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Preferences in Learning "Hiragana": A Comparative Study Between Mobile Apps and Paper Worksheets

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PREFERENCES IN LEARNING “HIRAGANA”: A COMPARATIVE STUDY BETWEEN
MOBILE APPS AND PAPER WORKSHEETS

A Thesis Presented

by

MICHIKO NAKADA

Submitted to the Graduate School of the
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ABSTRACT

PREFERENCES IN LEARNING “HIRAGANA”: A COMPARATIVE STUDY BETWEEN MOBILE APPS AND PAPER WORKSHEETS

MAY 2020

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In 2020, technology is generally accepted, and we can see many people using their digital devices such as smartphones everywhere. It is easy to see how dependent we are on technology, anytime and anywhere. Mobile apps are one of the time-effective tools for our daily lives. College students in the United States are always busy with their classes and assignments, and for them, apps are not only for having fun but are also convenient, reliable, and essential supporting tools for their academic and daily lives.

This paper examines the students' preferences in learning the Japanese writing system “Hiragana” with mobile apps and paper worksheets. The study had 14 participants who joined a 4-day-a-week class. The participants were asked to use both the app “*Ganbatte kana*” and copies of the worksheet “*Purinto Kizzu*” to practice Hiragana in and out of class. After all four classes over 1 week, the participants answered a questionnaire about the class and what they thought of using the paper and the app to study Hiragana based on their experience.

The results of this study showed that most students preferred the paper to the app. While most of them use their smartphones every day, they have an attachment to paper. Some of them preferred physical experiences more than digital experiences for writing. However, most of them appreciate the app's multifunctionality and convenience, and half of them want to use both apps and paper for their future learning. If we can use both in each strong area effectively, we can expect new technology and traditional materials to become more satisfying and useful learning tools.

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CHAPTER 1

INTRODUCTION

It has been 20 years since we defeated the Y2K problem, and technology in 2020 is considered one of our best friends. Children today have grown up in an environment in which technology is everywhere, and it is natural for them to be accustomed to it. It is not surprising to see parents giving their infants or toddlers a tablet to view YouTube videos or play games to have fun by themselves. Toddlers or preschoolers start studying how to write characters such as the letters of the alphabet or how to count numbers using applications (apps) installed on their parents'—or possibly even their own—tablet or smartphone while with or without their parents. School children may prefer playing with characters in fashion doll apps rather than dress-up dolls such as Barbie because it is possible to change not only their clothes but also their hairstyle, hair color, make-up, or even the shape of their body or facial appearance, which is impossible with real dolls.

Current college students, referred to as “Generation Z,” a name coined by Pew Research Center (n.d.), were born from about the mid-1990s to the late 2000s. Previous studies reported that college students use their smartphones 60 times a day and for more than 5 hours a day on average (Cheever et al., 2014; Lepp et al., 2015). They were born after the first smartphone, and they are also known as digital natives. If we see students on campus, it is easy to see how dependent they are on technology, especially smartphones and tablets, anytime and at anywhere in their lives. Many of them use apps to study for a quiz in class while they wait for a bus to come or ride the bus. Some may also use their smartphones or tablets to take notes or write an assignment in class. For students, apps are not only for having fun but are also convenient, reliable, and essential supporting tools for their academic and daily lives.

In general, repetition is one of the most important ways of learning and memorizing new information. Practicing the four skills of writing, reading, listening, and speaking over and over helps our understanding and memory function better. For instance, practicing writing is a good

way to memorize the characters of a new language. However, if learners write each character over and over without accurate recognition, they may memorize the wrong information. Although teachers may be able to correct these mistakes when they find them, it is not always possible to provide feedback to learners in a timely manner, and the wrong knowledge may thus be stabilized in the learner's brain, in which case it is not easy for them to fix the "fossilization" (Selinker, 1972) by themselves. Thus, in addition to repetition, noticing is also essential for learning (Schmidt, 1990).

Russell and Spada (2006) claimed the effectiveness of corrective feedback to L2 learners. However, throughout my experience as a Japanese language teaching assistant, there are various concerns about feedback to students' homework. It is not uncommon for students to make the same mistakes repeatedly without any improvement based on the feedback given on their homework by teachers, even though they are provided with many comments or corrections for where they have made mistakes and what they did not notice. It does not matter how long teachers spend on each student's assignment and how much effort they give to it. Both for learners who are busy with their college schedules and teachers who want to give quick and appropriate feedback, late feedback may be wasting time and should be improved because the feedback does not adequately reflect the time and labor that both learners and teachers expend their time on assignments. Therefore, we may posit that the timing of giving and receiving feedback would be one of the significant factors in students' self-examination.

However, there is a way for learners to receive timely feedback from teachers even when they cannot meet in person. Instead of teachers, apps may be able to provide this feedback. Apps are available on various platforms such as PCs, mobile tablets, and smartphones, and we can access them instantly on our own devices. Moreover, apps can be expected to help with learning and practicing by repetition with their interactive and multifunctional features.

In the busy life of college students, it is crucially important to establish learning styles based on their schedule or preferences. There is not only one style for everyone; the best way to learn is different for all, as is how effective each style is. Even though new technologies are being

generally accepted, this does not mean that people are already using apps for their study appropriately. They are one among many options that learners can choose to fit their lifestyle and learning requirements, and they can change their options depending on the situation. The aim of this study is to observe students' preferences of apps in learning Japanese characters and whether apps can be an option chosen by students now and in the future.

CHAPTER 2

THEORETICAL FRAMEWORK

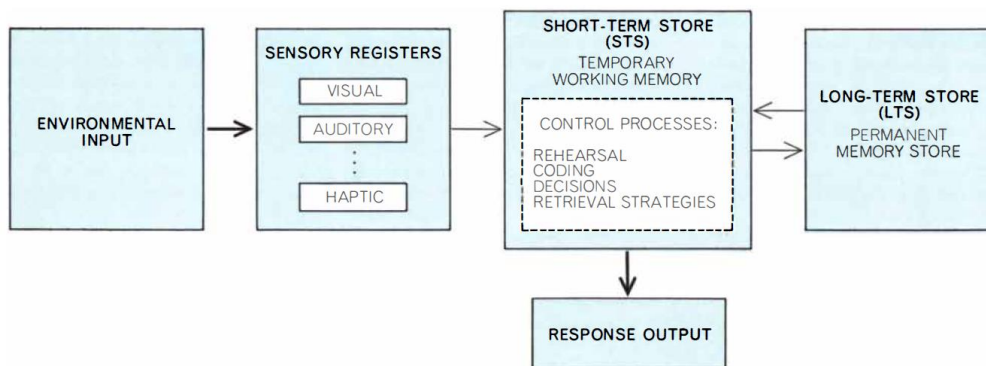
The theoretical framework for this study is based on the following psychological theories.

