Development and Evaluation of a Feedback Support System with Audio and Playback Strokes

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ABSTRACT
This paper describes the development and evaluation of a handwritten correction support system with audio and playback strokes used to teach Japanese writing. The study examined whether audio and playback strokes have a positive effect on students using honorific expressions in Japanese writing. The results showed that error feedback with audio has a positive effect on low-level students and that error feedback with playback has a positive effect on high-level students. While with-playback error feedback can enhance the episodic memory of high-level students, it can also impose an increased cognitive load on low-level students. Therefore, it is advisable for Japanese language teachers to use different feedback strategies and offer appropriate types of error feedback according to the level of students in order to enhance their Japanese writing skills.

KEYWORDS
Second Language Acquisition, Tablet PC, Error Feedback, Learning to Write Japanese

INTRODUCTION
Error correction and grammar instruction are major, perhaps even the primary, components of writing instruction in second language (L2) classes (Ferris, 2005). At the same time, providing error feedback on students’ essays is a very complicated issue in L2 writing pedagogy. Teachers’ and theorists’ views of the importance of grammar, error correction, and accuracy have undergone several changes over time. As seen in the critical debate between Truscott (1999) and Ferris (1999), research results and theories on error feedback are inconclusive and are still being discussed from various perspectives. In line with Truscott’s arguments, some researchers indicated that they did not find any significant effects of instructors’ error feedback on writing outcome (e.g., Cohen & Robbins, 1976; Polio, Fleck, & Leder, 1998). On the other hand, others (e.g., Robb, Ross, & Shortreed, 1986; Frantzen & Rissel, 1987) affirmed the effectiveness of error feedback, citing the reduction of errors in students’ essays.

This study was conducted on the assumption that error correction, grammar instruction, and editing-strategy training have positive effects on the overall development of student writers. Researchers have reminded us that the accuracy of students’ papers will not magically improve by itself (Eskey, 1983; Horowitz, 1986). Some researchers have also emphasized the inherent difference between first language (L1) and L2 writers (Leki, 1990; Silva, 1988; Zhang, 1995). One of the inescapable differences between L1 and L2 student writers is that the nonnative speakers commit errors related to both negative transfer from their L1 and incomplete acquisition of the target language. Because L2 students, in addition to being amateur writers, are still in the process of acquiring the L2 lexicon and morphological and syntactic systems, they need explicit intervention from their teachers to compensate for these
deficits and to develop strategies for finding, correcting, and avoiding errors. Several studies have demonstrated that error feedback can help students improve their accuracy in the short term, that is, on revisions of the same essay or on targeted patterns of error over the course of a semester (Fathman & Whalley, 1990; Ferris, 1995; Lalande, 1982). Moreover, as noted by a number of researchers, students value teacher feedback on their errors and believe that it helps them to improve their writing (Cohen, 1987; Leki, 1991; Radecki & Swales, 1988). Most important, instructors need to work towards finding the best ways of helping their students become the “independent self-editors” of their own work (Bates, Lane, & Lange, 1993; Ferris, 1995). At this point, we can at least conclude that most language instructors and L2 learners believe in the potential of error correction, grammar instruction, and editing-strategy training to have positive effects on student writers’ overall development (Ferris, 2005).

Verbal feedback, often referred to as “writing conferences,” is one kind of feedback approach in L2-writing development. It involves teachers’ direct interaction with learners and negotiation of the meaning of texts in face-to-face situations (Ferris, 1995). This process entails careful and specific teacher guidance in order for students to apply suggestions to subsequent drafts and aims at fostering their writing processes and facilitating their comprehensive efforts in later revisions. Verbal feedback provides teachers with an opportunity to respond to the diverse cultural, educational, and writing needs of their students, clarifying meaning and resolving ambiguities while saving time spent in the detailed marking of papers (Hyland, 2000). Both teachers and students tend to be positive about the opportunities that oral feedback offers, and research has suggested that students typically receive more focused and useful comments in oral feedback than in written feedback (Zamel, 1985).

