A pronunciation and vocabulary teaching aid for Spanish as a Foreign Language programs at Japanese universities utilizing a Spanish speech recognition system and corpora of academic Spanish

Abstract:

This paper reports on a project which researchers at two universities in Japan developed for Spanish as a Foreign Language CALL materials, which has two features, a Spanish speech recognition system based on the AmiVoice Japanese speech recognition system; and a Spanish verb collocation-based vocabulary teaching aid based on a corpus of academic Spanish. The first step was the creation of a Spanish speech recognition system for Japanese university students based on the AmiVoice Japanese pronunciation recognition system developed by Advanced Media Incorporated. The second step was the selection of vocabulary for a specific genre of academic Spanish, which was done in the following way: (1) Articles in a Spanish-language academic journal on Spanish Literature, Culture, History, and Language (themes typically chosen by students for graduation theses) compiled and published annually in Japan were used as the source of data for the compilation of a corpus. (2) All the verbs were extracted from the data. (3) The extracted verbs were compared with a corpus of verbs from graduation theses written in Japanese by Japanese university students and (4) by taking into account their needs for learning verbs, a list of verb-centered collocations was compiled. Finally, we developed a user-friendly Spanish pronunciation and verb collocation-based vocabulary teaching aid. The aid displays the verb collocations on a computer screen during pronunciation training. The training had two phases. The first phase required Japanese university students to carefully and repeatedly listen to model pronunciation examples of the vocabulary items, and to pronounce the vocabulary. This pronunciation training is intended to contribute to effective memorizing of the verb collocations. The next phase required the students to repeat the vocabulary items at the rate of the model utterance as well as to imitate the stress and other intonation features. This training is expected to help Japanese students speak Spanish more fluently.

Key words: ICALL teaching materials, speech recognition systems, academic vocabulary corpus, pronunciation training, verb collocation

1. Background

1.1. Corpus-based analysis of language use

Corpus-based analysis of language use provides us with three perspectives. The first is that words do not occur at random in a text, and that the open-choice principle, in which any word might follow any other as long as accuracy is maintained semantically and grammatically, does not provide for sufficiently substantial restraints on consecutive choices (Sinclair 1991). Sinclair (1991) also argues that a language user has available to him or her a large number of semi pre-constructed phrases that as units constitute single choices, even though they might appear to be analyzable into segments, i.e. the idiom principle. Nattinger and DeCarrio (1992) claim 'conventionalized form/function composites' can be included as a type of Sinclair's 'semi pre-constructed phrases.' These units of two or more words in pre-constructed phrases, or collocations, occur together in predictable patterns.
The second perspective is that preconstructed collocations are evenly distributed in a text, and that a large majority of a text consists of such collocations (Akano 2006). The following text from Akano (2006) illustrates how evenly preconstructed collocations are distributed in a text. The phrases indicated in boldface are all preconstructed collocations.

When confronted with failure, most people react with either positive thinking or negative thinking. Positive-minded individuals view failure as a learning experience, a valuable lesson which might lead to success in their next attempt. Such people recover quickly from discouragement and look to the future with hope. On the other hand, people who react to failure with negative thinking tend to view each case of failure as something vital to their whole life. They are easily discouraged and some fall into severe mental depression, making it hard for them to take even a small risk for the next challenge. Since nobody can escape from failure in life, it would be much better to develop a positive attitude toward it, increasing the chances for success.

Another survey revealed how evenly collocations are distributed in a text. The rate of collocations in 19 texts, mainly from London Lund Corpus of Spoken English and Lancaster-Oslo/Bergen Corpus of written British English, was calculated, and it was found that 55.38% of the texts were composed of pre-constructed collocations (Erman and Warren 2000). This result shows that the idiom principle, which Sinclair (1991) described, is activated in the text shown above.