2.1 Cognitive Processing and Memory

Cognitive psychology is the scientific study of the mind and of mental functions such as learning, memory, attention, perception, reasoning, motor control, skill, language, and conceptual development (Ellis, 2019). When we see, listen, smell, taste, or touch something, our brains work through many steps of operations to try to establish what it is and to what other objects it might be related. Some information comes to our minds as input from outside. Our brains try to understand what this is and give orders as to what we should do, which will eventuate in a bodily action as output. Atkinson and Shiffrin (1971) explained the concept of cognition as the following process:

INFORMATION FLOW through the memory system is conceived of as beginning with the processing of environmental inputs in sensory registers (receptors plus internal elements) and entry into the short-term store (STS). While it remains there, the information may be copied into the long-term store (LTS), and associated information that is in the LTS may be activated and entered into the STS. If a triangle is seen, for example, the name “triangle” may be called up. Control processes in the STS affect these transfers into and out of the LTS and govern learning, retrieval of information, and forgetting. (p.82)

Figure 1: Information Processing Model of Memory



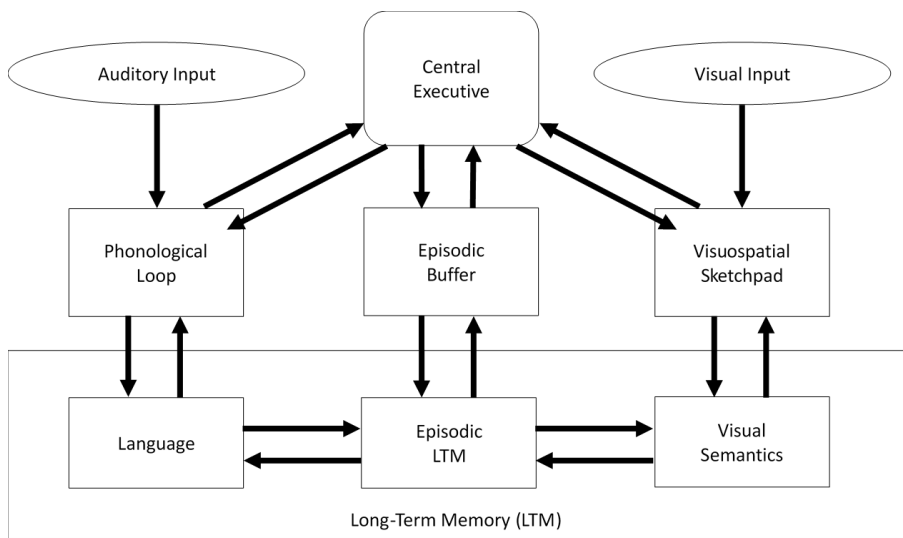
Adapted from “The Control of Short-Term Memory,” by Richard C. Atkinson and Richard M. Shiffrin, 1971, *Scientific American*, Vol. 225, No. 2, p. 82. Copyright 1971 by Scientific American, a division of Nature America, Inc.

Memory has different types, and the type we can remember after a protracted period is called long-term memory (LTM). When we receive stimuli from the world, it is stored as sensory memory, and some of what we pay attention to are retained as short-term memory (STM). “Memorizing” means storing some information in LTS but not STS. STM is the type of memory we use when we wish to retain information for a short time to think about it (Seamon & Kenrick, 1994). Because STM has a limited time to keep the information, “rehearsal,” which means an overt or covert repetition of information (Atkinson and Shiffrin, 1971, p82), is essential to transfer STM to LTM.

2.2 Working Memory and Memorizing Hiragana

The Atkinson–Shiffrin model shows that human memory consisted of three stores: sensory registers, STS and LTS, whereas Baddeley (2000) considered that there are four components other than LTM: 1) central executive, 2) phonological loop, 3) visuospatial sketchpad, and 4) episodic buffer. The central executive manages and controls all information coming from outside as stimuli and stored inside. It decides which information is necessary, where it is sent to or stored, and which functions are used to deal with it. The phonological loop is the component that deals with phonological information, and the visuospatial sketchpad is used for visual information. Each piece of information is temporarily stored there and undergoes rehearsal to be processed. The episodic buffer is the component that links all visual, spatial, and verbal information and makes integrated units of information with chronological orders. Therefore, the episodic buffer is assumed to be a bridge between LTM and semantic meaning.

Figure 2: Working Memory Processing Model (Baddeley, 2000)



For L2 learners, when they learn a new writing system, which is Hiragana, they receive two types of input. According to the website of learning support for schoolchildren by Hiroshima University:

Generally, elementary school children who have difficulties in learning how to read Kana characters, Kanji, and sentences have problems with working memory of language areas, and those who have difficulties in writing kana characters and kanjis and in calculating have problems with one of the visual areas. (n.d.)

Characters of Hiragana, which are totally new for learners and are almost like pictures rather than letters, are visual input, and the sound of Hiragana (how to read each Hiragana) is auditory input. Because each Hiragana is a phonogram, it is essential to memorize both shapes and sounds of Hiragana together. Looking at or writing them several times is not enough for ordinary people who do not have an exceptional memory to memorize all Hiragana correctly. To memorize them—to retain them as LTM—learners need to practice again and again because rehearsal can transfer STM to LTM.

Learning characters with paper and a pen, we can get information based on a visual sense, an auditory sense, and tactile sense, and those are accepted as the sensory memory in our brains. Some of the memory paid attention to remain as the STM, and through the rehearsal—repetition

of writing on paper or reading out the characters, STM transfers to LTM, and we can “memorize” new things (Atkinson–Shiffrin model). Moreover, apps tend to make it easier to learn the shape of each character as visual information and pronunciation of each character as auditory information together because digital devices more or less have a speaker and microphone, and the apps can use the audiovisual functions with them. The visual input and the auditory input are processed in the visuospatial sketchpad and phonological loop, and by means of rehearsal, the working memory changes into the LTM and will be stored in the LTS. (Baddeley’s Working memory model) Although it is ideal for practicing Hiragana with enough amount of both visual input and auditory input, there is not yet perfect learning material with both. We may say that paper is superior for visual input since the paper has a wider physical field of vision, and its visibility is better than apps. On the other hand, apps may be better tools for auditory input with their multimedia features and multifunctionalities.

2.3 Production vs. Recognition

For those who are starting to learn Japanese, learning Japanese letters is the first hurdle (Taniguchi, 2017). Taniguchi, who studied how Kanji is challenging to learn for learners without a Kanji background, had the following to say:

There are three factors to make Kanji hard to recall: 1) visual complexness (many stroke orders) of character’s shape affects the most, 2) even though the Kanji is visually simple (few stroke orders), nonlinearly one tends to be hard to recall, 3) for the Kanji which is visually complexed (many stroke orders), it is difficult to remember if it is asymmetrical. These points reflect the characteristics of recall of writing, and it shows that it is possible for learners who have not started learning Kanji to consider Kanji pictures, but not letters. (p.11)

Hiragana is not a series of logographs like Kanji, but it has a similar uniqueness. Hiragana letters have many shapes, consisting not only of linear lines but also curvy as well as asymmetrical ones. Taniguchi (2017) mentioned that it is crucial to teach explicitly what is unique about the shapes of Kanji and how to write the characters with the correct movement of writing and stroke order. When learners learn any of the Japanese writing systems, stroke order is significant because

it makes writing easier, faster, and better-balanced. Because learners who have not yet started studying Kanji can be thought of as seeing writing Kanji like drawing a picture, it is necessary to make them recognize Kanji letters. Similarly, for learners who have not learned Hiragana before, Hiragana can be seen as pictures but not letters. Therefore, it is essential to let learners know what kind of shapes are found in each Hiragana and how to write Hiragana with the proper order and movement of writing.

