

**A Review of Japanese CALL for Kanji, Vocabulary, and
Reading:
Findings, Best Practices and Future Directions**

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Abstract

This article reviews the last two decades of CALL research for kanji, vocabulary, and reading to shed light on the effects of CALL on learning and teaching Japanese. A review of kanji studies reveals, for instance, that although online games are implemented by teachers to increase motivation for kanji learning, gamification has been found to be more motivating and results in more time on task. Vocabulary studies reveal what types of glosses are the most effective (e.g., L1/L2 definition, audio) and how vernacular games can enhance vocabulary learning. The reading research shows, among other things, that online materials offer a variety of topic material likely to motivate students, but that use of online tools is necessary to mitigate cognitive overload. With so many teachers propelled into online delivery due to the pandemic, this is a timely examination of student outcomes, pedagogical best practices, and future directions.

Keywords: Teaching Japanese as a Foreign Language; Computer-Assisted Language Learning; Kanji Acquisition; Vocabulary Acquisition; Reading

Introduction

For the past two decades, technological innovations have created a boom in research on and interest in Japanese computer-assisted language learning (CALL). The recent global pandemic has made this research more relevant than ever as a sudden shift to online learning has forced teachers around the world to engage in online teaching. Besides Zimmerman and McMeekin's (2019) recent volume of Japanese CALL studies, fewer CALL studies are conducted on less commonly taught languages (henceforth LCTLs) and on non-alphabetic LCTLs, like Japanese, in particular. Moreover, many of these studies are not included in major CALL reviews (see Golonka, Bowles, Frank, Richardson, & Freynik, 2014; Grgurovic, Chapelle, & Shelley, 2013; Li & Swanson, 2014; Sauro, 2016; Wang & Vasquez, 2012), resulting in a lack of access to reviewed and condensed information on LCTL CALL that teachers could use to improve their application of technology both in online and face-to-face environments.

Of particular concern for teachers of Japanese is anything associated with reading and writing, which includes kanji, vocabulary, and reading. Teachers struggle with how to teach these in a typical face-to-face classroom let alone in an online environment. This article reviews the last two decades of Japanese CALL research and provides teachers and scholars with critical information on learning outcomes and best practices when using CALL for teaching and learning kanji, vocabulary, and reading. Accordingly, the studies included in this article focus on learning outcomes and/or best practices supported by either empirical (e.g., pre-, post-test scores) or qualitative evidence (e.g., student/teacher-reported, questionnaires, interviews).

The studies reviewed were found through a manual search (years 1999-2019) of journals related to CALL and/or Japanese.

Searches were also conducted via ERIC, Linguistics and Language Behaviors Abstract (LLBA), and the MLA International Bibliography. We included journal articles, chapters in books, and some dissertations, primarily when few articles had been published on the subject at hand. A quick note is also warranted about the overlap in some sections. Since research on kanji, vocabulary, and reading for learners of Japanese often overlap (e.g., reading involves kanji and vocabulary learning), the studies reviewed may appear in more than one place where applicable.

The Review

Kanji

One of the most challenging aspects of Japanese, learning kanji (Chinese characters), has received much attention from the beginnings of CALL research. Komori and Zimmerman (2001) were the first to review and critique web-based kanji learning programs and found that the programs had the potential to enhance autonomous kanji learning with the features provided (e.g., character readings, compound word examples, stroke number and stroke order shown in linked video files). While their review of online kanji programs evaluated what kanji CALL programs could offer, other studies sought to investigate how CALL affects kanji learning in general. The general trend in CALL research is to investigate issues that have been found to affect kanji learning in non-CALL contexts. For instance, some researchers have studied how different types of supplemental CALL activities affect important aspects of kanji learning like strategy use (Kuo & Hooper, 2004; Lin, Kajita, & Mase, 2007; Nesbitt & Muller, 2016) or affective factors like motivation (Van Aacken, 1999; Lin, Kajita, & Mase, 2007; Nesbitt & Muller, 2016; Sauerland, Broer, & Breiter, 2015). Still, other studies have examined how reading authentic texts in different CALL contexts (as opposed to paper-based) can facilitate incidental learning of kanji

(deHaan, 2005; McMeekin, 2019; Peterson, 2016). Lastly, although it does not mirror non-CALL issues, one study has examined how face-to-face classroom kanji instruction can be completely replaced by flipped instruction (Mori, Omori & Sato, 2016).

CALL: Kanji Strategies and Motivation

To provide some background, in the wider field of non-CALL Japanese second language acquisition (SLA), strategy use and motivation have been found to affect kanji learning at a fundamental level (Kondo-Brown, 2006; Mori & Shimizu, 2007). Considering one has to know 2,000+ kanji to be literate in Japanese, students who have underdeveloped kanji strategies, low motivation, anxiety, and negative beliefs struggle with learning kanji. One of the fundamental beliefs about L2 kanji instruction is that students are likely to be more successful when employing various strategies to help with kanji learning (Gamage, 2003a, 2003b). Motivation, likewise, is an essential component of studying kanji. Due to the large number of kanji to be learned, the difficulty of memorizing the meaning, writing, and multiple readings, students often get discouraged, and demotivation is commonplace (Hamada & Grafström, 2014; Haththotuwa-Gamage, 2006; Matsumoto, 2007). It follows that researchers investigating the effect of kanji CALL programs on learning would be most interested in these two factors, sometimes looking at both issues in a single study.

