# Toward the Cognitive Analysis of Non-Native Speakers' Handwriting in Japanese with iPad and LMS

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**Abstract**

Tablet computers have gathered attention in classrooms in Japanese university. Apple's iPad is the most popular among several varieties. BeeDance is a learning management system (LMS) for iPads created by a Japanese company to facilitate active participations of learners. The study was conducted at a Japanese university for learners who are not native speakers of Japanese. The learners' behaviors, stroke orders of hiragana, katakana, and kanji, and Japanese typing by keypad were observed. The future research possibilities for the analysis of cognitive understanding are introduced. In this paper, cognitive analyses of non-native speakers' Japanese handwriting are examined through the uses of BeeDance in classrooms.


Keywords: Japanese, handwriting, cognitive understanding, tablet, LMS

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**Introduction**

BeeDance is a Learning Management System (LMS) for iPad developed and sold by SCSK Corporation. Tokyo Denki University, School of Information Environment purchased 100 iPads and BeeDance system in April, 2015 and has been using them for English and Japanese language education. By using this system, we can ask questions from a teacher side and send files to multiple student iPads. In addition, students' iPad screen can be confirmed by the teacher or projected in the classroom through the projector, so students can check the answers among the students within the class.

First of all, we compare how the major LMS for the computers such as Blackboard Learn and the LMS for other tablets differ from BeeDance. In general, LMS has functions such as delivery and evaluation of teaching materials as course management in the same way, but BeeDance has several unique functions. In one of the image board functions, learners draw characters and letters by hand, and the teacher can observe how and what they do in real time. Moreover, with the text board function, it is possible to observe the dictation exercises by distributing video or audio files to the students' iPad, listening to the audio and filling in blanks, and observing the way the letters have been input when the students answer in real time. The function to observe the real-time response of BeeDance is not provided in other LMS currently used in general.

**LMS for Computers**

**Blackboard Learn**

Blackboard Learn, which is used by many universities around the world and is the largest LMS in the world, was developed in 1997 and has the functions of course delivery, communication engagement and content management. It has various functions ranging from preparation of learning content, assignment, management to learning evaluation, which is extremely useful. It also has an effective communication function for information sharing and notifications with students, which can be said to be a very useful LMS for improving education efficiency. For tablets and smartphones, Blackboard Mobile is on sale. The mobile version is a simple type for PC, and it does not have any unique functions.

**Moodle**

Moodle, an open-source e-learning platform developed by Martin Dougiamas in 1999, is a learning management system that helps create high quality online courses. It contains such functions as content management, creation, questioning and management of exercise in quiz format, functions, and Forum. Although it is possible to browse and use tablets and smartphones, since it was developed for PC, it does not have specialized functions for tablets.

**Sakai**

Sakai, released in 2005 under the assistance from the Andrew Mellon Foundation, is educational software developed by various universities and organizations around the

world, and has the function of class management. Delivery of teaching materials, confirmation of strengthening, submission of tasks, examination, etc. can be carried out and managed. Also, it has a bulletin board and chat function. As it was developed for PCs in the same way of Moodle, there are no special features for tablets or smartphones.

## LMS for Tablets

### eden LMS

Kraft Works' eden LMS is a cloud-type e-learning system that can be used not only for PCs but also for tablets and smartphones. Although it can create and distribute learning contents, it can be said that it is suitable for internal compliance education, new employee education, or store staff training from the background developed for enterprises. It lacks features for handwriting input which is a feature of tablets and smartphones.

### Platon

Platon is a teaching material delivery, e-learning support system for PCs, tablets, smartphones sold by Logos Ware. It was developed for employee education to conduct conventional group training with e-learning, and seems not to be suitable for use at university. It is also impossible to observe the learning situation in real time.

### Learning Ware

Learning Ware is a learning management system sold by Pro-Seeds. In addition to PC, tablets and smartphones are also supported. Although it has functions such as learning management and video distribution, it is suitable for human resource development and management of projects at companies rather than for school education. It has no function of handwriting input and learning situation observation.

## BeeDance

### General Overview

Examples of development of lectures using BeeDance and their effects are reported in Shishido et al. (2016). Regarding functions, BeeDance is an LMS developed specifically for the uses on the iPad, is completely different from the LMS for general PCs, tablets, and smartphones as mentioned in the previous section. Main functions include response, image board, text board, recording, and file sharing. In the following, we will introduce the features and application examples of each function, and also describe the unique features of BeeDance.