Most children in Japan are able to read and write Hiragana through the experience of learning with their parents and their teachers. Some may start to learn Hiragana by reading; others may start by writing, or others may by reading and writing together. In any case, most children spend their time reading and writing Hiragana either at home, preschool, or elementary school, so they have enough time to learn. In contrast, college students in the United States have to learn to both read and write Hiragana concurrently in a short period of time because of lack of time. L2 learning is more challenging than L1 acquisition. Furthermore, college-level Japanese language courses are intensive and have less time to spend on each learning component compared to the experience of L1 children. Without enough time to spend on learning as L1 children do, it is essential to learn both reading and writing effectively. To memorize both how to read and write Hiragana, the repetition of reading and writing is important. As explained in Baddeley's model, the shape of each Hiragana as visual input is processed in the visuospatial sketchpad and the pronunciation of each Hiragana as auditory input is treated in the phonological loop, and after rehearsal, the memory will be stored in LTS. Apps can have both visual and audio information, and thus they can help learners practice writing and reading together.

CHAPTER 3

LITERATURE REVIEW

3.1 Using Mobile Apps for Foreign Language Learning

According to Steel (2012), college students download various apps on their mobile devices for foreign language learning and use them for time-effective consultation in various situations. However, not many researchers have investigated students' personal use of apps for learning and learning benefits. Steel described how students use mobile apps to maximize the effectiveness of their out-of-classroom learning time and what kind of benefit they receive for foreign language learning. While 56% of students reported using mobile apps to support their university learning, 23% ranked them in their top three technologies. Through the survey, Steel reported that students use mobile apps to use their time effectively by fitting learning into their daily lives regardless of locations and opportunities, and students perceive the specific learning benefits through the experience of the apps for foreign language learning.

For busy college students, one of the essential factors in their daily lives is time management. Thinking about how to manage a day, a week, a month, or a semester is one of the most elemental key points in good college life. To this end, "pockets of time" (Kukulska-Hulme, 2012, p.2), or the time between classes or commuting time, are significant. Students appreciate the flexibility and convenience of using their apps to meet their personal learning needs at times and in places that suit their lifestyles (Steel, 2012).

3.2 Timing of Feedback

Pressey (1927, 1932) believed that the long intervals during which students waited for feedback hindered learning and that this could be improved by providing feedback immediately. Skinner (1954) indicated that students could rarely get the teacher's attention to what they spoke in conversational classrooms. Even though there were many good answers by students, it is almost impossible for teachers to pick up on what every student says in class and to provide feedback

immediately in a large group classroom, which is typical for an elementary language class, and therefore it is essential for students to study outside of class with material that can give them immediate feedback.

Kulik and Kulik (1988) experimented with comparing the performance of two groups; one was a group of students who received immediate feedback, and the other was a group of students who received delayed feedback to measure the effects. The results showed that applied studies using actual classroom quizzes and real learning materials usually demonstrated immediate feedback to be more effective than delayed. They concurred with Kulhavy (1977) that, typically, to delay feedback is to hinder learning, except in special experimental situations, and that immediate feedback produces a better effect than delayed feedback.

As learning material outside of class, many teachers give students homework assignments. Homework is a good opportunity for students to receive feedback on their work from teachers. Because of the vast amount of material to study, for college students, getting feedback on their assignments is essential. Although students can get feedback on their homework sooner and more certainly than in a classroom, they often do not get their work returned with comments quickly. In many Japanese language programs at colleges in the United States, a paper workbook tends to be used for homework, and the paper workbook is one of the biggest reasons for the delay of feedback. It may take one to two days after students actually write the assignment for them to get feedback, even if the teacher tries to give it as soon as possible. If students could submit their homework online digitally instead of paper, they might receive feedback somewhat sooner. However, they still could not attain real-time feedback while completing homework. Feedback given with appropriate timing is hugely helpful for learners, so inappropriate or overly late feedback is not acceptable. Apps are potentially one solution to this problem because apps are interactive and may involve immediate feedback.

3.3 Paper Books? Or Electronic Books?

Recently, the market for electronic books (e-books) has become bigger and bigger, and e-

book devices have become one of the familiar ways to read books. According to the Association of American Publishers' annual report of 2019, publishers of books in electronic formats made \$2.04 billion in revenue in 2018, and the U.S. Pew Research Center stated that 77% of adult Americans owned smartphones, 51% owned tablet computers, and 22% owned e-readers in 2016. Compared to smartphones and tablets, electronic book readers (e-readers) are not yet major, but this is because people do not need to own e-readers to read e-books. Additionally, the Pew Research Center (2019) reported that 81% of people over 18 years old now own smartphones. This means that the vast majority of Americans have opportunities to read books without buying and owning physical books, at any time and anywhere, whether they take such opportunities or not.

Kobayashi and Ikeuchi (2012) explained the learning effect by a difference of display media and text contents. They cited the fact that tablets such as Apple's iPad and e-book readers such as Amazon's Kindle accounted for sales of over \$300 million in the United States in 2010 and highlighted the advantages of e-book readers, which can hold a great deal of content and are excellent in terms of space-saving and portability, as well as having functions such as searching, which cannot be done with the traditional paper medium. They pointed out that the significant characteristic of e-book devices is that they are not only for reading for fun but can also be used by students or professionals to deepen their knowledge or to gather information through the internet (Kobayashi & Ikeuchi, 2012).

When we read with a mobile tablet like an iPad, we can easily access more information not only from books but also through the internet, whereas we can only learn what is written in a book when we read a paper book (p-book). The tablet can make it possible to go beyond the limits of reading with multiple functions. Reading a book with an e-book app makes use of not only the contents of the book and the convenience of the app but also the possibility of the tablet. If we focus only on "reading," readers may prefer p-books based on their experience of reading or preference, but we can accrue more experience that we cannot with p-books if we expand our horizons.

Despite the fact that increases use of electronic tablets, the study of Kobayashi and Ikeuchi

(2012) showed that p-books (printed books) tended to be slightly better to help students memorize and understand contents compared to e-books when participants read the explanatory sentences and literary sentences. However, the data also showed that participants could read explanatory e-books faster than p-books. The participants' answers showing benefits of p-books included the following: "*eyes and a body are not tired with p-books,*" "*I can focus on the contents of p-books,*" and "*paper is more familiar.*" On the other hand, the benefits of e-books include that they are "easy to read words displayed on the screen clearly" and that it is "easier to turn the pages." Some participants seemed to prefer p-books since they are used to reading physical books and are familiar with the paper, but others confirmed the e-book's usability. In the end, Kobayashi and Ikeuchi (2012) concluded the following:

- 1) e-book devices are still brand-new media, and there is a vast gap of readability between p-books and e-books;
- 2) people have more experience reading p-books than e-books; and
- 3) the advantages of p-books may change in the future when people get used to reading e-books or have more experience reading e-books than p-books.

Yoshimura and Kobayashi (2018) gave their students both p-books and e-books as reading materials to determine their preferences in their extensive reading (ER) in a Japanese class. The study showed that about 90% of students preferred p-books, and they chose p-books more than e-books to read in the ER class. Since the ER class aimed to encourage students to read Japanese books for fun as much as possible by choosing books based on their interests, which is difficult to experience in regular intensive Japanese reading courses, it may be concluded that students had a stronger attachment to p-books. In the ER class, students enjoy reading more than they do in other language classes, which means that the relationship and connection between readers and books becomes closer and stronger.