In addition, research has shown that multimedia can be used to enhance input and increase the likelihood of noticing in order to facilitate L2 acquisition (Mayer, 2005). For example, aural input in listening comprehension can be enhanced by the use of dynamic visual information, and the processing of linguistic information can be facilitated by the use of video (Neuman & Koskinen, 1992; Sharp, Bransford, Goldman, & Risko, 1995). Researchers have also reported that it is easier to recall information when that information is presented frequently and in different contexts (Smith, Glenberg, & Bjork 1978). The various factors of episodic memory, including time, place, and associated emotions, seem to work naturally together to support working memory (Tulving, 1983). For example, Eldridge, Lamming, and Flynn (1992) have reported that the use of a video diary system to record the characteristics of books or file cases helped the subject of an experiment remember more details by recalling the video elements related to the books.

There have been many papers on feedback in English as second language (ESL), yet there is little research that focuses on oral and playback feedback in learning Japanese writing. This study investigated the question of enhancing episodic memory with feedback content and error positioning not only by presenting handwritten error feedback with oral explanations, but also by showing the teacher’s correction process to incorporate the notion of time and position.

**LITERATURE REVIEW**

**Theory of Social Presence**

The presence of a teacher is an essential element for enhancing meaningful interactions to activate second language communication and is a strong predictor of satisfaction in educational environments (Garrison & Anderson, 2003). There are various views regarding the definitions of social presence. Originally, Short, Williams, and Christie (1976) proposed the concept of
social presence by using the term “salience” to describe sociopsychological or interpersonal phenomena. Gunawardena (1995) and Richardson and Swan (2001) defined social presence as “perception” or “the degree to which participants in mediated communication feel socially and emotionally connected” (Richardson & Swan, pp. 1545-1546) to the viewpoint of the recipient. On the other hand, Garrison and Anderson (2003) defined it in relation to the viewpoint of the sender as “the ability of participants in a community to project themselves socially and emotionally, as ‘real’ people, through the medium of communication being used” (p. 50). With regard to the factors for enhancing social presence, Gunawardena (1995) mentioned the degree of “intimacy” which depends on physical distance, eye contact, smiling, and the “immediacy” of the social interaction. Hackman and Walker (1990) examined the role of instructors in distance learning and found that both the verbal and nonverbal behaviors of the instructor have a positive effect on perceived learning and satisfaction: “Off-campus students felt as though they learned more when their instructor provided them with specific feedback on individual work through comments on papers, oral discussion or some other means, (or) solicited phone calls” (p. 202). Other studies also considered the effects of instructor immediacy in various learning environments, from the traditional classroom to distance education environments, and similarly found that such behaviors significantly influence the learning experience (Anderson, 1979; Freitas, Myers, & Avtgis, 1998). Accordingly, the current study considered providing nonverbal personalized handwritten feedback and verbal feedback to students to enhance the presence of instructors and enable them to better understand error feedback in an e-learning environment.

Noticing

Studies in the fields of cognitive science (Tomlin & Villa, 1994) and cognitive psychology (Carr & Curran, 1994) demonstrated that learning cannot take place without “noticing” input. Researchers in second language acquisition (Robinson, 1995; Schmidt, 1995) have examined methods to attract learners’ attention to the target structures. Some researchers have employed methods such as textual enhancement, input flooding, and processing instruction to guide students’ attention toward the target structures. Textual enhancement, for instance, highlights the forms to be noticed by using bold or uppercase letters, underlining, shadowing, and different fonts. However, the advantages of textual enhancement over unenhanced input have not been clearly demonstrated (Corbeil, 2007); some studies have reported no positive benefits, whereas others have (Leow 2001). Therefore, more studies are needed to clarify whether enhanced input can trigger attentional processes. The current study is an attempt to contribute to this line of research by seeking to determine whether learners find feedback enhanced by audio and playback strokes more effective in attracting learners’ attention and improving their accuracy than traditional methods.