Van Aacken (1999), for instance, examined correlations between students' (n=6, 1st year) motivation for learning Japanese, attitudes toward CALL, and learning strategies when using a kanji CALL program (CALL-Kanji Quiz). Based on surveys, most students reported instrumental motivation (e.g., studying Japanese for one's career) to learn Japanese and this strongly correlated with the use of metacognitive strategies (e.g., planning, organizing) as well as a positive attitude toward the use of CALL. On the other hand,

Van Aacken found a negative correlation between integrative motivation (e.g., wanting to socialize) and attitudes toward using CALL. She concluded that students who report more integrative motivation may use more social kanji learning strategies (e.g., asking/working with others), and for this reason, they may be less positive about using CALL. While Van Aacken's study suggests that different types of motivation may affect students' attitudes toward CALL and strategies, the low number of participants means the findings are tentative at best.

Lin, Kajita, and Mase (2007) similarly investigated strategies but focused solely on mnemonic strategies aimed at learning kanji. Their goal was to see how the use of a mobile (non-cell phone) device which uses audio/visual mnemonic aids (based on Heisig, 1986) and a flashcard quiz component might affect students' use of strategies and anxiety toward kanji learning. Comparing the pre- and post-questionnaire/survey results of eight beginner students, they found that the program increased students' knowledge and ability to use kanji learning strategies (mnemonic) and differentiate kanji, as well as lowered their anxiety. Because of the small number of participants, results are not conclusive, but suggest that programs designed to facilitate strategy use rather than just rotely introducing kanji can help students build a strategy base. This, in turn, may build confidence and lower learner anxiety for more successful kanji learning.

Other research shows that self-generated mnemonics may be more useful than supplying pre-made ones for long-term retention (Kuo & Hooper, 2004) and that dual coding (visual + verbal) may be more effective than single coding (Mayer & Sims, 1994). Using a computer program to investigate the learning outcomes of different mnemonic conditions of 92 high school students (no knowledge of Chinese characters), Kuo and Hooper (2004) looked at five experimental groups: 1) Translation – participants were provided with L1 translation and instructed to memorize, 2) Verbal – a verbal

mnemonic was provided based on etymology, 3) Visual – a picture was shown that represented the kanji, 4) Dual coding (visual + verbal) – a combination of conditions 2 & 3, and 5) Self-generated mnemonic – participants were given L1 translation and told to generate a mnemonic. Immediate and delayed post-kanji tests revealed that students in the self-generated mnemonic condition had the highest level of achievement on both tests (dual coding was second) and spent three to four times more time on task, but that the difference between the self-generated and dual coding condition was not significant. They also found that students had difficulty generating mnemonics for abstract words, and this was reflected in more errors on their delayed-post tests. More so than the previous studies with fewer participants, Kuo and Hooper's study with 92 participants offers more solid conclusions that can perhaps be generalized. Their study shows, for a significant number of students, that CALL programs should either prompt students to create their own mnemonics or offer dual coding, but that for abstract kanji words, programs should offer help in creating mnemonics.

In terms of motivation studies, Nesbitt and Muller (2016) found that their study on three digital games they designed to motivate second-level students (n=38) of Japanese to study kanji had mixed results. While some students reported (via post-questionnaire and journal entries) that the digital games were fun and motivating, several preferred to use online flashcards and stopped using the digital games partway through the class. Nesbitt and Muller (2016) concluded that although the games were likely to motivate some students, others preferred a more straightforward, easy-to-use system like flashcards (i.e., rote memorization) for learning kanji, and that creating digital games for an educational environment perhaps overcomplicated learning. One is left wondering, however, if students at higher or lower levels would evaluate the use of these types of games differently.

In a slightly different twist on gaming, Sauerland, Broer, and Breiter (2015) compared the motivation and success rates of two groups of beginner students using a CALL kanji writing app (flashcard-like) on Android. One group (n=10) used the gamified version (e.g., points, badges, a storyline, and "fights" with other kanji drawers), and the other (n=9) used the normal version (basic flashcard version). They found that although both groups of students' success rate in learning the kanji via the app was around 80% per kanji, the gamified group showed slightly better success per kanji than the normal group. Moreover, based on usage statistics, they found that the gamified groups used the app more often and longer, indicating that their motivation to use the app for kanji learning was higher than the other group. Thus, while Nesbitt and Muller's (2016) findings suggest that students may not prefer digital learning games made for classroom study over straightforward flashcard-type programs, Sauerland, Broer, and Breiter (2015) suggest that gamification may be effective in terms of motivating students and improving their success rates.