Electronic devices are getting more and more popular, and people like their convenience and usability and enjoy digital experiences. It is not as easy to bring p-books anywhere, anytime, compared to e-books. However, Yoshimura and Kobayashi's (2018) study showed that the physical

“inconvenience” of p-books could make comfortable and rich experiences of reading. We may say that paper books make it easier to earn more physical experiences than tablets do, and the feel of the texture of the paper can be relaxing. The weight of books and physical movements such as turning pages may increase stimulation, and this information may connect to episodic memory, which makes it easier to enhance memory (Baddeley’s episodic buffer.)

3.4 Teaching Hiragana

Miyagi (1997) introduced how previous researchers had shown how to teach Hiragana to L2 learners and outlined her new teaching method for Hiragana. For learners whose native language and its writing and phonological system are different from Japanese, because of interference between them, it is not easy to learn Hiragana orthography.

The Japan Foundation (1988) demonstrated one of the examples of teaching Hiragana in the book *Kyōshi-yō Nihongo Kyōiku Hando Bukku 2 Hyōki* [*Handbook for Japanese Language Teachers II Writing*], saying that it is a common way to start teaching each Hiragana individually following Hiragana chart and to make learners check how to write or read each Hiragana character after finished teaching a couple of lines of the chart. Miyagi agreed with this and explained that pronunciation, the shape of letters, and how to write are taught together following the syllabary order when Hiragana is taught in many education institutions. Miyagi (1997) mentioned that “HIRAGANA in 48 minutes” is a teaching method of Hiragana developed by Quackenbush and Ohso (1983), and this helps learners memorize Hiragana with a visual image associated with Hiragana and its sound. For example, “い” is similar to the shape of “ii” of “Hawaii,” and “う” is an image of an old woman whose back is bent saying “ooh! [u:]” Learners can make connections with the visual image and sound of Hiragana easily, and therefore, they can memorize effectively. Miyagi reviewed that Majima (1992) outlined the CALL system “EasyKana” as Hiragana’s introduction. This program was forged from the idea that it takes longer for L2 learners to learn Hiragana, and it is inefficient that learners practice reading and writing in class. Learners can study stroke orders of each Hiragana with its sound, practice reading each Hiragana, and check the

reading and meaning of vocabularies using Hiragana already learned before. Learners can use this program for preview, practice, and review, and they can study at their own pace.

Miyagi (1997) indicated that the connection among sounds such as pronunciation and pitch accent, orthography, and meaning is crucial to learning Hiragana. Thus, she created “24 go de Gojūon [24 words for Japanese syllabary]” for learners to understand Hiragana and the phonological system naturally and memorize them efficiently. The characteristics of the method are as follows: 1) learners study Hiragana with 24 basic Japanese words so they can practice Hiragana as meaningful words; 2) the words are categorized by groups of pitch accent like “*i sū*” (“*i*” is lower, and “*sū*” is higher), and learners can also pay attention to the accent while they learn group by group; 3) learners study Hiragana with the visual image (Hiragana and image of each word) and sound, and it is easier to connect one to another to memorize them together.

3.5 Summary of Work Yet to Be Done

Although Japanese teaching and learning using apps have been researched inside and outside the classroom, very few studies have been focused only on Hiragana learning. Acquiring the skills of Hiragana recognition and production is the first challenge for learners and is also critically important in learning Japanese and has a great influence on further learning. In the average Japanese class taught in a U.S. college, after learning Hiragana, Katakana comes as a second writing system and Kanji as a third. For that reason, the experience of Hiragana learners is that they get to know the characteristics of the Japanese writing system, what Japanese characters are shaped like, how to draw lines and write with good balance, and so on, which can be used in learning Katakana and Kanji.

The elementary Japanese course at UMass Amherst is scheduled to finish work on Hiragana as the first Japanese writing system in week 1 or 2, which means that students are expected to master Hiragana in 1 or 2 weeks. In other words, students can concentrate on learning Hiragana and pay attention to how to write accurately before the class begins in earnest. Once the class officially starts, many vocabulary and grammar topics are covered, and students cannot spend

sufficient time memorizing them or being careful about writing. Students cannot afford to see the feedback from teachers and spend their time correcting their mistakes, even if they cannot write Hiragana appropriately. Some highly motivated students may try to make their writing better, but in most cases, this may not be easy despite a great desire on the part of the student. It may be already too late to give them feedback to correct their writing after regular class starts. Even among upper-level students who have completed the class in elementary Japanese, it is not uncommon that some have distinct handwriting habits. Generally, advanced-level students tend to set their learning goals as improving their speaking or understanding the culture more deeply, and they do not particularly care about the quality of their handwriting. Thus, not many of them make a great effort to ameliorate their unique habits based on advice from teachers. Ultimately, it is a crucial point that students can learn and practice Hiragana writing effectively, receiving appropriate and timely feedback during the 1 or 2 weeks of the Hiragana introductory period.

3.6 Research Questions

The research questions the current study examined are as follows. The first research question is, “*which modality do students prefer: 1) paper worksheets or 2) a mobile app if both are available?*” Based on previous studies, both paper and apps are popular among college students. The technology-friendly generation may also still have an attachment to paper, whereas they prefer to use their smartphones in their daily lives. The second research question is, “*which modality do students think is more effective: 1) paper worksheets or 2) a mobile app if both are available?*” The third research question is, “*how much do students’ lifestyles affect the results of RQ1 and RQ2?*” is the third research question. It is easy to imagine students who use the app more frequently for fun and/or self-study tending to prefer using the app to study Hiragana too, and they may think the app is more effective compared to those who do not use apps in general. The fourth research question is, “*do students practice more with the app or paper worksheets?*” Because they are too busy to study in one place for specific hours, they may prefer to use the app in their spare time. However, on the other hand, the previous studies also showed that they enjoy the physical

experience with paper. Finally, the fifth research question is, “*if the app can help students study better than paper worksheets, how does it work?*” Since there are different characteristics and advantages/disadvantages in paper and apps, it is important to see how differently both work for helping student’s learning. If apps are more helpful than paper worksheets in students' perception, we can expect apps to help them motivate and learn better in the future.

CHAPTER 4

METHODS AND PARTICIPANTS

4.1 Participants

The target population for this study comprised 14 students at UMass Amherst who had never studied Japanese formally in class. They were interested in the Japanese language for a certain reason: being interested in Japanese anime, games, or music or being curious about languages that are different from English. Some of them mentioned that they wanted to take introductory-level Japanese the following semester and considered this study as the first step to Japanese language learning.

The participants signed the consent form, which was confirmed by the Institutional Review Board (IRB). Because this study is based on research conducted at UMass Amherst, and the target was their students, the research proposal was submitted to IRB and received permission in October 2019.