Feedback Methods in an e-Learning Environment

There are many methods that teachers can use to correct students’ digital writing. For example, teachers can correct errors directly on students’ printed copies; they can also correct errors using Word’s comment function to insert corrections between lines or comments in the right-hand margin. When learners use Word to read the teacher’s feedback, they must click on the comments on the right-hand side of the page and follow the red line to determine which word is connected to the correction. This is inconvenient and results in students’ disregard of important feedback (Li & Akahori, 2006). Moreover, teachers can also add corrections with a mark-up language that can be used via the internet or email. For example, MATE and CoCoA support writing mark-ups with a stylus, facilitating cooperative and collaborative writing activi-
ties (Ogata, Hada, & Yano, 2001). Another possibility involves the use of an automated writing evaluation (AWE) system based on natural language processing to automatically check grammatical or structural mistakes (Yang & Akahori, 1998). AWE has become increasingly available for use in classrooms and large-scale assessments. For instance, e-rater and Criterion, developed by Educational Testing Service, can produce a holistic score and provide students with feedback on their essays. In validating AWE systems, most studies have emphasized evidence of agreement between computer-generated and human-generated scores (Burstein, Kukich, Wolff, Lu, & Chodorow, 1998; Foltz, Kintsch, & Landauer, 1998; Larkey, 1998; Page & Peterson, 1995). However, although AWE systems can supply varied feedback, none of them yields feedback that is remotely similar to what a trained writing instructor can provide, and the ability of students to utilize the feedback is questionable (Warschauer & Ware, 2006). As Otoshi (2005) revealed, Criterion encountered difficulties in detecting errors in all categories, and some of the model sentences were not considered to be effective unless learners could understand their errors. It is not at all clear that AWE can ever replace a human instructor’s feedback. Human instructors are still required to check local errors, as well as global errors, and to provide effective feedback.

**Pen-based Input Devices**

With the rapid development of tablet PCs, PDAs, and other touch-screen devices, it is now quite common to write directly on screens using pen-based input devices. In fact, many schools have attempted to introduce such input devices in their lectures or use them to improve their students’ performance (Lebow, Lick, & Hartman, 2004). Backon (2006) believed that the pen and digital ink are a part of a new paradigm that is closely connected to individual learning although research in this area is sparse. According to Backon, individual learning and creativity are more easily stimulated by a stylus than a keyboard. As an input tool, the keyboard is designed to communicate faster but not necessarily better. By contrast, the digital pen is an extension of the human hand, making it naturally connected to several regions of the brain. He stated that “the pen approach suggests more flexibility in teaching and learning” (p. 3). The analysis of both quantitative and qualitative data showed that the interactive software used in the pen-enabled environment engaged students more in learning by enhancing note taking, understanding, and communication, as well as increasing attention and motivation in the learning process. It appears that the use of pen-based devices can make our handwritten feedback on students’ writing easier, quicker, and more highly individualized, thereby making the computer look like paper, feel like paper, and in fact be better than paper.

**PREVIOUS RESEARCH AND DEVELOPMENT**

Prior to this study, the authors designed and developed an online correction system—Digital Ink Correction (DiNoCo). The system was developed using Microsoft Tablet PC SDK and Agilix InfiNotes control and includes rich ink note-taking tools such as lines, highlights, color, eraser, extend tools, and so on. With this online system, students can send writing assignments to the teacher, and the teacher can use the system to correct the students’ errors and send the assignments back to students. The authors conducted a comparative evaluation project using paper, Word, and DiNoCo prior to the study described here to investigate whether there were different effects on the students’ learning. Those results showed that the students who used handwritten-based feedback provided by DiNoCo were able to recall more corrections than those who used the other two media. The students were also able to become aware of the corrections more easily and pay greater attention to the teacher’s corrections in the handwritten mode (Li & Akahori, 2006).
For the present study, we updated DInCo so that it could supply multimedia information to increase students’ noticing by enabling them to play back the teacher’s handwritten corrections and listen to the teacher’s oral explanations. When a new stroke is written on the tablet PC, the new handwritten stroke and elapsed time are recorded, and the teacher’s explanation of the error is simultaneously recorded using a microphone. Thus, the students could playback the handwritten correction along with the teacher’s oral explanation in total synchronization (see Figure 1).