### Response

With the response function, you can distribute the multiple choice questions (Figure 1) and descriptive questions all at once to the students, totalize the answers in real time (Figure 2), and project the results onto the projector. Everyone in the classroom can check the screens. For multiple choice questions, it is possible to create up to 5

choices. Immediately after answering, we can find out the comprehension level of the students. It can be used as a practice exercises like quizzes. In addition to questions, it can be applied to questionnaires as well. Furthermore, since it is possible to instantly show the result of the answers with a graph (Figure 3), the students can check the comprehension level of the whole class and the situation of their own answer. In the response function, after learning a word or grammatical matter, it can be used as a small test to check comprehension level. Fill-in-Blank type of questions is very effective for this function. Other LMS can also display questions of multiple choices and descriptive questions, however, displaying correct answers, showing graphs of correct answer rates, displaying response time and ranking (Figure 4) etc. are unique functions of BeeDance.
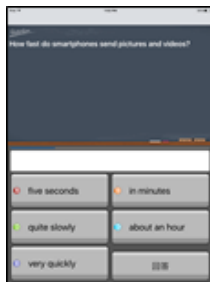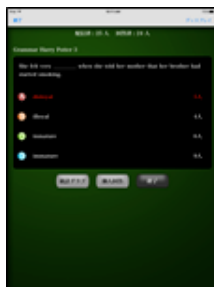


Figure 1: Response
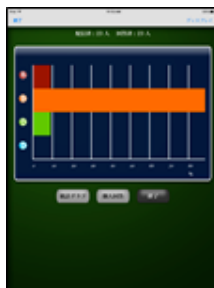


Figure 2: Checking answers



Figure 3: Graphic Statistics



Figure 4: Ranking and Time of Response

**Image Board**

Like the whiteboard, the image board function can be used for handwriting by students on a blank screen. Questions created with the jpg files format including images, picture, and illustration can be delivered simultaneously and handwritten answers can be observed in real time. It is also possible to correct the student's answer from the teacher's iPad and project it to the screen in the classroom. As exercises using the image board, as vocabulary study, writing hiragana, katakana, and kanji by handwriting are possible (Figure 5). It is possible to use this function for drawing and answering the words of the part indicated in the illustration or paintings explained orally by the teacher. We can project the screens of the students to the whole class through the projector (Figure 6), and observe the situation of answering by handwriting in real time. We can also correct mistake or mark on the student's screen (Figure 7). These are unique features provided only on BeeDance.


Figure 5: Handwritten Answer


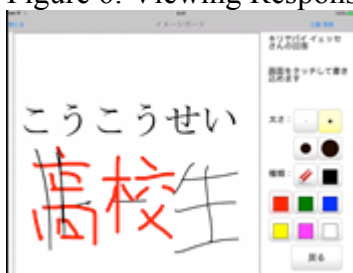Figure 6: Viewing Responses of Whole Class


Figure 7: Correction on Student's iPad

**Text Board**

The text board function (Figure 8) can distribute questions using images, video, and audio files all at once. The students can answer them by keyboard input, and the teacher can check the response status in real time. We can correct student's answer from the teacher iPad and project it to the screen. The text board function can be used like a simple Language Laboratory (LL) device. As an example of utilization, it is

possible to transmit video and audio files together with fill-in blank questions, performing dictation exercises. Although any typical LMS have a function to deliver audio and video files and present a question, the function of observing the response situation in real time and sending the comments back to the students iPad can be unique only for BeeDance. (Figure 9).


Figure 8: Text Board


Figure 9: Teacher's Comment on Student iPad

**Recording**

The recording function allows students to save the voice uttered by students as a file. Also, they can submit the saved file by sending it to the teacher. For the utilization of the recording function, we can let each student record their utterance and let the other students listen to the recorded voice, make mutual evaluation of the pronunciation, and so on. Also, since some students do not like giving a speech standing in front of the classroom and presenting them in a form to announce them in front of the classroom, we can also let them submit their own speech with the recorded file and the teacher later opens the audio file. We can listen and evaluate their speech later.

