

A Japanese Learning Support System Matching Individual Abilities

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Abstract

With the growing popularity of Japanese learning, a large number of learning support tools or systems have been developed to help Japanese learners in various situations. We have particularly noticed the increasing necessity of systems developed as web applications, most of which are free and easily accessed, and hence regarded to be the most significant resources for Japanese learners. However, none of the existing studies has considered the difference in language ability among Japanese learners. Learning contents and instructional method in these systems usually remain unchanged at all times without taking account of individual variations while in some cases they are supposed to vary with the real language ability of each Japanese learner. In this paper, we have developed a web application to provide appropriate suggestions and different learning materials for each Japanese learner based on their individual Japanese abilities. Specifically, we divide the language ability into several elements, propose different methods to quantify each element, and generate feedbacks or training questions for the Japanese learners. Experimental results have partially shown the effectiveness of our methods.

1 Introduction

More and more people are learning Japanese as the second or foreign language. According to a report issued by the Japan Foundation, Japanese

learners have increased 9.1% all over the world since 2009¹. With the growing popularity of Japanese learning, a large number of learning support tools or systems have been developed to help Japanese learners in various situations (Liu et al, 1999; Fujita, 2001; Suwa, 2006; Zhang, 2006; Gao, 2005; Kakegawa, 2000; Nakano and Tomiura, 2011). We have particularly noticed the increasing necessity of systems developed as web applications, most of which are free and easily accessed, and hence regarded to be the most significant resources for Japanese learners. Here are some examples. Asunaro² presents the dependency relations between phrases in a given Japanese sentence, Obi³ classifies the difficulty of a given text into 13 levels, Reading Tutor⁴ analyzes a given text and shows the difficulty level of each morpheme in it, and Chantokun⁵ discovers the misuse of a case particle in a user's input and shows the potential alternatives as well.

However, none of the existing studies has considered the difference in language ability among Japanese learners. Learning contents and instructional method in these systems usually remain unchanged at all times without taking account of individual variations while in some cases they are supposed to vary with the real

¹<http://www.jpf.go.jp/j/japanese/survey/result/survey12.html>

²<http://hinoki.ryu.titech.ac.jp/asunaro/main.php?lang=jp>

³<http://kotoba.nuee.nagoya-u.ac.jp/sc/obi2/>

⁴<http://language.tiu.ac.jp/>

⁵<http://cl.naist.jp/chantokun/index.html>

language ability of each Japanese learner. Capturing the personal feature of a learner's language ability and providing her with the most appropriate learning contents in the most proper way will definitely make the learning procedure more efficient.

Our final goal in this work is to develop a web application to provide appropriate suggestions and different learning materials for each Japanese learner based on their individual Japanese abilities. Specifically, we divide the language ability into several elements, propose different methods to quantify each element, and generate feedbacks or training questions for the Japanese learners. Here in this paper, we describe the basic idea in Section 2, and describe a few modules we have developed as the first step of the whole system in Section 3, 4, and 5. Finally, we end this paper with a conclusion in Section 6.

2 The Basic Idea

The general framework is composed of two main parts: the interactive interface and the background processing platform. When the learner inputs some words, the system will carry out two kinds of analysis in turn: morphological analysis and syntactic parsing. Here, we use the free Japanese analyzing tools, Cabocha⁶ and Knp⁷, to carry out the analytical tasks.

Then the system tries to figure out the linguistic ability of the current user. The linguistic ability structure is divided into several elements: Kanji character, vocabulary, case particle, sentence pattern, inflection, and honorific expression. So far, we have developed two modules for case particles and sentence patterns respectively.

Finally, based on the analytical results, the system generates different feedbacks or practice questions for each Japanese learner trying to provide her with the most appropriate learning contents in the most proper way, which might make the learning procedure more efficient.

3 Usage of Case Particles

We have mentioned Chantokun, a previous web application, in Section 1, where wrong usages of case particles could be discovered and corrected. Case particles are the most important components in Japanese sentences. It is impossible to generate a grammatically correct

sentence without using any case particles. We in this work consider case particles as one of the most critical factors to analyze the linguistic ability of Japanese learners, and propose a method to conduct a profound analysis on their usages of case particles.

Here, similar to Chantokun, we also use 3-gram data from Google N-gram Corpus⁸ to discover and modify the wrong usages of case particles. The 3-gram corpus is extracted mainly from web pages containing a large number of 3-continuous-word fragments in the form of "W1 CP W2". Here, CP indicates a case particle, W1 and W2 represent the two words surrounding it. However, the difference between our work and Chantokun lies in that we incorporate dependency relation analysis into the error checking task as shown in Figure 1.