Figure 1
Sample DInCo Display

The present study focuses on the integration of oral explanations and playback strokes in handwritten error feedback in order to create an e-learning environment that more closely resembles traditional face-to-face, paper-based written corrections by language teachers. The study explores the use of audiovisual effects as a way to promote greater noticing and learning than the usual method of providing only handwritten feedback. The study also evaluates students’ reactions to the use of such a personalized system as a learning tool and investigates whether there is any relationship between the students’ perceptions of the system’s effectiveness and their actual learning outcomes.
In sum, the hypotheses of this study are as follows:

1. Oral explanation or playback strokes coordinated with handwritten feedback generate a positive effect on learners’ perceptions when learning Japanese writing.

2. Oral explanations or playback strokes coordinated with handwritten feedback has a positive effect on memorization of strokes.

**METHOD**

**Participants**

A total of 84 Chinese students at a Japanese language school in China participated in the study. All the students had Chinese as their first language and enrolled in the language school to learn Japanese as a second language. Forty-four students were in an advanced class (those who had studied Japanese for about 1 year), while the other 40 students were in the intermediate class (those who had studied Japanese for a half year). All the students had experience in using computers and browsing the internet.

**Materials**

To create authentic material for use in the study, the authors asked a Japanese language teacher to use DInCo on a tablet PC to provide error feedback on a writing sample from a Chinese student. The teacher’s oral explanation and handwritten feedback strokes were recorded by the system. The writing sample consisted of a letter addressed to a high-profile individual for which the use of honorific expressions is required. Unlike Japanese, Chinese does not have a great variety of honorific expressions. Ho (1999) reported that modern Chinese had lost the majority of its honorific expressions by the middle of the twentieth century, and, accordingly, Chinese students learning Japanese may well encounter difficulties in mastering honorific expressions (Miyaoka & Tamaoka, 2001). As a result, the teacher made several corrections to errors in the use of honorific expressions in the writing sample. The corrected writing sample was then used in the study.

**Procedure**

We employed a 2 X 2 design to examine the effects of audio and playback variables, resulting in four treatment conditions: (a) no-sound and no-playback stroke correction, (b) no-sound and with-playback stroke correction, (c) with-sound and no-playback stroke correction, and (d) with-sound and with-playback stroke correction.

First, all the students took a pretest with 20 fill-in-the-blank questions on Japanese honorific expressions in which they completed the sentences with the correct forms of the Japanese honorific expressions provided in parentheses. The students were then randomly assigned to one of the four treatment groups. They were given 30 minutes to review the writing sample with the teacher’s feedback, study the errors in the sample, and determine why they were in fact errors based on the teacher’s handwritten feedback with/without oral explanation and with/without playback strokes. The students were then asked to complete a questionnaire about the feedback provided by the teacher.
Finally, after completing the questionnaire, the students took a posttest in which they corrected the same writing sample on paper to check how much of the feedback they were able to understand and recall after reviewing the sample with the teacher’s feedback. All of the data obtained from the pretest, the questionnaires and the posttest were submitted to analysis.

RESULTS
Analysis of the Pretest
First, a Japanese teacher was asked to score the answers on the pretest. Then, an analysis of variance was conducted to determine whether the four groups differed in their performance of Japanese honorific expressions. No significant difference was found among the four groups’ mean scores. This result showed the similarity of the four groups, which enabled us to make further comparisons in the survey that followed. The students were divided into high-score or low-score groups based on their pretest scores, and the following comparison analyses were conducted using the answers of the two groups.