When we memorize words which name things, that is, nouns, what should we do? In the struggle to memorize words, Lewis (2000:15) claims that much of language teaching, over the years, has been based on an assumed dichotomy of grammar and vocabulary: master the grammar system, learn lots of words then you will be able to talk about whatever you want. This traditional view of language has encouraged students to learn to name a lot of things and develop an extensive vocabulary which consists predominantly of nouns. Grammar is seen, in this view, as a means of using vocabulary in communication.

Even though the meaning of nouns may be understood, learners obviously find it difficult to engage effectively in written or spoken communication. A plausible explanation of this difficulty is a lack of knowledge about collocations since these language patterns comprise much of spoken and written English. However, a simple list by list learning of collocations does not diminish the formidable challenge of language learning—there are more collocations than there are words because one word may be a component of a great number of collocations. Thus, principled approaches to collocation-based language learning need to be explored (Lewis 2000).

Since it is true that verbs are the main grammatical elements of a sentence, our current research on teaching corpus-based collocations focuses mainly on verb-based collocations; i.e. verbs are given to the students first and then, the other words which collocate with the verbs are presented. It may be argued that the focus on verb-centered collocation patterns is most suitable for learners of Spanish at beginning levels who are in the process of learning the most frequent words of their target language. On the other hand, university-level EFL learners, with six years of English learning experience, found it useful to acquire collocation patterns with lower frequency nouns in order to become proficient in the use of academic English (Ishikawa et al. 2007).

Finally, the third perspective is that since all words occur in collocation patterns, teaching collocations may be efficient ways to teach aspects of language other than vocabulary. Collocation-based teaching may usefully include instruction and practice in pronunciation at segmental and supra segmental levels.

1.2. Spanish as a Foreign Language program at Japanese universities
Unlike EFL students who have six years of English study prior to university entrance, Spanish is a language which Japanese university students learn from the very beginning in the first years of undergraduate studies and therefore, a focus on verb-centered collocation patterns would be suitable. In order for Japanese students to write reports or graduation theses in Spanish, they need to have a sufficient knowledge of academic verbs and their collocates as they are used in academic settings.

A common way for Japanese students to learn academic Spanish verbs and their collocation-based vocabulary is to look for such verbs and vocabulary in Japanese-Spanish dictionaries. Unfortunately, Japanese-Spanish dictionaries published in Japan often do not have enough phrases to help Japanese students write reports or graduation theses in Spanish. This is the reason why we developed a pronunciation and vocabulary teaching aid for Spanish as a Foreign Language programs.

1.3. The Integration of CALL and Common Teaching Practices

Bax (2003) refers to a future normalization stage in the development of CALL teaching methodology in which CALL materials are neither isolated from the mainstream of classroom face-to-face (FtF) teaching in CALL labs nor used merely as supplementary materials to core FtF instruction but so completely integrated into all foreign language teaching that it would be unthinkable not to have CALL materials as a normal feature of all classroom learning. Although it is beyond the scope of this paper to report on a methodological extension of the CALL materials discussed here, it is likely that the materials will be used in Blended Learning approaches, a combination of CALL and face-to-face teaching (Neumeier 2003). For example, it is probable that the pronunciation skill development of students using CALL materials would be monitored and supported by teachers in classroom settings. Indeed, sustainable motivation in independent CALL learning situations may depend in part working out appropriate balances in the use of learning materials independently and in teacher-student collaboration, as is necessary in distance learning (Moore and Kearsley 1996). However, as Stracke (2007) reports in a study of student dissatisfaction with a Blended Learning environment, the development of methodologies which integrate CALL and FtF instruction needs to be carefully worked out, even on an individual student basis.

2. Study aim

This study reports on a project in which we developed a pronunciation and vocabulary teaching aid for Spanish as a Foreign Language programs at Japanese universities using a Spanish speech recognition system and a corpus of academic Spanish. The teaching aid which displayed the verb collocation-based vocabulary on a computer screen during pronunciation training was integrated into Spanish for Specific Academic Purposes courses for third and fourth year undergraduates. It was intended that the teaching aid would enable students to improve their command of academic Spanish by

- raising awareness of certain verb collocation-based vocabulary and its language use typical of academic Spanish
- providing opportunities to learn what sort of nouns, adverbs, and prepositional phrases academic verbs collocate with
- facilitating memorization and fluent use of verb collocation-based vocabulary through pronunciation training.