Learning Kanji in Context

Besides kanji strategies and motivation, an issue that has received much attention in non-CALL kanji learning is learning kanji in context through reading, whether sentences or entire texts (Everson & Ke, 1997; Mori & Nagy, 1999; Mori & Shimizu, 2007; Mori, Sato, & Shimizu, 2007). Studies on this noted several findings; that the perception students have of kanji being difficult was associated with more rote memorization strategies as opposed to learning kanji in context (Mori & Shimizu, 2007), that reading kanji in context tends to help students learn novel kanji (Mori, Sato, & Shimizu, 2007), that learners are best able to recognize kanji when they use cues from the kanji itself (e.g., morphological information) along with information derived from context (Everson & Ke, 1997; Mori & Nagy, 1999), and

finally that students should be given opportunities for extended reading so as to develop more intrinsic motivations for learning (Grabe, 2004, 2009).

In this same vein, some CALL studies, rather than using flashcards or instructional games, have looked at learning kanji in context such as in online reading tasks or playing vernacular games (i.e., not designed for instructional use) (deHaan, 2005; McMeekin, 2019; Peterson, 2016). The focus is often on incidental learning of kanji, rather than a specific focus on teaching kanji through these contexts. Peterson's study (2016), for instance, asked a simple question: whether kanji recall is better in an in-print versus digital reading environment. He compared students' (n=27, 3rd semester) immediate post-activity kanji recall in three different conditions 1) print-text readings, 2) online readings, and 3) reading game-based text in a vernacular game (Tomodachi Life). Peterson found that immediate kanji recall (students wrote down kanji they recalled) was better for the online readings than the print-text condition and that there was no statistical difference between the online readings and game condition. For the difference in print-text and online condition, Peterson noted that the ease of cutting/pasting into Google Translate in the online condition (vs. typing words into Google Translate in the print-text condition) might have allowed students to process more kanji/vocabulary, which possibly facilitated better recall.

McMeekin (2019) also looked at immediate post-activity kanji recall, examining whether online reading activities could facilitate kanji learning. Students (n=13, intermediate - 3rd semester) were asked to complete an online reading task (TripAdvisor.jp) using a pop-up hypertext dictionary (*Rikai*) and a supplemental task sheet. Immediately after the activity, students were asked to do a kanji free recall. The students mainly recalled kanji that were both targeted on the task sheet and at the i+1 level (the level just beyond a student's

current level of ability; Krashen, 1985). However, out of pure interest, some students also recalled kanji beyond the $i+1$ level that were not on the task sheet. Besides using the pop-up dictionary, students also reported using both top-down (inferring the meaning of kanji based on context, schema) and bottom-up strategies (using semantic, phonetic information of kanji) to guess the meaning of the unknown kanji. McMeekin's study thus suggests that supplemental materials are essential to promote the recognition of specific kanji, but that kanji beyond the $i+1$ level is not likely to be recalled unless student interest motivates them to do so. Moreover, the study suggests that online reading provides contextual cues that support student use of a variety of kanji recognition strategies.

Adding another layer of understanding to gaming/gamification and kanji learning, deHaan (2005) explored incidental kanji learning (unrelated to kanji taught in class) and attitudes toward gaming using a vernacular Nintendo baseball game. He found that his subject ($n=1$, advanced - 7 semesters) was motivated to play the game (an admitted gamer) and that his ability to recognize kanji (pre/post- test) that appeared in the game increased over one month. However, the subject admitted that it was difficult to be successful at the game and pay attention to learning at the same time. The study thus tentatively suggests that for students who like games, gaming might be one way to facilitate kanji learning. However, it also supports Brett (2001), who noted that there is often a tension between learning from a game and trying to play it successfully because too many things to process (e.g., audio, video, text and game tasks) can cause cognitive overload and make learning difficult. With only one participant, however; these findings are not generalizable to the general population.

Flipped Kanji Learning

In a departure from studies that examine technology as a supplement to classroom kanji learning, Mori, Omori, and Sato (2016) looked at replacing traditional classroom kanji instruction study with out-of-class technology use. Comparing CALL and non-CALL conditions, they investigated how online tools including tutorial videos, a flashcard app (Quizlet), games (Quia), and Blackboard quizzes used in a flipped/non-flipped condition affected the post-lesson kanji test scores of 46 mixed beginner (1st semester) and intermediate (3rd semester) students. The results showed that the beginner students' kanji scores increased in the flipped condition in the first semester but were the same for both conditions in the second semester, while there was no significant difference for either condition for the intermediate students. Additionally, similar to Nesbitt and Muller's (2016) study, students reported that the games were the least helpful. The intermediate students, in particular, preferred the flashcard approach over the videos and games, perhaps explaining why there was no difference in the flipped vs. non-flipped conditions (i.e., they did not use all the CALL resources provided). The takeaway is that online tools can be just as effective or sometimes (especially for beginners) even more effective than traditional teaching methods for kanji teaching/learning, but that instructors may not want to spend time creating games if students prefer simple flashcard programs.