Analysis of the Questionnaires
A questionnaire was designed with 22 items on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much) (see questionnaire in the appendix to this article). A 2 (with or without audio) X 2 (with or without playback strokes) ANOVA was used to assess students’ perceptions of the effect of audio or playback-stroke variables as indicated in their responses to questionnaire items. The ANOVA results revealed an interaction tendency between audio and playback strokes on the item “Are you satisfied with the corrections?” $F(1, 84) = 3.20, p = .07,$ and the item “Do you understand the teacher’s corrections?” $F(1, 84) = 3.35, p = .07.$ A significant main effect of the use of audio was found between the with-audio and no-audio groups on the item “Can you follow the process of the teacher’s corrections?” $F(1, 84) = 16.00, p < .01,$ and the item “Do you understand the teacher’s corrections?” $F(1, 84) = 8.78, p < .01.$ A more important, main effect for playback stroke between the with-playback stroke and no-playback stroke groups was found on the item “Do you feel that the teacher has corrected the writing earnestly?” $F(1, 84) = 4.74, p < .05,$ and the item “Do you feel as if the teacher is sitting beside you and correcting the writing?” $F(1, 84) = 3.56, p < .05.$ These findings provided partial support for the hypothesis that audio and playback-stroke variables have a positive effect on students’ perceptions of the effectiveness of the audio and playback-stroke procedures and their satisfaction with them.

Factor analysis was also conducted to categorize the items in the questionnaire. The results showed that students’ responses in the survey could be grouped into five factors as follows: “learning attitude,” “effectiveness of media,” “requirements of online environment,” “satisfaction with correction,” and “social presence.” Considering the factor loading, the initial 22 items were reduced to 17, and the number of items in each category turned out to be 6, 4, 2, 2, and 3, respectively. The five factors accounted for 64.4% of the variance. The reliability (alpha) coefficients for the five factors were 0.846, 0.671, 0.733, 0.643, and 0.533, respectively. Therefore, these items seemed to be sufficiently reliable for assessing the students’ responses.

A 2 X 2 ANOVA was further conducted to evaluate the effects of audio and playback-stroke variables on the five factors with regard to the low-score and high-score groups (see Table 1).
Table 1
Means and Standard Deviations of the Factors for the Low-score and High-score Groups

<table>
<thead>
<tr>
<th>Factors</th>
<th>No audio</th>
<th>With audio</th>
<th>No audio</th>
<th>With audio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Low-score group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning attitude</td>
<td>3.79 (.52)</td>
<td>3.22 (.98)</td>
<td>3.75 (.88)</td>
<td>3.35 (.86)</td>
</tr>
<tr>
<td>Effectiveness of media</td>
<td>4.29 (.44)</td>
<td>3.25 (.25)</td>
<td>4.53 (.21)</td>
<td>3.07 (.88)</td>
</tr>
<tr>
<td>Requirements of online environment</td>
<td>3.50 (.82)</td>
<td>3.67 (.58)</td>
<td>3.88 (.69)</td>
<td>3.94 (.58)</td>
</tr>
<tr>
<td>Satisfaction with correction</td>
<td>4.00 (.41)</td>
<td>3.33 (.29)</td>
<td>4.38 (.35)</td>
<td>3.50 (.79)</td>
</tr>
<tr>
<td>Social presence</td>
<td>3.19 (.66)</td>
<td>3.22 (.38)</td>
<td>4.33 (.53)</td>
<td>4.15 (.75)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-score group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning attitude</td>
<td>3.67 (1.02)</td>
<td>3.47 (.92)</td>
<td>3.12 (.92)</td>
<td>3.40 (.68)</td>
</tr>
<tr>
<td>Effectiveness of media</td>
<td>4.04 (.93)</td>
<td>4.07 (.45)</td>
<td>3.62 (.78)</td>
<td>3.69 (.85)</td>
</tr>
<tr>
<td>Requirements of online environment</td>
<td>4.14 (.75)</td>
<td>3.36 (.92)</td>
<td>3.50 (1.29)</td>
<td>3.88 (.77)</td>
</tr>
<tr>
<td>Satisfaction with correction</td>
<td>4.07 (.84)</td>
<td>3.55 (.47)</td>
<td>3.63 (1.03)</td>
<td>3.58 (.51)</td>
</tr>
<tr>
<td>Social presence</td>
<td>3.43 (1.22)</td>
<td>3.12 (1.24)</td>
<td>4.42 (.79)</td>
<td>3.92 (1.05)</td>
</tr>
</tbody>
</table>

