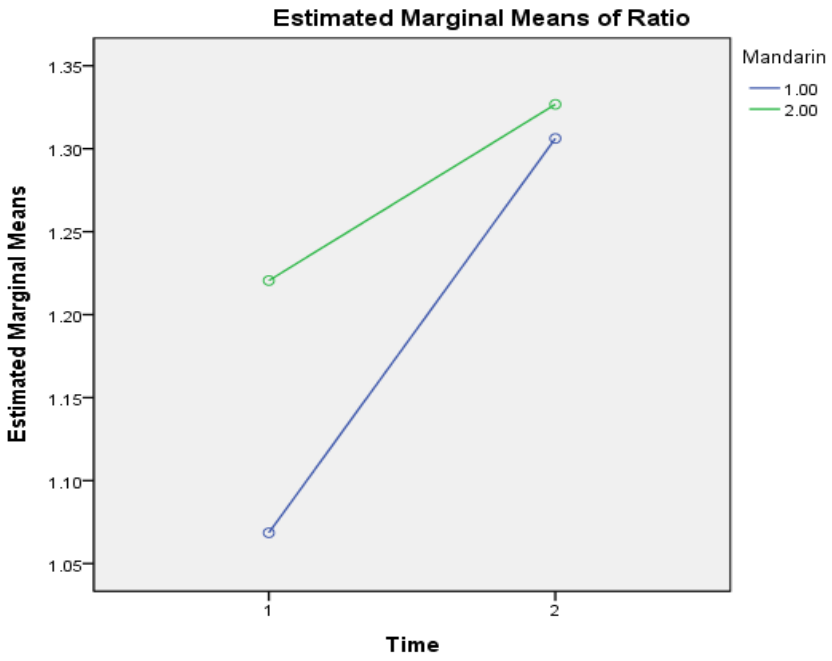

Figure 4 Rhyme duration gains with respect to Mandarin background

For the "fluency model," trials from the 10 students in this research cohort were extracted for analysis. The overall question completion rate is around 60%. This may suggest that the "fluency model" may need to accommodate slower learners in order to raise the completion rates. In order to identify representational disfluency types among elementary learners, trials of the students have been transcribed and disfluency types (filler, breakdown, and pauses) were analyzed. Based on the preliminary analysis, the study concludes that: 1) the number of words uttered correlates with a breakdown having a medium effect size ($r=0.6$, $p<0.05$), and; 2) the number of words uttered does not correlate with conversational fillers or pauses.

Further investigations need to be carried out in order to confirm whether or not the conversational fillers used were a transfer of first language speaking style. Moreover, professional raters' and native speakers' perception and judgement on accuracy/intelligibility may be used in further research to test whether or not a relationship exists between disfluency types and listener perception and whether there are correlations between raters'/native speakers' judgement and rhyme duration gains.

6. Conclusion

In this research, the subject's rhyme duration and first syllable to second syllable rhyme ratio have improved. The current results encourage a more extensive use of web-based computer-assisted pronunciation training (CAPT) to enhance Cantonese language teaching and learning.

As to the improvement of learners' pronunciation accuracy, the subject's rhyme

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duration and first syllable to second syllable rhyme ratio have improved in this study. The results could be extended to other second language teaching and learning contexts. In some languages, such as English and Japanese, duration also played an important role. The current results encourage a more extensive use of web-based computer-assisted pronunciation training (CAPT) to enhance language teaching and learning, especially in pronunciation training courses at higher educational levels. The results show that teacher pronunciation demonstration videos were beneficial. Web-based audio-visual feedback is also useful to support pronunciation training along with classroom instruction. Moreover, pronunciation knowledge could also be delivered in video format so that students could learn according to their own needs.

As to learners' fluency, this study, through investigating fluency tokens produced by elementary Cantonese learners, concludes that the frequency of disfluency types (conversational fillers, breakdown, and pauses) differed among the participating subjects. The current study suggests that breakdown type disfluency occurred more frequently if learners tried to speak more, while filler type disfluency did not have such a correlation. Further investigation could be carried out to confirm whether or not filler type disfluency tends to be a transfer of first language speaking style. The results of this research have implications for designing overall oral assessment rubrics by considering learners' first language interference. The results could be extended to disciplines such as education studies, second language teaching, and second language assessment.

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