Overall Findings for Kanji Learning

Overall, the findings on technology use for kanji learning are tentative given some of the smaller number of participants in the studies. Nonetheless, they suggest that CALL programs can facilitate learning, increase motivation, and improve the use of kanji learning strategies, but that these claims are affected by certain factors. That is, students' preference for CALL activities may depend on their motivation for learning Japanese. For students with high social

motivation, instructors may want to supplement CALL activities with an interactive, social activity. In terms of strategy use, CALL programs that encourage the use of self-generated mnemonics and/or offer dual encoded (visual + verbal) mnemonics (especially for abstract concepts) may be most effective for learning kanji. Additionally, students may prefer to learn kanji through CALL as compared to more traditional methods, but students report that they are more motivated to use flashcard programs and find them more effective than digital games. This should not be confused with gamification, the application of game-design elements (e.g., scoring badges, competition) to learning, which Sauerland, Broer, and Breiter (2015) suggests motivates students and results in slightly better kanji learning than non-gamified CALL programs designed to complement classroom learning. That said, although students may not prefer kanji games designed for classroom learning, instructors may be able to facilitate incidental learning of game-related kanji for students interested in gaming who have time outside of class to play vernacular games in Japanese. Non-gaming activities with online reading may also offer opportunities for learning kanji in context. However, pop-up dictionaries and supplemental materials are recommended to deal with the excessive number of kanji on websites and focus students' attention on kanji at or just above students' processing level ($i+1$). Lastly, for instructors who wonder how much CALL can replace in-class kanji instruction, flipped kanji instruction using video tutorials and flashcard programs is, at the very least, as good as (and sometimes better) than traditional in-class instruction particularly with beginner learners.

Vocabulary

In terms of vocabulary, research has focused on how CALL can make the process of learning and retaining vocabulary more efficient.

This includes studies on the use of multimedia glosses, flashcards and more incidental learning of vocabulary via digital games.

Vocabulary and Glosses

The use of different gloss types has received particular attention in Japanese L2 vocabulary studies (James, 2009; Nagata, 1999; Nielson, 2016) because non-CALL L2 studies show that vocabulary glosses used in reading material reduce cognitive load by providing immediate comprehensible input for unknown words, increase ‘noticing’ (Nagata, 1997; Sharwood-Smith, 1993) and/or depth of cognitive processing of lexical content (Craik & Lockhart, 1972).

Thus, many CALL vocabulary studies focus on what types of glosses provide the most benefits to learners and result in the most retention. In an early study, using a self-authored CALL program (Banzai Readings), Nagata (1999) divided students ($n=26$, 2nd semester) into two groups; those who read a text which targeted vocabulary in a) a multiple gloss condition - students required to choose from two different L1 translations (multiple-choice L1 gloss condition) and received immediate feedback or b) a single gloss condition - students were given the L1 (English) gloss and did not have to choose. A comparison of pre- and immediate-post vocabulary tests showed that students in the multiple gloss condition outperformed (significant at $p=0.01$) the students in the single gloss condition. However, though the mean scores were slightly higher in the multiple gloss group for the delayed post-test, it was not statistically significant. Interestingly, the students’ scores in the delayed post-test had dropped dramatically for both groups, suggesting that some post-treatment activity is needed to solidify long-term retention of vocabulary introduced in the one-time reading activity.

Later research expanded the investigation of glosses to include multimedia (e.g., pictures, videos) and different

orthographies (e.g., kanji, kana, romaji). Okuyama (2007), for instance, argued that making the processing of Japanese words easier might facilitate better vocabulary processing for learners of Japanese. She tested (immediate, delayed-post) the learning effects of a CALL program in two conditions; a) a control group (31 beginners) - provided with vocabulary exercises that offered hiragana spellings of the word, audio recordings and colored illustrations and, b) an experimental group (30 beginners) - given all of the control group glosses plus a romaji gloss. Although both conditions showed promising vocabulary retention (approximately 50% retained), there was no significant difference in the vocabulary gains between either condition. Closer examination, however, revealed that the audio recordings were accessed more by the students and that this correlated with the most gains in vocabulary. This study thus suggests that audio glosses are more effective than pictures and text glosses and that adding romaji glosses does not affect learning outcomes.

James (2009) similarly looked at the effectiveness of different glosses on incidental vocabulary learning (n=35, 3rd, 4th-year students) using an online story platform (Cyberhon). Each kanji word highlighted in the text had a hiragana gloss plus one of three conditions; 1) English (L1) text definition only 2) English (L1) text definition plus illustration, and 3) English text definition plus video. He gave two post-tests, one that tested the students' recognition of the kanji version of the word and the other that tested the hiragana version. The video-annotations showed the highest acquisition rates (post-test scores), suggesting that video content may be the most effective at promoting incidental vocabulary acquisition for both kanji and hiragana words. However, counter to expectations, for the kanji post-test, the English definition + illustration condition had lower acquisition scores than the English definition only condition. This contrasted with the hiragana post-test, which showed higher scores for the English definition + illustration condition. James

(2009) concluded that illustration glosses may not be as effective for remembering kanji words and that different glosses may be required for hiragana and kanji vocabulary acquisition because students likely process them differently.