The results showed that there was a significant main effect for audio on the factor “social presence” for both the low-score group, $F(1, 23) = 14.70, p < .001$ (see Figure 2) and the high-score group, $F(1, 30) = 4.39, p < .05$ (see Figure 3). The students who reviewed the with-audio corrections reported a higher level of presence than those who reviewed the no-audio corrections. The result supported our assumption regarding the positive effect of providing oral error feedback to students.
There was also a significant main effect of playback strokes on the factor “effectiveness of media,” $F(1, 23) = 10.54, p < .05$ (Figure 4) and the factor “satisfaction with correction,” $F(1, 23) = 10.90, p < .05$ (Figure 5) for the low-score group students. The students who studied no-playback stroke corrections felt more satisfied and thought that this way was more effective than studying with-playback stroke corrections. The result failed to support our assumptions regarding the positive effects of providing playback-stroke error feedback to students.

Analysis of the Corrected Writings

After answering the questionnaire items, the students completed the posttest in which they corrected the writing sample by recalling the teacher’s feedback and identifying the errors. A Japanese language teacher who had taught Japanese for 10 years counted the number of both correct and incorrect answers. All the corrections patterns done by the students in the posttest were classified into four types: F-C (false to correct), F-F (false to false), C-F (correct to false), and C-C (correct to correct). That is to say, the students’ self-corrections were not the same as those of the teacher since the students tended to make similar mistakes repeatedly (Ishibashi, 2000). This is because the students had learned Japanese for only a limited time and were not very familiar with the honorific expressions as yet. In addition, they could not understand all the handwritten error feedback supplied by the teacher. In this study, we only considered the F-C (false-to-correct) pattern, cases in which the students successfully replicated the teacher’s corrections. By investigating the F-C pattern, we could assess how well the students were able to understand or recall the teacher’s feedback with oral explanation or playback strokes.

A 2 X 2 ANOVA was conducted to evaluate the effects of audio and playback-stroke variables on the F-C number for both the low-score and high-score group students. Table 2 shows the mean number of F-C corrections in the posttest.
Table 2
Means and Standard Deviations of the F-C Corrections in the Low-score and High-score Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>No audio M (SD)</th>
<th>With audio M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-score group</td>
<td>9.57 (4.35)</td>
<td>5.60 (3.51)</td>
</tr>
<tr>
<td>High-score group</td>
<td>10.71 (4.15)</td>
<td>14.36 (3.08)</td>
</tr>
</tbody>
</table>

The ANOVA results indicated that there was a significant interaction effect between audio and playback strokes in the low-score group, $F(1, 29) = 15.17, p < .001$ (see Figure 6). Within the no-playback stroke condition, there was no significant difference in the F-C numbers between the students who reviewed the no-sound correction ($M = 9.57$) and those who read the with-sound correction ($M = 7.08$), $p > .05$. However, within the with-playback stroke condition, those in the with-audio condition ($M = 13.56$) showed a significantly higher number of F-C corrections than those under the no-sound condition ($M = 5.60$), $p < .05$. Again, the result supported our assumption regarding the positive effects of providing oral error feedback to students.