**File Sharing**

In the file sharing function, it is possible to deliver and receive files between the teacher and students. Major files of MS-Office such as Word, Excel, PowerPoint, PDF, jpg file, etc. can be saved. We can also attach a file attached to a mail and send it, or we can link with files of photos and videos taken on iPad.

**Analyzing Cognitive Understanding through BeeDance**

**Observation and Analysis of Learning Activities through Image Board**

**Observing Stroke Order through Image Board**

As computers have become widespread, writing of letters by hand has been getting less used, but for the learners who learn Japanese as a foreign language, it is considered important to acquire the stroke order of hiragana, katakana, and kanji. Rather than learning characters like a figure, we understand the characters from various meaningful influences such knowledges as stroke order, radicals, phonological, graphonomical, and semantic. Learning correct stroke order is fundamental to writing activities (Tamaoka & Yamada 1999).

In the image board function of BeeDance, learners can write letters by handwriting, and the teacher can observe the situation in real time (Figure 10). Since there is a limit to observing the state of all the students during the lecture, we connected the teacher's iPad to the Mac PC and used the Quick Time recording function to record the whole situation of the activity. After the lecture it is also possible to observe the whole situation slowly (Figure 11).


Figure 10: Observing Stroke Order of Kanji


Figure 11: Viewing Responses of Whole Class

**Cognitive Analysis from Observation of Stroke Order**

In the case of international students from the kanji areas, there are no particular problems with respect to writing stroke of kanji, but those from non-Kanji areas seem to feel difficulties in understanding stroke order. Regarding hiragana and katakana, regardless of kanji or non-kanji areas, it seemed to be influenced by how those students learned basic Japanese. Those who received formal Japanese guidance seem to understand relatively correct stroke order, but those who have started learning Japanese by self-taught and who did not receive guidance of proper stroke order at the basic stage are ambiguous in stroke order. We have found some differences in understanding of Japanese characters based on these factors:

1.  Where the students are from.
One of the students observed was from Taiwan. She was already familiar with kanji, had enough knowledge, and so she did not have big problems. On the other hand, the other three students in this experiment were from Indonesia and Finland and they were not familiar with kanji. They had big problems since they did not have enough knowledge necessary to understand kanji. However, hiragana and katakana seemed to be a little easier than kanji to learn the stroke order even for those students.

2. Formality of education

There were some differences in understanding of kanji between the students who learned Japanese formally and informally. Some students said that they have learned Japanese for the first time through reading manga, playing video games, or watching Japanese anime on TV. They did not receive any formal education of the Japanese language at the beginning. Those students seemed to have difficulties in understanding stroke order and made mistakes rather often. On the other hand, those who receive formal education of the Japanese language at the beginning did not seem to have major difficulties in writing. They have acquired correct orders of stroke from the beginning.

**Observation and Analysis of Learning Activities through Text Board**

**Observation of Learning Activities through Text Board**

With the text board function, we can ask dictation format questions to fill in blanks with video. When students answer, they use keypad to input characters. At that time, it is possible to observe the state of character input by each student in real time. (Figures 12 and 13)

Using the keypad, it is possible to observe and record what kind of difficulties the learners have when entering Japanese, such as conversion from Roman alphabet input to hiragana and katakana, selection of errors and typos in converting to kanji. As an example actually seen, it seemed that trial and error occurred when entering a loanword with katakana.


Figure 12: Typing


Figure 13: Over all

**Cognitive Analysis of Observing Learning Activities**

In the answer to the dictation type questions, when inputting the heard sound as a character, it was possible to observe the state of errors input from the influence of uncertain knowledge and mistakes in understanding. In terms of sounds, things that

cannot be entered accurately, even if they are used to listening, are noticeable when expressed in letters. From these aspects, it is considered that it is useful to use the text board to elucidate the cognitive understanding about character input.

**Conclusion**

As mentioned above, by using BeeDance, it is possible to observe various learning behaviors of learners in real time. As technology progresses in the future, behavior observation using tablets and LMS is expected to be useful for clarifying further cognitive understanding.

In conclusion, we can observe and analyze non-native students handwriting especially stroke of order through BeeDance. The recording with Quick Time is helpful for checking the response after class. We hope this method will help analyze student cognitive understanding of Japanese characters. However, we need further studies for this topic to clarify more details about cognitive understanding of Japanese characters by non-native speakers.

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