Expanding James' (2009) study, Nielson (2016) used a video platform software to provide glosses for vocabulary that appeared in subtitles on a popular Japanese film. He compared students' (23 intermediate – 2nd, 3rd semester) vocabulary recognition (pre-, post-, delayed post-test scores) in six gloss conditions (English (L1) definition of kanji words, the English definition of kana words, Japanese (L2) definition of kanji words, Japanese definition of kana words, no definition of kanji words, and no definition of kana words). He found no difference in vocabulary learning and retention (post-test scores) for either the kana or kanji words. As for the gloss types, not surprisingly, the no definition conditions were the least effective. However, contrary to what he originally posited, the L2 (Japanese) definition condition resulted in higher scores for both kana and kanji words than the L1 definition condition. This supported the findings of other research (Lomicka, 1998) that L2 glosses can be more effective than L1 glosses.

Vocabulary Learning and Gaming

More recent research has started to go beyond the finer points of glosses to investigate ways that students learn vocabulary through digital games or game-mediated activities. The Involvement Load Hypothesis (Hulstijn & Laufer, 2001) maintains that games have the potential to promote (for instance) vocabulary learning because they focus a player's attention on words through repetitive tasks in a narrative-based context that helps students connect skills, knowledge, and experiences within the game (Hitosugi, Schmidt, & Hayashi, 2014). The use of authentic L2 in vernacular games, in particular, can also motivate students to use and learn through games

(deHaan, 2005; Sykes & Reinhardt, 2012). Studies in this area have mainly focused on the suitability of vernacular games for L2 classes, especially in terms of how supplemental materials can support learning through games (Miller & Hegelheimer, 2006; Shintaku, 2016, 2019), as well as how students perceive game-mediated learning (deHaan, 2005; Shintaku, 2019).

One of the main problems with vernacular games is that they are made for native speaker use and, as such, are not always suitable for L2 classrooms. This is why “wraparound activities” (Sykes & Reinhardt, 2012) are recommended, supplemental materials/activities that link or scaffold L2 learning with gameplay before, during, and/or after game use. Shintaku's (2016, 2019) studies, in particular, address the importance of wraparound activities when using vernacular games to promote vocabulary learning. In her first study, Shintaku (2016) used a variety of supplemental materials/activities (e.g., vocab. lists, fill-in-the-blank, matching, comprehension questions) with an online game called *Yuurei yashiki no nazō* (Mysteries of a Haunted House). She found that 1) not only were her participants' (n=9, intermediate, 4th semester) post- and delayed-post-vocabulary test scores higher, which indicated short and long-term retention of the game-related vocabulary, but also that the supplemental materials played a crucial role in facilitating this vocabulary learning. Specifically, the students reported (questionnaire) that the strategies they used for learning the vocabulary were facilitated mainly by the supplemental materials.

Shintaku's (2019) second study reiterates the importance of different supplemental materials but also focuses on the suitability of vernacular games for beginner learners. She used a vernacular game (*Fuyu Shougun vs. Nabe Bugyou Game 1* – General Winter vs. the Nabe Master Game 1) for vocabulary learning, but this time created supplemental activities, not only to scaffold students' (n=47, beginner) learning and practice of the game-vocabulary, but also to

introduce additional vocabulary relevant to the game. She had the students practice the new vocabulary with the grammar they had learned in class (e.g., frequency adverbs, location words). Though her study does not look at learning outcomes, student questionnaires and free-text feedback revealed that the students' attitude toward learning vocabulary through the game while completing the supplemental activities was positive, but that there were some issues with the game design. Since these students had just learned hiragana, some felt the game was too fast to read the words flashed on the screen. Others thought the in-game font was difficult to read, and because the game was simple (suitable for beginners), some students complained that the simplicity and repetitiveness made it boring to play. Based on these observations, Shintaku recommended careful vetting of vernacular games before using them to complement classroom learning. The games should be challenging enough to make them interesting, but not so challenging as to cause cognitive overload. Moreover, supplemental materials are needed to focus students' attention on learning targets and create links to L2 learning in the classroom. Thus, although Shintaku's (2016) findings were promising, she made a point of substantiating these findings with a follow-up study using a larger number of participants. To further substantiate her conclusions, it would be interesting to add a control group using no supplemental materials to see if, indeed, supplemental materials play a major role in vocabulary retention.

Hitosugi, Schmidt, and Hayashi (2014) also looked at the types of activities that might facilitate vocabulary learning through games. They gathered data from two slightly different studies using Food Force (a vernacular game). In Study 1 (S1), students (n=9, low advanced) were given no quiz or unit test, so the digital game activities had no effect on their grade. Basically, no pre-vocabulary lists were given, but the students completed game activities along with task sheets with the target vocabulary embedded in them. Study