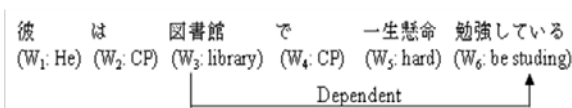


Fig. 1. The dependency relation analysis

Besides the error check and correction, we have developed another function involving the case particles. Through the correct use cases of case particles from the user's input texts, we try to estimate the user's level of dealing with case particles. Here we define two kinds of measurements: GUR (General Understanding Rates), and GER (General Error Rates) as shown below.

$$GUR = \frac{\sum x_i}{G_{\max} \times M}$$

$$GER = \frac{\sum y_i}{G_{\max} \times N}$$

Here, x_i and y_i stand for the occurrence frequency of the correctly used 3-gram and the modified 3-gram in the 3-gram corpus. M is the number of correctly used case particles in the user's input texts, and N represents the number of case particles that have been modified. G_{\max} is the highest occurrence frequency in the 3-gram corpus. We try to reflect the user's understanding ability towards the frequently used case particles, and the tendency to make mistakes with these formulas.

In the experiments for wrong-usage detection of case particles with 100 sentences extracted

⁶<http://code.google.com/p/cabocha/>

⁷<http://nlp.ist.i.kyoto-u.ac.jp/index.php?KNP>

⁸http://www.gsk.or.jp/catalog/GSK2007-C/GSK2007C_README.utf8.txt

from Lang⁸, we get the results as shown in Table 1 with different experimental arguments. Here, “Abs” indicates the absolute threshold value. For example, “Abs(0)” means the case where a wrongly used case particle is detected without considering the difference between the wrong usage and the most frequent usage in the corpus. On the other hand, “Rel” indicates the cases where a specific magnitude relationship between the wrong usage and the most frequent usage has to be taken into consideration. Generally, “Rel(10)” is the most effective one among all the argument sets.

	Precision	Recall	MissRate	F-value
Abs(0)	0.69	0.42	0.19	0.51
Abs(100)	0.66	0.60	0.31	0.63
Abs(500)	0.65	0.74	0.39	0.69
Rel(10)	0.76	0.75	0.23	0.75
Rel(50)	0.75	0.60	0.20	0.67
Rel(100)	0.73	0.53	0.19	0.61

Table. 1. Experimental results for case particles

4 Usage of Sentence Patterns

A sentence pattern indicates some specific usage of certain words to express some particular context or meaning (Han and Song, 2011). Here is a very simple example: “～あげく” meaning “in the end”. The signal “～” acts as a placeholder with certain strict conditions. In this sentence pattern, only two kinds of expressions could be used to replace “～” in front of “あげく”: past tenses of verbs or a particular formal noun in Japanese, “の”. Whether a Japanese learner is able to use a sentence pattern correctly is considered as another significant indicator of her real Japanese linguistic ability.

To the best of our knowledge, Reading Tutor is the only web system which has made contributions on learning sentence patterns. Reading Tutor analyzes the input sentence, recognizes the sentence patterns used in it, and elaborates the usage of each sentence pattern found. However, Reading Tutor is not able to recognize the wrong sentence-pattern usages. In other words, even if an expression other than the past tense of a verb or the particular formal noun “の” appears in front of “あげく”, Reading Tutor is not able to indicate the mistake.

During the practical sentence-pattern learning process, compared with the simple and outward sentence-pattern searching function, it is usually more important to tell the user whether the sentence she has just composed using a particular sentence pattern is correct, and where the problem is lying if the answer is no. Our study differs from Reading Tutor on this aspect.

1. ～○
2. ～○～
3. ～～○
4. ○～△
5. ～○～△
6. ～○～△～□
7. ～○～△～□～◎

Fig. 2. Main structures of sentence patterns

Generally, there are seven kinds of structures lying in all sentence patterns as shown Figure 2. Here, the signal “～” is a placeholder as described above, and each signal except “～” indicates a partial expression of the whole sentence pattern. During the analytical procedure, we use Cabocha to obtain the conjugated form for each “～”. Meanwhile, we create a huge table containing all the combining rules in advance based on a sentence-pattern dictionary (Ask Shuppan, 2008), and develop a module to discover the wrong usages of sentence patterns and provide feedbacks on correct usage based on the combination-rule table.

Specifically, we follow the steps below to accomplish this task taking “～あげく” as the specific case here.

- Step1.** Search the input sentence for “あげく”
- Step2.** Obtain the part-of-speech (POS) and conjugation information of “～”, the expressions in front of “あげく” using Cabocha.
- Step3.** Compare the POS of “～” and that in the combination-rule table.
- Step4.** Exit the process and present the user with the message “POS Error” if they do not match.
- Step5.** Compare the conjugation information of “～” and that in the combination-rule table.
- Step6.** Exit the process and present the user with the message “Conjugation Error” if they do not match.