4.2 Design of Study/Experiment and Procedure

For this study, a 4-day-a-week class was held three times. (see Table 1) First, 18 students in total appeared on the first day of the class, but only 14 finished all scheduled classes. Because the schedule and contents of the Hiragana class were changed after the first week (group 0) class, data on certain participants (two students) cannot be used for this experiment. Two participants in the second week (group 1) stopped coming to the class halfway through, so the effective number of participants was 14 (seven for each group; group 1 and 2.) Students were asked to use both the mobile app “*Ganbatte kana*” (see Figure 3) and copies of the worksheet “*Purinto Kizzu*” (see Figure 4) to practice Hiragana outside of class (see Table 2 and 3); for example, for group 1, they were expected to use the app for self-study on the first day, worksheets on the second day, and they could choose whichever they preferred on day 3. To make sure that the order of using self-study materials did not affect this study, for group 2, the order in which students used the materials for

their self-study was switched: the copies of the Hiragana worksheet on day 1, the app on day 2, and either one on day 3.

The amount of Hiragana characters that students learned in class and which appeared in quizzes, as well as in a test on day 4, were controlled, and the combination of words and characters was the same regardless of whether learners used the worksheet or the app. The app had additional functions that the worksheet did not contain: 1) a quiz mode of Hiragana reading and writing, and 2) the ability to check the accuracy of Hiragana writing and stroke orders. So, to fill the gap, an additional paper homework sheet that covered Hiragana reading, writing, and stroke orders was given to students on the day of self-study with paper materials. For paper worksheet self-study, participants needed to wait to be given corrections by the next class, whereas they could receive feedback from the app immediately. From day 2 to day 4, students submitted their paper homework (there was no homework submission if the assignment was through the app) and soon had it returned with written feedback. Thus, students could know what they did wrong with their homework in class, but not at the time they were doing self-study.

Table 1: Hiragana Class Schedule

	Day 1	Day 2	Day 3	Day 4
Contents of class (60mins)	1) Introduction 2) Lecture of Hiragana 1 3) Practice Hiragana 1	1) Hiragana 1 review & quiz 2) Lecture of Hiragana 2 3) Practice Hiragana 2	1) Hiragana 2 review & quiz 2) Lecture of Hiragana 3 3) Practice Hiragana 3	1) All review 2) Test 3) Questionnaire

Table 2: Learning Materials Used in and out of Class for Group 1

	Day 1 <App>	Day 2 <Paper>	Day 3 <App&Paper>
in-class materials	Ppt slide for class “Ganbatte kana”	Ppt slide for class “Purinto Kizzu”	Ppt slide for class “Ganbatte kana” “Purinto Kizzu”
self-study materials	“Ganbatte kana”	“Purinto Kizzu” Additional HW	“Ganbatte kana” “Purinto Kizzu” Additional HW

Table 3: Learning Materials Used in and out of Class for Group 2

	Day 1 <Paper>	Day 2 <App>	Day 3 <App&Paper>
in-class materials	Ppt slide for class “Purinto Kizzu”	Ppt slide for class “Ganbatte kana”	Ppt slide for class “Ganbatte kana” “Purinto Kizzu”
self-study materials	“Purinto Kizzu” Additional HW	“Ganbatte kana”	“Ganbatte kana” “Purinto Kizzu” Additional HW

4.3 Materials Used for the Experiment

For practice with the paper worksheet, the Hiragana worksheet from the website “*Purinto Kizzu*” was used, and with the app, learners downloaded “*Ganbatte kana*” for their self-study. The reasons “*Purinto Kizzu*” was chosen are 1) it is easy to recognize each Hiragana, 2) they use an appropriate font for learning handwriting such as *Kyōkasyo-tai* [textbook typeface], 3) learners can practice tracing the model, 4) the stroke order direction is provided, 5) there is enough space to repeat writing in one page, 6) they are free and easy to get online, and 7) there are various formats to practice Hiragana. For “*Ganbatte kana*,” 1) it is easy to recognize each Hiragana, 2) they use an appropriate font for learning handwriting such as *Kyōkasyo-tai*, 3) a function of handwriting is provided, 4) learners can practice tracing the model, 5) the stroke order direction is provided, 6) learners can repeat writing, 7) a function of each sound of Hiragana is provided, and 8) it is free. Even though many Hiragana learning apps are available, most of them do not have a

handwriting function and use the appropriate font; for example, in Kyōkasyo-tai “さ” vs. MS Mincho “さ,” both indicate the sound of “sa.” They look similar, but for “さ” of Kyōkasyo-tai, it is three strokes, and the second and third lines are separate, while for “さ” of Mincho, the second and third lines are connected, and it seems to be two strokes. The Mincho font is usually used for typing or printing, so we see this kind of font often in daily life. However, people’s handwriting is more like Kyōkasyo-tai. Because many textbooks on the Japanese language adopt Kyōkasyo-tai for the introduction of Hiragana, the app with Kyōkasyo-tai was chosen for this study.

Figure 3: Hiragana practice app “Ganbatte kana”

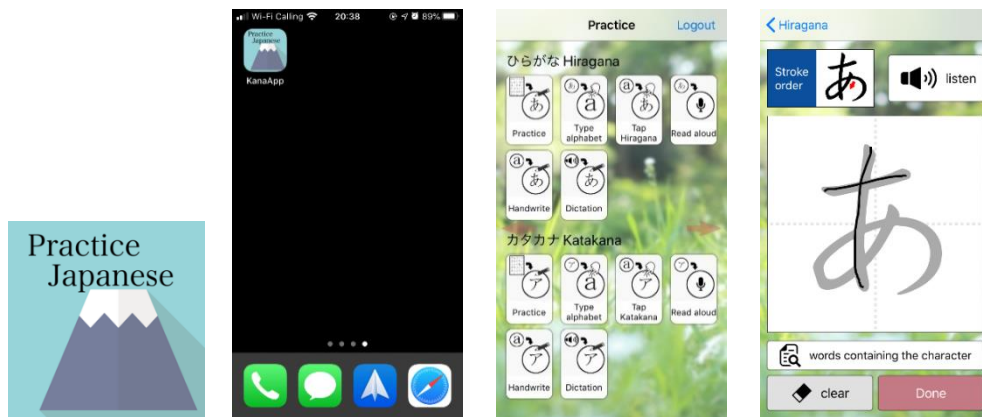


Figure 4: Hiragana practice paper drill “Purinto Kizzu”

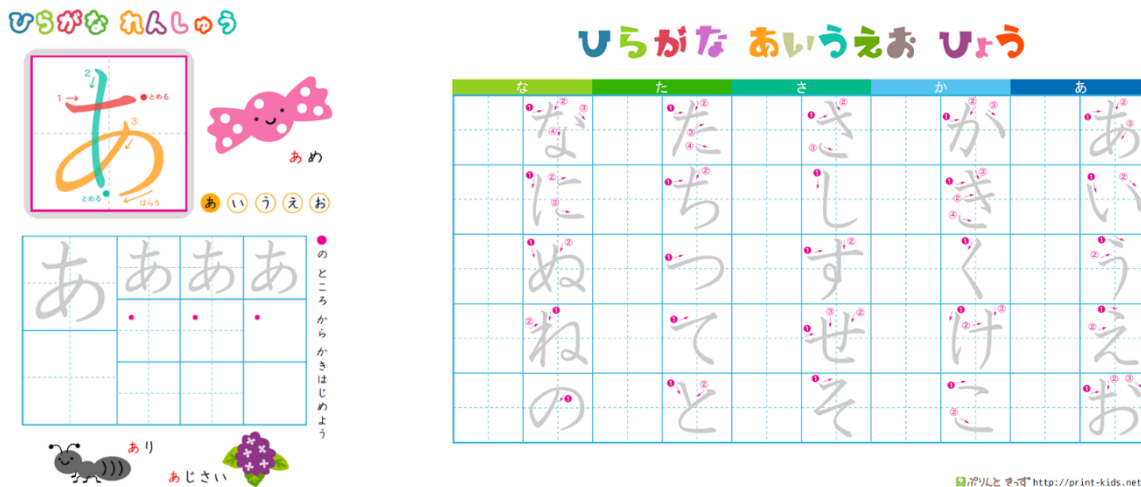


Figure 5: An Example of Additional Hiragana Paper Homework

HW1 Name: _____
 Class of Hiragana

1. romanization -> Hiragana

Ao (blue)		Uketsuke (receptiondesk)	
Kasa (umbrella)		ie (house)	
Ike (pond)		sushi	
Kisoku (rules)		Shio (salt)	
Takai (tall, expensive)		Teki (enemy)	