2 (S2) students (n=11, low advanced) engaged in these same activities, but were given a list of key vocabulary, took a quiz and a final unit test, and their scores were included in their class grade. Both groups were given pre-, post, and delayed-post (5 weeks later) tests. Hitosugi, Schmidt, and Hayashi (2014) found that students in both S1 and S2 recalled the newly learned words from Food Force in the immediate post-test and delayed post-test (five weeks later), but that the students in S2, where the focus was more on vocabulary testing, made better gains than the S1 students. Moreover, when testing the S2 students on their retention of game-related vocabulary versus vocabulary learned from the textbook, the students had retained more of the game-related vocabulary. This provided support for the Multimedia Theory that students learn and retain more when using multimedia than just text alone (Mayer, 2002). Moreover, in interviews, students commented that the multimedia game was engaging and motivated them to want to learn the content. In terms of suitability, the authors noted that the game was just complex enough, and the tasks were scaffolded to allow the students to "fill in the gap," providing an *i+1* (Krashen, 1982) environment that promotes learning. While Shintaku's studies focus on how a variety of supplemental materials and wraparound activities are essential to promote vocabulary learning through games, Hitosugi, Schmidt, and Hayashi's (2014) research further suggests that a) overt targeting of vocabulary is perhaps more effective than simply embedding the vocabulary in tasks and that b) increasing extrinsic motivation through quizzes and tests and including these scores in students' grade may be a critical component to increasing vocabulary learning and long-term retention.

Overall Findings for Vocabulary Learning

These studies offer pieces of the puzzle to our understanding of how different CALL materials and instructional methods enhance and/or

detract from vocabulary learning. To summarize, the gloss research suggests that multiple-choice, audio, and L2 glosses are more effective, while romaji glossing has no effect, and single L1 glosses are not as effective as L2 glosses. L2 (Japanese) definitions + video glosses are most effective for both kana and kanji vocabulary, but L2 definitions + picture glosses for kanji vocabulary are least effective, suggesting that kana/kanji are processed differently. Research on vernacular games suggests that a) students are motivated to use games to learn, b) learning vocabulary in a multimedia context versus just text alone may be most effective and that c) choosing an appropriate-level digital game, d) scaffolding students through games through supplemental materials and activities, and e) having tests and quizzes with scores added to students' grades may increase vocabulary learning and long-term retention.

Reading

Studies for L2 learners of Japanese have focused on the efficacy of computer-mediated tools for improving reading comprehension (Kitajima, 2002; McMeekin, 2019; Vasquez-Calvo, Zhang, Pascual, & Cassany, 2019), computer-mediated versus print-based reading (Abe, 2016; Peterson, 2016), extensive reading (Nakano, 2016; Odell, 2020), and also reading for enhancing ACTFL's "Five C's" (Communication, Cultures, Connections, Comparisons, and Communities) (Fukai, 2005).

Reading and Computer-Mediated Tools

Early research on how computer-mediated tools and materials could enhance reading comprehension consisted mainly of descriptions of CALL programs (Houser, Yokoi, & Yasusa, 2002; Kang & Maciejewski, 2000; Kitajima, 2002; Nara, 1994; Sawaki, 2003). Kitajima's (2002) article, however, differed from the others in that it outlined the features of computer-mediated courseware designed to help readers resolve anaphora and make backward inferences

(Japanese texts exhibit frequent referent omission). Kitajima used authentic newspaper articles and included hypermedia (audio, hiragana reading, English definitions) for the kanji, hypertext (English definitions) for vocabulary, and segments of complex sentences. Also, exercises focusing on anaphoric resolution, and backward inferencing were provided. JFL students (n=8, 4th year) tested the courseware and reported that the exercises, in particular, helped them understand the intersentential connections in the text. Kitajima's study thus demonstrated how computer-mediated tools could help improve higher-order interpretation skills by resolving common issues that L2 learners face when reading Japanese.

Other studies have focused on how different gloss types in hypertext could alleviate some of the cognitive load for unknown vocabulary or kanji and affect learning opportunities through reading (see James, 2009; Nagata, 1999; Nielson, 2016 – reviewed in the vocabulary and kanji sections above). Only a few studies (Toyoda, 2016; McMeekin, 2019; Vasquez-Calvo, Zhang, Pascual, & Cassany, 2019), however, have looked at online dictionaries or pop-up translation tools (e.g., Reading Chuta, Asunaro, Rikai, and WWWJDIC). Toyoda's (2016) article reviews the different tools and discusses their usefulness, but does not actually look at learner outcomes when using these tools. McMeekin (2019), as discussed in the kanji section, reports on the immediate learning effects of a web-based reading task that required learners of Japanese (N=13, intermediate - 3rd semester) to use online dictionaries WWWJDIC(<http://nihongo.monash.edu/cgi-bin/wwwjdic?1C>), *Jisho* (<http://jisho.org/>) and a pop-up dictionary (*Rikai* (<http://www.rikai.com/>)) while reading. The task used Japanese Trip Advisor for selecting a restaurant to eat lunch and to complete a task sheet (bridging activity). This reading activity exposed learners to authentic online materials, which allowed for incidental learning to occur while reading authentic online text (see additional

details in the Kanji section). Pre- and post-questionnaires revealed an increase in student motivation and confidence in reading online texts. She concluded that both dictionaries and the pop-up tool (*riikai*) enabled students to read content that would not be accessible to them otherwise and therefore fostered learner autonomy, motivation, and confidence in reading.