⁹<http://lang-8.com/>

The above process will be iterated for all the signals including “○”, “△”, “□”, and “◎” for all the other patterns in Figure 2.

We have conducted a simple experiment to examine the effectiveness of our sentence-pattern processing module. Here, we extract 200 correct sample sentences each containing at least one sentence pattern from another Japanese sentence-pattern dictionary (Ask Shuppan, 2007). Table 2 shows the experimental results.

Recognized Sentence Patterns	328(100%)
Correctly recognized sentence patterns	279 (85%)
Wrongly Recognized Sentence Patterns	49(15%)

Table. 2. Experimental results for sentence pattern

Cases of failure have been observed with the following reasons.

1. Delicate difference lies between the sentence pattern dictionary and the Morphological analyzer.
2. Oral Expressions are used instead of the formal ones in “○”, “△”, “□”, and “◎”.
3. The sentence pattern dictionary is non-exhaustive.
4. Normal usages are incorrectly equated to certain sentence patterns

The first three issues come from the inadequacy of the sentence-pattern dictionary, and are possible to be addressed completely or partially through incorporating other dictionaries and complementing the current one simultaneously.

The last issue indicates the case where a normal expression containing one of four special signals (“○”, “△”, “□”, and “◎”) is misattributed to a sentence pattern. Here is an example.

Input:

私は大学を卒業するまでそこで過ごしました。
(I lived there until I graduated from the college)

Feedback:

「～て」を接続しなければいけません
(The 「する」 connection must be replaced by the 「～て」 connection)

According to the Feedback, the input sentence should be modified as “私は大学を卒業してまでそ

こで過ごしました” meaning *I graduated from the college to live there*. The modified sentence has a completely different nuance from the input sentence which is also correct. Our future task includes figuring out strategies to address this kind of problems.

5 Practice-question Generation

Another significant difference between our system and other previous studies lies in the function of providing practice questions and feedbacks based on the user’s linguistic ability and self-assessment. Specifically, practice questions are provided to help the learners improve their abilities to use a certain case-particle or sentence pattern. On the other hand, feedbacks are given to the learners to indicate their scores and what they should pay particular attention to during the practicing process.

5.1 Determination of Question Form

Some existing studies have mentioned the relation between the learning effect and the learning method or feedbacks during the process of foreign language learning. Yokoyama analyzed the effectiveness of negative feedbacks (NFs) and represented some perceptions on the difference between explicit and implicit NFs (Yokoyama, 1996). In another study, Nishitani and Matsuda explored the possibility to manage the language-anxiety level of the learners (Nishitani and Matsuda, 2008). Profound survey on the above studies leads us to the following ideas.

1. Feedbacks are generally effective for foreign language learning
2. Expositions tailored for a particular learner is necessary.
3. Different Question forms should be provided to learners of different levels
4. Language-anxiety element might be taken into consideration to select the most appropriate learning method.

Based on the above considerations, we have developed three modules for our practice-question generation function: Character Judgement, Question-form Determination, and Feedback Generation. Character Judgement conducts a questionnaire with each learner having an assessment page filled out in the system. Questions contained in the assessment page come from Motoda’s study (Motoda, 2000), and are used to assess the user’s language-

anxiety and feelings of self-esteem. Figure 3 shows the screen shot of the questionnaire in our web system.



Fig. 3. Screen shot of the questionnaire

Average assessments from the questionnaire are used to estimate the user’s character and self-perception, which will be used in the Question-form Determination module.

In our system, four forms are used to provide practice questions: multiple-choice question, fill-in-the-blank question, true-false question, and error-correction question. Following the idea suggested by Yokoyama, we assign difficulty levels from 1 to 4 to each of the four forms. For example, multiple-choice questions are comparatively simple, and error-correction questions are usually difficult compared with others.

In the Question-form Determination module, judgement on question form is carried out based mainly on the user’s total accuracy so far. For example, if the learner has achieved a total accuracy of 90%, she will be given the chance to step on to the higher difficult level. Similarly, the user will be forced to reduce her difficulty level to an easier question form. This is the basic policy to adjust the question form for each learner. However, there are situations where we must consider users’ characters as well. For instance, if the user’s language-anxiety is comparatively high, we will set a stricter condition for her to raise the difficulty level. The most appropriate form will be selected for a particular user in accordance with her character and self-perception.

The third module, Feedback Generation, applies the opinions of Nishitani and Matsuda on the effects of feedbacks, and outputs a feedback sentence according to the user’s character.