There was a significant main effect for the playback-stroke condition on the F-C numbers of the high-score group students, $F(1, 33) = 9.45, p < .005$ (see Figure 7). Within the no-audio condition, those under the with-playback condition ($M = 14.36$) showed a significantly higher number of F-C corrections than those under the no-playback condition ($M = 10.71$). Moreover, within the with-audio condition, those in the with-playback condition ($M = 14.64$) showed significantly higher numbers of F-C corrections than those under the no-playback condition ($M = 9.60$).

**DISCUSSION**

The primary purpose of this study was to determine the effects of handwritten feedback with audio and playback strokes on students’ learning L2 writing. Another purpose was to examine the memorization outcomes after reviewing such error feedback.
First, the hypothesis that the teacher’s oral explanation has a positive effect on the students’ perception was partially supported. The questionnaire results showed that there was a main effect for audio on the factor “social presence” both in the low-score and in the high-score groups. Moreover, in the posttest, among the students under the with-playback stroke condition, the students in the low-score group under the with-audio condition showed significantly higher numbers of F-C corrections than those under the no-sound condition. However, in the high-score group, there was no significant difference between the F-C number in the students who reviewed the no-sound corrections and those who studied the with-sound corrections.

These results indicate that the with-sound corrections had a positive effect on the low-score group, but not on the high-score group. This may be because the low-score students could not understand the handwritten error feedback. They needed more information (through additional explanation) to understand why there was an error and learn how to correct it. Contrary to this result, the high-score group students had sufficient knowledge to understand the error feedback with only an indication of an error, even without the teacher’s explanation. As the expertise reversal effect of cognitive load indicates, when instructional procedures such as physically integrating multiple sources of information lose their advantage with increasing learner expertise, they become disadvantageous compared to split-source visual presentation because information that is essential for novice learners becomes redundant for expert learners (Kalyuga, Ayres, Chandler, & Sweller, 2003). These results suggest that language teachers should supply personalized error feedback according to learners’ level of language proficiency since low-level students need more explanation to learn how to correct their errors, while high-level students need only error indication to identify and correct errors by themselves.

Second, the hypothesis that the playback strokes enhance students’ episodic memory was also partially supported. In the analysis of the posttest, among the students under both the no-audio and with-audio conditions, those under the with-playback condition showed a significantly higher number of F-C corrections than their counterparts under the no-playback condition. This shows that the playback strokes had a positive effect on the high-level students’ episodic memory. They could identify more corrections by recalling the positions where the error feedback appeared. On the other hand, among the students under the with-playback stroke condition, those under the no-sound condition showed a significantly lower number of F-C corrections than their counterparts under the with-audio condition in the low-score group. In addition, the questionnaire results showed that the students in the low-score group who reviewed no-playback stroke corrections felt significantly more satisfied and thought that this method was more effective than those who studied the with-playback stroke corrections.

These results failed to support our assumptions regarding the positive effects of providing error feedback with playback strokes to students. This is probably because the information in the form of playback strokes places a large cognitive load on the low-level learners, resulting in attention dispersion and a negative effect on memorization. As research about the split-attention effect of cognitive load indicates, attention will be split between multiple sources of visual information that are all essential for understanding (Sweller, Chandler, Tierney, & Cooper, 1990). Multiple sources must be mentally integrated before the instruction can be understood and the material learned. Mental integration imposes a heavy extraneous cognitive load that is reduced by physically integrating the multiple sources of information. Moreover, the redundancy effect of cognitive load will also occur when there are multiple sources of information in which one source is sufficient to allow understanding and learning while the other sources merely reiterate the information of the first source in a different form—they are redundant (Chandler & Sweller, 1991). In sum, episodic memory could be enhanced for the high-level students owing to the playback strokes, but it could place a heavy cognitive load.
on the low-level students. This suggests that appropriate types of error feedback should be offered to the learners; otherwise, the redundant information can have a negative effect on students.