2. Hiragana -> romanization

あつい		こえ	
えき		かお	
いす		せかい	
とし		とち	

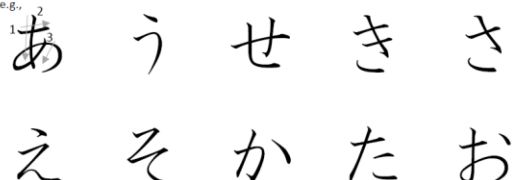
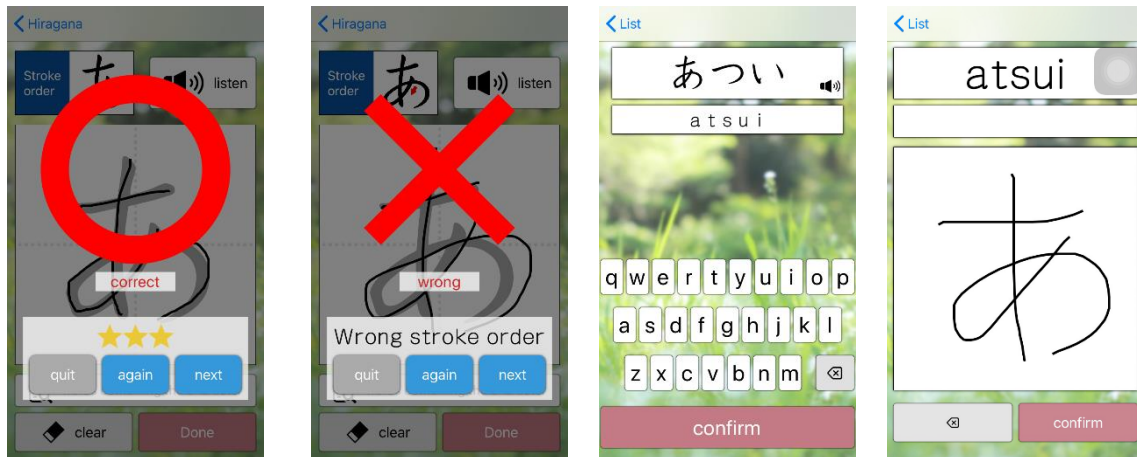
3. write each number of strokes and arrows.
 e.g. 

Figure 6: Quiz Functions in App “Ganbatte kana”



CHAPTER 5

RESULTS AND ANALYSIS

5.1 Data Analysis Method

After all four classes over 1 week, we asked participants to complete questionnaires about the class and say what they thought of using paper or digital materials to study Hiragana based on their experience both in and out of class. We collected score data for homework, quizzes, and tests from participants but did not use them for data analysis on this occasion for several reasons: 1) the number of sample participants was not sufficient, 2) some participants did not submit paper worksheets as homework, 3) some participants had already self-studied Hiragana with the app or their friends' textbooks, 4) some participants used materials other than “*Purinto Kizzu*” and “*Ganbatte kana,*” and 5) because this research class was super-intensive, it is hard to say whether the scores for HW, quizzes, and tests are reliable.

5.2 Results

5.2.1. *Interpretation of the questionnaires*

Here, the purpose of the questions in the questionnaires that participants completed after the class is explained. We posed 19 questions and 21 sub-questions to assess participants' preferences and opinions regarding this class (see Appendix for details).

The following questions were set to appraise participants' language background and customs or preferences of handwriting. Was there any correlation between them and whether participants preferred paper or app? Question 1) asked participants' names, and for questions 2) and 3), what their first language was and what languages they could write other than their native language were asked. This could help us learn if there are any languages that could be advantageous in learning to write Hiragana, what they are. As for questions 4) to 7), we asked participants about how much they are familiar with handwriting. It could be that if some of the participants were connected to handwriting based on their experience, habits, or preferences, they

might have preferred paper worksheets to mobile apps. Conversely, those not familiar with handwriting may have had a stronger connection with apps than worksheets.

- 2) *What is your first language? (If you are multilingual, please choose the one you can think deeply with.)*
- 3) *What are the languages can you write?*
- 4) *Do you have a custom or habit of handwriting?*
- 5) *Have you ever been taught how to handwrite prettily or carefully?*
- 6) *Do you think your handwriting is good (or not bad)?*
- 7) *Do you like (or not hate) handwriting?*

Question 8) and its ten sub-questions asked how participants liked to remember new things in foreign language learning. These were their preferences and habits when learning foreign languages and did not necessarily work well for them. They were roughly divided into two groups: learning with paper or learning with the app. We could see which type of learning participants preferred and how this affected the study.

- 8) *How do you like to remember new vocabulary/words/foreign languages? (Likert scale; 1: Not really to 10: Very much)*
 - a. *Writing them (on paper) again and again*
 - b. *Looking at them (on paper) again and again*
 - c. *Reading them aloud (with paper) again and again*
 - d. *Listening to the sounds of them (with paper) again and again*
 - e. *Using paper flashcards again and again*
 - f. *Writing (or typing) them (on mobile/tablet/PC app) again and again*
 - g. *Looking at them (on mobile/tablet/PC app) again and again*
 - h. *Reading them aloud (with mobile/tablet/PC app) again and again*
 - i. *Listening to the sounds of them (with mobile/tablet/PC app) again and again*
 - j. *Using flashcards (on mobile/tablet/PC app) again and again*

We posed questions 9) to 11) to participants for the purpose of knowing how long they spent practicing Hiragana on paper and the app and which one they wanted to use for further study. For 12) and 13), we asked how long they usually used mobile apps for their self-study or non-study

matters, from which we could discern how familiar they were with mobile apps in general. The more participants liked to use mobile apps in their daily lives, the more we could say that they liked to learn Hiragana with the app. In the same way, we could say that those who did not use mobile apps daily did not like to use the app for learning Hiragana because they were not used to using mobile apps.

9) How long did you spend practicing Hiragana on paper out of class each day? (average)

10) How long did you spend practicing Hiragana on the mobile app out of class each day? (average)

11) Which one do you think you will use if you continue studying Hiragana in the future?

12) How long do you usually use mobile apps for study in a day? (average)

13) How long do you usually use mobile apps NOT for study in a day? (e.g., SNS/videos/games/etc.)