5.2 Extraction of Question Source

As described in Section 3, we use the Google 3-gram Corpus to discover and modify the wrong usages of case particles. Here we extract 3-grams from the same corpus as the source of practice questions. When the system decides to generate a practice question regarding a particular case particle according to the result of a first-time ability test, the context of the particular case particle is also employed.

For example, if the user messes up with the 3-gram “ W_1+CP+W_2 ”, the user will receive a set of 3-grams as the practice questions with similar contexts. Specifically, 3-grams in the following form are randomly extracted from the Google Corpus and used to generate practice questions for “ W_1+CP+W_2 ”.

$$W_{1SP}/W_{N1SS} + CP + W_{2SP}/W_{N2SS}$$

Here, W_{NSP} indicates the words holding the same POS as W_N , and W_{N1SS} indicates the words holding the same semantic feature as W_N . We use Juman¹⁰ to extract semantic features for nouns, and Japanese Wordnet¹¹ to extract semantic features for verbs.

On the other hand, we generate practice questions for sentence patterns from a news corpus¹². Specifically, we take the following steps to accomplish this task.

- Step1.** Extract the body text from the corpus.
- Step2.** Segment the body text into sentences.
- Step3.** Clip the sentences containing at least one sentence pattern.
- Step4.** Examine the correctness of the sentence-pattern usage with the program described in Section 4.
- Step5.** Change the inflected form of the verb around the special signals in a sentence pattern to another.
- Step6.** Present the whole sentence containing a blank or a wrong verbal inflected form to the user as a practice question.

¹⁰<http://nlp.ist.i.kyoto-u.ac.jp/index.php?cmd=read&page=JUMAN&alias%5B%5D=%E6%97%A5%E6%9C%AC%E8%AA%9E%E5%BD%A2%E6%85%8B%E7%B4%A0%E8%A7%A3%E6%9E%90%E3%82%B7%E3%82%B9%E3%83%86%E3%83%A0JUMAN>

¹¹<http://nlpwww.nict.go.jp/wn-ja/>

¹²<http://www.nichigai.co.jp/sales/mainichi/mainichi-data.html>

Some practice-question examples generated in this way for multiple-choice practice question and true-false question are shown in Figure 4 and 5.

Comparing with the web text, news articles are more formal which indicates the ease to find appropriate sample sentences, whereas facing the risk that extracted sentences tend to be long and thus comparatively difficult for entrance-level users.

- 問1、今、くい止めないと老化が急劇に **進んで** あそれがある
- 問2、宇根助教授は「希少な在来種に影響が **出た** 恐れがある」と話す
- 問3、たばこの火でも、引火 **しよう** 恐れがある
- 問4、この人物が再びテロを **起こし** 恐れがあるとして行方を追っている
- 問5、この人物が再びテロを **起こそう** 恐れがあるとして行方を追っている
- 問6、「波の影響で今後も漂着 **し** 恐れがある」と話している
- 問7、結局、計170億円が足りなく **なり** 恐れが出ている
- 問8、また、車庫の屋根や車からも2階に **上がられない** 恐れがある

Fig. 4. Screen shot of the multiple-choice practice questions

- 問1
- 前輪タイヤと車軸の連結部が外れ走行不能になれば恐れがある
- 前輪タイヤと車軸の連結部が外れ走行不能になって恐れがある
- 前輪タイヤと車軸の連結部が外れ走行不能になる恐れがある
- 前輪タイヤと車軸の連結部が外れ走行不能になるう恐れがある
- 前輪タイヤと車軸の連結部が外れ走行不能になり恐れがある
- 問2
- たばこの火でも、引火し恐れがあったという
- たばこの火でも、引火しよう恐れがあったという
- たばこの火でも、引火する恐れがあったという
- たばこの火でも、引火すれば恐れがあったという
- たばこの火でも、引火せず恐れがあったという

Fig. 5. Screen shot of the true-false questions

6 Conclusion

This paper describes some work we have been doing towards the development of a Japanese learning system. The principal difference between this work and the previous studies lies in the linguistic ability structure we have defined, and the idea that each learner is able to obtain his or her own linguistic-ability evaluation and customized learning contents. We have implemented three modules to help users with their usage of case particles and sentence grammars so far. Some evaluations have shown the effectiveness of our strategies. Figure 6 is the screen shot of our web system

However, as elaborated in Section 4 and 5, we still have ways to improve the method and obtain better results. Also, some ongoing modules

including those for Kanji character, vocabulary and honorific expression are to be finished as soon as possible. What matters most of all, is a questionnaire targeted toward the JSL learners to examine the learning effectiveness for them with the help of our web application.



Fig. 6. Screen shot of our web interface

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