Furthermore, according to the questionnaire results, the students could understand the error feedback more deeply and felt a stronger teacher presence by reviewing the feedback coordinated with audio. Although the students read all the feedback on a computer, they felt as though the teacher was correcting the writing in person. This shows that the teacher’s oral explanation strengthens the relationship with the students and has a positive effect on students’ learning motivation.

LIMITATIONS OF THE STUDY
In this study, the with-audio and with-playback handwritten feedback was the most complex method. This kind of audiovisual information had measurable effects on student learning in the study, but playback speed and the synchronization between the audio and playback strokes may have also produced unexpected effects. Some students claimed that the playback speed was so slow that they had to wait until it finished to get the whole picture of what the teacher had written. Some said they did not have the patience to wait for the playback to finish, and other students stated that the teacher’s oral explanation did not quite synchronize with the playback strokes because the playback stroke process took longer than the oral explanation process. In fact, the language teacher was not familiar with writing error feedback on the tablet PC, so she wrote rather slowly. As a result, some students felt bored because after they listened to the oral explanation, they had to wait for the strokes to be played back.

Another limitation was that the study period was conducted over a short term. Thus, the data collected in the study may have only represented the students’ perception of the feedback and their short-term memory changes. Moreover, since all the participants were receiving this kind of feedback for the first time, both their anxiety with and curiosity about the media would have also affected the results of the study.

Considering all these limitations, further studies focusing on the speed of playback strokes and the degree of synchronization between audio and playback strokes are needed to examine the influence of the integration of audiovisual information. In addition, long-term studies should be conducted to evaluate whether handwritten feedback with oral explanations or stroke playback is more effective than other forms of feedback at promoting greater awareness in support of learners’ self-correction and improvement in their writing performance.

CONCLUSION
In this study, the authors introduced a handwritten feedback support system with audio and playback strokes and undertook a research project to determine whether audio and playback strokes have positive effects on students’ Japanese writing skills. First, the results of the questionnaire showed that both the low-level and high-level groups felt a high level of social presence on the part of the teacher when using the with-audio feedback. Furthermore, the low-level group students showed more satisfaction with corrections and felt greater effectiveness of the media than the high-level group under the no-playback stroke condition. Second, analysis of the corrections made by the students demonstrated that the with-audio error feedback had a positive effect on the low-level students, while the with-playback error feedback had a positive effect on the high-level students. Apparently, the with-playback er-
ror feedback enhanced the high-level students’ episodic memory, while, at the same time, imposing a substantial cognitive load on the low-level students. Overall, this study suggests that language teachers should use different feedback strategies and offer appropriate types of error feedback according to the level of students’ language proficiency in order to enhance their writing skills and motivation to learn when studying Japanese writing. However, given the limitations of the study, more research on this and other methods of giving feedback is needed to assess their effectiveness for students’ actual learning outcomes.

REFERENCES


**APPENDIX**

**Questionnaire**

1. Do you think error feedback is important for you?
2. Can you identify whose handwriting the feedback was given by?
3. Can you recognize the feedback was provided by the teacher herself?
4. Can you follow the process of teacher’s corrections?
5. Did it take much time to read the feedback?
6. Did the handwritten feedback catch your attention naturally?
7. Was it easy to read the teacher’s feedback in this way?
8. Did you understand the teacher’s corrections?
9. Are you satisfied with the corrections?
10. Do you like this style of feedback?
11. Did you feel closer to the teacher?
12. Did you feel that the teacher had corrected the writing earnestly?
13. Did the feedback improve your understanding of the nature of errors?
14. Did the feedback enhance your motivation for learning Japanese?
15. Did the feedback increase your trust in the teacher?
16. Did the oral explanation help your understanding of the errors?
17. Did the playback strokes help your understanding of the errors?
18. Did you feel as if the teacher was sitting beside you and correcting the writing?
19. Do you like to receive this kind of feedback through the internet?
20. Do you like to submit your writings online?
21. Please write down your comments, if any, on the system.
22. What do you expect of the teacher’s feedback in the future?

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