In order to achieve the above three objectives, a user-friendly verb-collocation based Spanish vocabulary teaching aid using a Spanish speech recognition system for Japanese university students and a corpus of academic Spanish was developed.
3. Development of a pronunciation and vocabulary teaching aid for Spanish as a Foreign Language programs at Japanese universities

3.1. Development of a Spanish speech recognition system

We developed a Spanish speech recognition system for Japanese university students based on the AmiVoice Japanese pronunciation recognition system by Advanced Media Incorporated.

3.1.1. Speech data

Speech data of 17 Spanish native speakers (5 males, 12 females) and speech data of 54 Japanese university students (13 males, 41 females) were collected. Since the speech data of Spanish native speakers are perfectly intelligible, only the speech data of Japanese university students were scored on a range from 1 (hardly intelligible) to 4 (perfectly intelligible) by two Spanish native-speaking foreign language teachers. The rate of inter-rater reliability of the scores by the two Spanish native-speaking teachers was $r = 0.96$.

3.1.2. Pronunciation lexicon

We developed a Spanish speech recognition system for Japanese university students based on the AmiVoice Japanese pronunciation recognition system. We composed a totally new pronunciation lexicon for detection of Japanese students' pronunciation of Spanish in the following way:

- Spanish phonemes which are inconsistent with Japanese phonemes were replaced with the Japanese phonemes they coincide with.
- Spanish phonemes which do not exist in Japanese were replaced with very similar Japanese phonemes.

By means of a speech recognition system which implemented the above pronunciation lexicon, the speech data of Spanish native speakers and Japanese university students were evaluated. As a result, only 29.63% of the speech data of Spanish native speakers were perfectly intelligible by the speech recognition system, while the speech data of Japanese university students were perfectly intelligible at the rate of 77.40% by the speech recognition system.

3.1.3. Acoustic model adaptation and its evaluation

In order to enhance the degree of accuracy for the speech data of Spanish native speakers, MLLR (maximum likelihood linear regression) and MAP (maximum posterior probability estimation) were adapted to the speech recognition system described in section 3.1.2. Fig. 1 shows the effect of MLLR and MAP adaptations for the speech data of Spanish native speakers and Fig. 2 shows the effect of MLLR and MAP adaptations for the speech data of Japanese university students.
Using MLLR and MAP adaptations, the degree of accuracy for the speech data of Spanish native speakers was shown to have remarkably improved; however, at the same time the speech data of the Japanese university students indicated deterioration. In order to improve the degree of accuracy for the speech data of Japanese university students, Japanese phonemes were added to the pronunciation lexicon described in section 3.1.2 and as a result, the degree of accuracy for the speech data of Japanese university students was shown to have improved as is shown in Fig. 3.
A Spanish speech recognition system with the pronunciation lexicon described in section 3.1.2 as well as Japanese phonemes was included as a component of the teaching aid.

### 3.2. Selection of vocabulary

Although in Japan, Spanish is a language which students learn from the very beginning in the first years of university undergraduate studies, the selection of the vocabulary for Spanish for General Academic Purposes courses may include low frequency words as well as high frequency words. In particular, Spanish for Specific Academic Purposes courses may require the learning of words which are characterized by language use which may not appear in any other genre of Spanish. Selection of the vocabulary for one specific genre of academic Spanish was done in the following way:

1. Articles written by native speakers of Spanish in *CUADERNOS CANELA*, a Spanish-language academic journal published in Japan were used as the source of data for the development of a corpus.
2. All the verbs were extracted from the data.
3. Those extracted verbs were compared with a corpus of graduation theses written in Japanese by Japanese university students.

Taking into consideration the students' needs, a list of verb collocations was compiled.