Another study that examines the use of online translation or dictionary tools is Vasquez-Calvo, Zhang, Pascual, and Cassany (2019). Using virtual ethnography (Hine, 2015), one of the participants (an anime fansubber), read and analyzed the Japanese subtitles of an anime to produce subtitles in Catalan.¹ With the help of Google Translate, Tangorin, and Jisho, he converted the subtitles into hiragana and romaji due to his limited knowledge of katakana and kanji. He spent hours analyzing the text to determine the best translation into Catalan. The researchers explain that his translation skills were developed independently, although he was a part of an online community of fansubbers for anime. The authors concluded that through reading and analysis, implicit learning of the target language occurred. One has to be cautious in interpreting these types of studies. That is, very few students are as motivated as the participant in this study likely was and reported gains are often anecdotal. Future studies would do well to address whether this method (used as perhaps a class activity) would lead to learning gains for average students and/or whether it would lead to improving a learner's ability to read authentic texts without the use of a machine translator.

Computer-Mediated versus Print-Based Reading

Other researchers have sought to determine the benefits of computer-mediated versus print-based reading beyond the use of

¹ This ethnographic study examines three participants. However, the other two participants are not learners of Japanese, and thus the discussion of the findings has been omitted here.

hypertext/glosses in reading systems and dictionaries (Abe, 2016; Peterson, 2016). Peterson (2016), for instance, found that students (n=27, 3rd semester) who read folktales online, showed more incidental learning of vocabulary and kanji than students who read print-based manga or read while playing video games. (See the kanji section for additional details). In contrast, Abe (2016) found that her subjects preferred print-based reading over online reading. Abe's (2016) study qualitatively analyzed five self-studying learners' (various levels) preference and motivation to read different paper-based Japanese texts (graded readers, textbook readings, manga, children's books) and web-based materials (NHK Newsweb Easy articles). The study found that the learners were least interested in the paper-based textbook readings; however, despite reporting extensive use of technology for self-learning, only two learners chose to read the online texts. Abe concluded that the number one problem associated with motivation to read as a part of self-study was not the difference between paper-based versus web-based materials, but that there were few authentic materials available at the students' reading levels that suited their varied interests. Although Abe had only five participants, this point can likely be generalized to all student groups—not enough interesting, level-appropriate reading material.

Extensive Reading via Websites

Extensive reading (ER) in a printed medium has been shown to improve students' reading speed and comprehension while acquiring vocabulary/kanji (Leung 2002). Although there are many authentic materials now located on the web, as mentioned previously, finding materials that are grade or level appropriate is still challenging. Nakano (2016) (n=17, various levels) used questionnaires to examine the motivations of learners using the online ER materials. Using JGR SAKURA (<https://jgrpg-sakura.com/>), Nakano (2016) found that non-kanji background learners reported that, due to limited

vocabulary, they relied more on scaffolding while using ER. Those with a kanji background were not as positive in their evaluation of ER's use for improving reading proficiency. More recently, Odell (2020) conducted a self-report case study over 10-weeks of using a website (tadoku.org) for improving reading. He read 2-3 stories a week, and at the conclusion of the ten weeks, he wrote his own short story. He kept a reading log for thoughts and ideas. Based on his self-observations, his kanji and vocabulary recognition had improved along with his ability to write more common kanji. Although caution should be noted when interpreting the results (self-reported case studies involving highly motivated participants do not usually represent the average student), his study indicates that there is potential for learners via extensive reading materials in an online context. Future studies are needed, however, that are less subjective and include verification of results through pre- and post-assessments.

Reading and the Five C's

Attempting to move beyond a focus solely on reading comprehension, Fukai (2005) analyzed how an internet-based newspaper reading project addressed goals in five areas of curriculum standards (Standards, 1996: The five C's - Communication, Cultures, Connections, Comparisons, and Communities) for U.S. foreign language classrooms. The project involved readings from Japanese newspaper articles, peer group discussions and email exchanges with NSs about the articles, and writing similar articles. The students (n=6, 4th year) not only reported improved reading skills, but also that the project helped them build communities of learning through reading as well as an out-of-class interest in reading Japanese. Fukai argued that a singular focus on reading comprehension alone is not enough to motivate and sustain students' learning through reading in this technological age: that it is crucial to expand learning to address the five C's.

Overall Findings for Reading

These studies suggest some tentative findings about reading and CALL. First, online materials may be preferred over print-based materials and that reading during digital game use in particular shows some promise for increasing reading proficiency. Additionally, the use of online reading tools (e.g., pop-up dictionaries, Google Translate) shows promise for reading websites in terms of reducing cognitive load and for assisting with materials of interest for learners (e.g., anime subtitles), and may result in learning. Results from learners using extensive reading materials online, although very preliminary, are promising in terms of accessibility for learners and teachers. However, in some cases where learners are self-studiers, they may not be motivated to read online material that does not meet their interests. Kitajima (2002) and Fukai (2005) argue that reading is not just about comprehensible input; instead, it requires higher-order interpretation skills and addressing the five C's to provide a well-rounded approach to reading. Additional studies should examine learners' engagement with a wide variety of authentic online texts while using different online reading tools to consider how technology can aid in the comprehension of those texts.