After asking these questions, we asked participants which one they preferred to use to study Hiragana. This was not the same question as 11), which asked which one the participants wanted to use for future self-study. Instead, question 14) asked which one—paper or mobile app—they preferred to study Hiragana. Whereas question 11) asked participants to choose paper, mobile app, or both, in 14), we asked them to choose either paper or app. Some learners may choose learning materials beyond their preference, and some may want to keep learning in their favored way. Finally, in 15), we wanted to know why participants liked the learning material they chose in their answers to 14). This question may be related to question 8), but here, the participants answered why they liked the material. From the answers, we could discern what the advantages and disadvantages of the learning materials were.

14) Which do you prefer to study Hiragana?

15) Why do you think you like it (paper worksheet or mobile app, which you chose in 14))?

- *Easy to practice writing each Hiragana*
- *Easy to remember the shape of each Hiragana to write*
- *Easy to remember stroke orders of each Hiragana*
- *Easy to practice reading each Hiragana*
- *Easy to remember each Hiragana reading*

- *Easy to practice listening to the model's pronunciations of each Hiragana*
- *Easy to check my pronunciation of each Hiragana*
- *Easy to practice each Hiragana again and again*
- *Can study anytime*
- *Can study anywhere*
- *Other...*

Question 16) and its 11 sub-questions asked the participants which learning material was more effective. These questions were related to questions 11) and 15), but we expected more specific and detailed responses. From their answers, it may be possible to say why paper or the app is more effective for learning Hiragana in each perspective. Some may think an approach is more effective because they like it rather than because they think it works. Therefore, question 8) and its 10 sub-questions were asking for the participants' preferences, whereas question 16) and its sub-questions were asking which one they thought was more effective. Preference is one of the best motivations to learn. However, there may also be other effective ways of learning that students do not know and with which they are not familiar. The participants probably did not like either learning material because they had never experienced them before. Through this class experience, the participants may have noticed the advantages they had not realized before.

16) Which do you think (paper worksheet or mobile app) is more effective? Why do you think so?

- a. to practice writing each Hiragana*
- b. to remember the shape of each Hiragana to write*
- c. to remember the stroke orders of each Hiragana*
- d. to improve the accuracy of each Hiragana writing (Hiragana shapes)*
- e. to improve the speed of each Hiragana writing*
- f. to practice reading each Hiragana*
- g. to remember each Hiragana reading*
- h. to practice listening to the model's pronunciations of each Hiragana*
- i. to check your pronunciation of each Hiragana*
- j. to motivate and/or entertain you to practice each Hiragana*

k. others (If you have any other reasons to say that one of them is more effective, please write below.)

Question 17) was set in this questionnaire in case the participants used learning materials other than the paper worksheet and app introduced in class. For this study, the participants were not expected to use other tools to learn Hiragana out of class, but it was necessary to check what these tools were if they did use them. Even though they were not desirable, it was also good to know what kind of other materials the participants liked to use.

17) Did you use any learning materials other than the worksheets and app introduced in class? If yes, please write what it was in "Other."

We asked question 18) to get ideas for future studies. Because there is no perfect learning material that suits every learner on Earth, it is always necessary to know what the problems are and what we need to improve in the tools for future learning.

18) Was there anything inconvenient or that you did not like with the paper worksheet or the app? Do you have any suggestions to make them better? (e.g., The app should make a sound to tell me what the Hiragana is every time I try to handwrite a Hiragana.)

5.2.2 Answers to research questions

The results from the study are explained using the relevant research questions. To answer research question 1 (RQ1), the participants answered 11) and 14) in the questionnaire after the class. For RQ2, they answered 16), and for RQ3, 2) to 10).

RQ1: Which modality do students prefer: 1) paper worksheets or 2) a mobile app if both are available? Question 11) is "*Which one do you think you will use if you continue studying Hiragana in the future?*" For this, 50% of participants (7 of 14) said that they wanted to use both paper worksheets and the app for their future study, 35.7% (5 of 14) chose paper, and 14.3% (2 of 14) chose the app (see Figure 7). This result is impressive because more than 50% of participants answered that they actually liked to study with paper for question 14). One participant answered "both," saying, "*I can use app on my way home and use paper version to practice when I am in library.*" Like this participant, others also mentioned that they liked the

app’s mobility and paper’s physical characteristics for writing. Meanwhile, some of them also agreed with the app’s convenience, whereas most of them preferred to memorize Hiragana through the experience of handwriting on paper. One of the participants who preferred paper worksheets answered, *“I prefer to use study with paper. After writing the characters and hearing the pronunciation from the mobile app, I can associate the characters I wrote with pencil with the sounds.”*

For question 14), *“Which one do you prefer to study Hiragana?”* 64.3% of participants (9 of 14) preferred paper (28.6%, or 4 of 14, said that they would choose paper if they had to pick one), and 35.7% (5 of 14) preferred the app (28.6%, or 4 of 14, said that they would choose the app if they had to pick one) (see Figure 8). Even if they preferred to study with paper worksheets, some of them also appreciated the advantages of the app.

Figure 7: Question 11) “Which One Do You Think You Will Use If You Continue Studying Hiragana in the Future?”

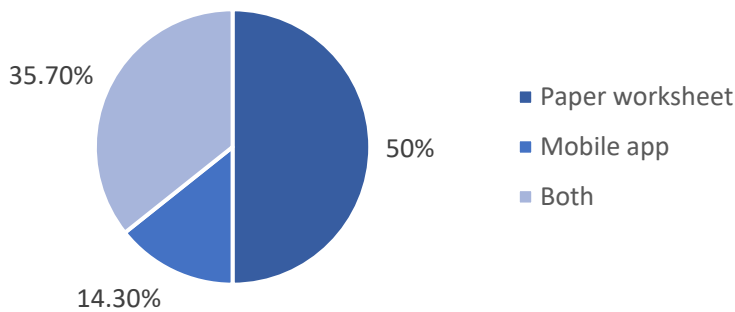
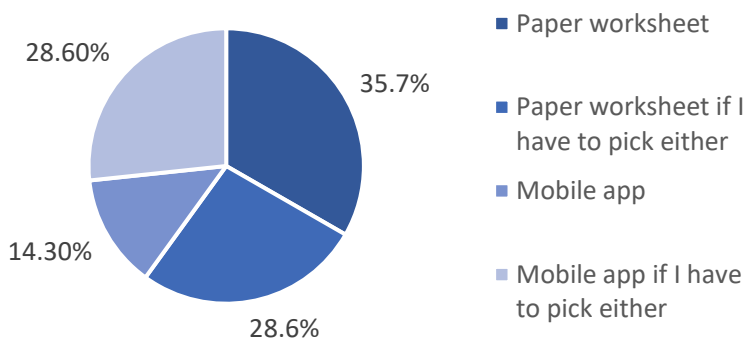


Figure 8: Question 14) “Which One Do You Prefer to Study Hiragana?”



From the answers to question 14), the participants preferred paper to the app if they had to choose one. Even though more than 60% of them preferred paper to the app, the data from question 11) shows that 50% still wanted to use both paper and the app together for their future self-study.