### 4. Specification of the pronunciation and vocabulary teaching aid for Spanish as a Foreign Language programs at Japanese universities

Fig. 4 is an initial computer screen display of the teaching aid named “Banco de Verbos.” Students insert a Japanese word which they want to learn into a search box.
5. Functions of the pronunciation and vocabulary teaching aid

5.1. Choice of verbs

After students insert into a search box a Japanese word which they want to learn, they can see and choose a selection of academic Japanese vocabulary. Fig. 5 is a computer screen display that shows a selection of academic Japanese vocabulary related to a Japanese word “kanga-eru,” which means “to think” in English.

After students choose an item of academic Japanese vocabulary which they want to learn in Spanish, they perform a simple mouse click on the desired academic Japanese vocabulary item in order to see verb collocation-based Spanish phrases which include Spanish verbs relevant to the academic Japanese vocabulary that students choose. Fig. 6 shows a list of Spanish phrases.
If students highlight a Spanish phrase that they want to learn, they will see three buttons appear on the right end of the phrase, e.g. "COPY," "PLAY" and "SPEAK." Fig. 7 is a computer screen display of the three buttons.

If students select the "COPY" button, they are able to copy and paste the highlighted Spanish phrase into the text of their report or graduation thesis. If students select the button "PLAY," they are able to listen to the Spanish phrase that they choose. If they select the "SPEAK" button and they say the phrase, their pronunciation and their utterance speed are evaluated by a Spanish speech recognition system (described in sections 3.1, 5.2, and 5.3).
5.2. Evaluation of students' pronunciation

The effects of students' listening training are transferred to their pronunciation ability, and similarly, students' pronunciation ability is transferred to their listening training. Moreover, listening training is more effective when phrases rather than single words are used. This is because the phonology and meaning can be inferred when phrases rather than single words are used (Ikuma et al. 2004). The teaching aid configures four levels for the evaluation of students' pronunciation. Four different figures were installed according to the four levels.

1. ◯: This figure indicates that the students' pronunciation is like a Spanish native speaker.
2. ○: This figure indicates that the students' pronunciation is good, although some Japanese phonemes are present.
3. △: This figure indicates that some Japanese phonemes are included at the end of some consonants (such as /su/ instead of /s/).
4. ×: This figure indicates that the students' pronunciation contains many Japanese phonemes or is like English.

In addition to the above four figures that indicate the four levels of the evaluation of students' pronunciation, any word which was inaccurately pronounced is coloured red as is shown in Fig. 8.

Figure 8. A computer screen display of the teaching aid evaluating a student's pronunciation.

5.3. Evaluation of students' rate of utterance

Two bar graphs under the Spanish phrase in Fig. 8 indicate the utterance length: The upper one shows the model utterance and the lower one shows the students' utterance. We define an utterance as a meaning unit and we divide all Spanish phrases in the teaching aid into meaning units. By requiring students to match the model utterance length, that is, to follow the rate of the model utterance as well as to imitate the stress and other intonation features repeatedly, it is expected that Japanese students will be trained to speak Spanish more fluently.
6. Direction and future projects

At the present time, this multimedia teaching aid is available only in the classroom. In the near future, it will be stored in an e-learning server and will be accessible not only from the classroom but also from students' homes. We also plan to collect data regarding the students' access to the server and the evaluation of their pronunciation training so that we can gain a better understanding of students' progress and also determine which sections of the teaching aid require improvements. The second future project will be to try to develop systems which will promote effective memorization by students of vocabulary based on the feedback on pronunciation proficiency by the Spanish speech recognition system.

In addition, we hope that our research will contribute to developments in Blended Learning (BL) methodologies which, as defined by Neumeier (2003), is a combination of face-to-face teaching and computer-assisted learning in a single teaching and learning environment. The aims of our CALL research in collocation-based pronunciation teaching are related to productive language use situations in face to face classroom discussions of students' graduation theses. Thus, further research which might shed light upon optimal BL conditions would be welcome. In particular, exploration is needed on how CALL teaching aids, which encourage and support outside-the-classroom independent learning, can be integrated into face-to-face components of academic foreign language courses by developing BL classroom materials, teaching strategies, and learning activities.

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