Summary, Conclusions and Future Directions of the Field

The goal of this article was to review and summarize relevant Japanese CALL studies on Japanese kanji, vocabulary, and reading. The kanji studies, for instance, suggest that CALL can be used to improve motivation and kanji strategy use while noting that self-generated mnemonics and dual encoded cues (visual, verbal) seem to work well, but that for abstract concepts, students may need more help generating mnemonics. Moreover, in terms of using kanji games, some students find gaming interesting, but others are not motivated to use the games and want more straightforward flashcard-type apps. However, gamification (awarding badges, etc.) might provide

students with even more motivation and result in more time spent on task. For those students who are interested, vernacular games may be useful for incidental learning of kanji, but for students who prefer a more integrative learning style, teachers should incorporate CALL activities that involve a social aspect. Flipped instruction (video tutorials and flashcards) seems to work as well as classroom instruction, and the use of pop-up dictionaries for recognition and learning of kanji in context is promising. In short, it all boils down to a simple premise: for best results, teachers should consider implementing a range of CALL activities that take into account different motivation types and learning styles.

The vocabulary studies have tended to focus on gloss types, suggesting that when teaching vocabulary to students, it is helpful to have different gloss types that provide information in the form of L2 definitions, audio, and pictures, with an understanding that kanji vocabulary may be processed differently than kana. Moreover, using vernacular games might motivate students and offer some vocabulary learning, but that the difficulty of these games should be mitigated by scaffolding students and adding follow-up activities like tests and quizzes to motivate learning.

Research on reading Japanese shows that web-based materials may offer more variety. Thus, students may be more motivated to read them, particularly if the reading is task-based or connected to out-of-class interests (or perhaps related to the Five Cs). If teachers are going to use online reading, however, reading tools such as pop-up dictionaries are essential for mitigating vocabulary difficulty and reducing cognitive load. Extensive reading materials also are excellent resources but are limited at this point in terms of the volume of materials, most likely due to copyright issues. Digital games may also provide motivation and opportunities for enhancing reading proficiency, but teachers need to balance the

tension between playing the game and learning from it, so a fun game does not become too tedious.

The studies reviewed here offer small glimpses into teaching Japanese through CALL; however, they are far from conclusive. A few notes of caution are in order for those just starting to explore CALL for virtual classrooms or to supplement face-to-face instruction. First, although the studies in this review provide an excellent starting point to understanding the complicated nature of online learning, there are still too few studies to provide conclusive evidence of learning outcomes. Remediating this is not easy. The research would benefit from instructors and researchers who grew up as digital natives pursuing innovative studies examining the use of technology for kanji, vocabulary, and reading.

Second, while some of these studies examined in this review have a large number of participants, others are case studies or have fewer than 10 participants. These smaller ethnographic studies provide critical first steps, but do not provide definitive answers. Nonetheless, such studies are valuable in that they generate ideas, interest and encourage researchers to seek out answers. One issue that compounds the small participant issue is smaller class sizes in Japanese programs. To increase participant numbers in studies, it may be beneficial to team up with researchers at other universities and programs. Additionally, replication of studies can verify originally tentative conclusions.

Third, many of the studies reviewed here, specifically the motivation studies, tend to collect data via surveys. While this type of study captures students' motivations for strategy use, it does not answer how motivation and real-time learning strategies/outcomes can be measured. That is, can we measure or capture in real-time what strategies are being used by learners rather than just what they report they are using for kanji, vocabulary, and reading? How to monitor this is a more significant issue, but with more screen-capture

technology available today, this may be a new avenue for investigation. For example, think-aloud protocols used for studies that collect audio-recorded conversational samples and then play them back to participants could also be used to investigate learning strategies. That is, one could have students use Zoom as a way to capture what they are doing on- and off-screen. With the increase of learners having access to Google Meet, Zoom, and other programs that allow for screencasting, this could be a positive step for SLA research in general.

Finally, what is needed is not only replication of the studies in this review to determine if findings can be corroborated in different participant populations (e.g., beginner, intermediate, advanced) and contexts (e.g., online versus supplemental use of CALL), but also research on a broad range of issues that have not yet been investigated. For instance, how CALL can be used to teach students to write kanji versus just for memorization and recognition is something the current literature does not address. Similarly, how does one teach vocabulary exclusively through CALL rather than just using CALL for supplemental activities? Or, does task-based CALL reading increase reading proficiency and enhance incidental learning of kanji and vocabulary? Finally, what types of valid learning assessments can be employed via CALL? This latter point is foremost in teachers' minds now that many of us are exclusively online for the Fall 2020 semester. Beyond knowing what programs exist and how to use them, teachers are interested in understanding, through careful research, what entails sound pedagogical practices for teaching non-alphabetic languages via CALL. Indeed, teaching online during these unorthodox times provides scholars, researchers, and teachers with the opportunity to shed light on learning outcomes and best practices for CALL, particularly for Japanese and other less commonly taught languages. The demand for our creativity in these unprecedented times may provide us with many new avenues for research,

innovative access to participants, and pioneering technology use. With that in mind, we would like to encourage scholars and teachers alike to consider contributing to the field in what could be the single most significant leap forward in the field of CALL.

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