Some participants answered that they liked paper because they believed that their physical movement with paper during practice improved their memory. They could gain more information on the four senses of visual perception, auditory perception, tactile perception, and (probably) olfactory perception while handwriting with paper and a pencil than with the app. So, it is possible to say that handwriting with paper and a pencil can give us more extrinsic stimuli, and it may strengthen the effect of the episodic buffer more than handwriting (or should we call “fingerwriting”?) with apps. Because the episodic buffer is the component linked to various kinds of information, it may be possible to make a more meaningful chunk of memory, which can much more easily be connected to other information and be memorized well. The app used in this class also needs handwriting to practice Hiragana, but it may yield less information than paper. Handwriting with the app is done with one finger and the screen of a smartphone. It may be less effective for memorization compared to paper if we spend the same length of time on each, and the number of times repeatedly handwriting is the same.

One of the participants described why he/she liked to practice writing with paper more than with the app was because “paper form builds muscle memory.” This participant’s native language is English, and he/she has no experience of learning different types of writing systems other than the alphabet. As for the first language, it is usually familiar for us to write because we have known and written it for so long. We know the system of writing and how to move our bodies, including our fingers, hands, and arms, to write letters. Conversely, we need more training with foreign languages, especially those whose writing system is far removed from our native language. For learners, writing letters in different writing systems means writing with physical movements that they have never experienced before. To onboard an unfamiliar movement, we need to repeat the motion again and again. Our bodies and muscles gradually grow accustomed to it through repetition, and it will become a smoother movement, which we call muscle memory. When we

learn something new, it is necessary to practice with our brains and our bodies. In this study, paper and the app were provided for writing Hiragana. Even though the participants could practice handwriting with both, it is evident that the app bestowed less experience of movement compared to paper. The app was used on a smartphone with a small screen, which means that the physical motion was limited, and the touch was totally different from that with paper because a finger was used to write. The difference might not be huge if the goal were to write on digital devices. However, the format of the quiz and test in this study was paper, which is why the participants may have preferred paper over the app.

Digital devices, especially smartphones, are small, which makes it easy to carry and use them anywhere. That said, for learners who would like to concentrate on their study using a desk and chair, the screen of the smartphone may be too small. If staying in one room for a protracted time, the app may not be suitable compared to paper. Learners can be more relaxed with the app because they do not need to stay in one place, but for those who do prefer to stay in place and focus on their studies, the paper is more suitable. For starters, paper as a traditional learning tool has been used for thousands of years, and even for the app-friendly generation, the paper is a more familiar writing tool than the app. Because students in an extensive reading class preferred p-books to e-books because they liked the feel of a book's weight and the excitement of turning pages (Yoshimura & Kobayashi, 2018), some chose the familiarity of paper rather than the accessibility of the app. In fact, from the results, only a few people spent their time on using the app.

On the other hand, the app's availability is much greater than that of paper because college students are busy, and they need to manage their time and use their pockets of time usefully. It would be highly beneficial if they can make enough time and find a space to concentrate on their studies, but unfortunately, this is not always possible. Some of the participants realized this and thought the app would be helpful in their future studies. From the results of the questionnaire, the participants do not appear to have used the app for long, which is why they may not have felt the effect of the app and a sort of accomplishment. As mentioned earlier, learning Hiragana with the app is more effective because it can have functions in terms of both visual input and auditory input.

For memorizing Hiragana, it is essential to learn the shape of the character (visual information) and the sound (audio information) together. Some participants felt the benefit, but others could not owing to a lack of usage. Finally, the mobility of the app with a smartphone can also make learners feel more comfortable when they self-study. Learners can feel more relaxed and less stressed if they can use the app anywhere and in any situation: lying on their bed before sleep, listening to music on the grass with nice weather, and so on. Although some people may thrive on studying in a tense atmosphere, it is better to study in a comfortable environment.

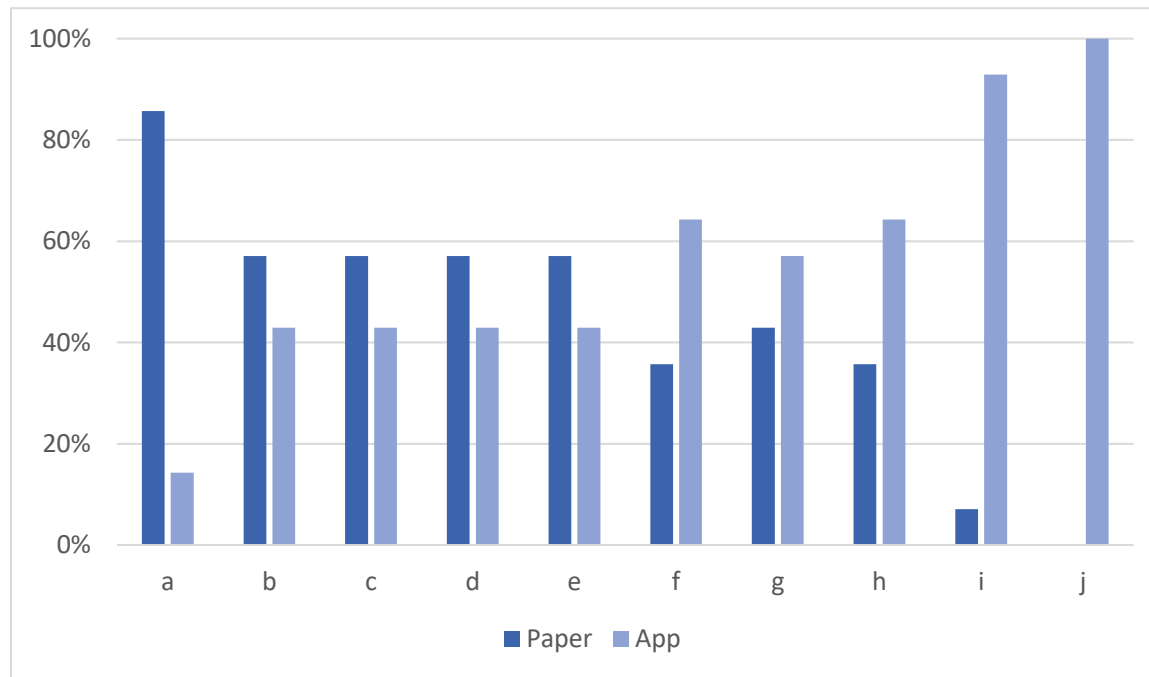
RQ2: Which modality do students think is more effective: 1) paper worksheets or 2) a mobile app if both are available? Participants seemed to think that both paper and electronic materials are useful in their own ways, based on the previous result. Question 16) “Which do you think (paper worksheet or mobile app) is more effective? Why do you think so?” contained 10 sub-questions (see Table 4 and Figure 9 below). Table 4 illustrates that the participants preferred paper over apps in the first five questions (a, b, c, d, e), while apps were preferred in the latter half of the questions (f, g, h, i, j). Even though the results showed that the paper won 5 of 10 questions and the app also won 5 of 10, it does not mean that it was a tie. The results of 5 questions (b, c, d, e, g) came out with a small difference between them. The question i. and j. asked about the functions that were only available in apps such as listening to and practicing the pronunciation and reading of each Hiragana aurally.

Table 4: Question 16) “Which Do You Think (Paper Worksheet or Mobile App) is More Effective?”

Sub-questions of Question 16)	Paper	App
a. to practice writing Hiragana	85.7%	14.3%
b. to remember the shape of Hiragana to write	57.1%	42.9%
c. to improve the speed of Hiragana writing	57.1%	42.9%
d. to remember Hiragana reading	57.1%	42.9%
e. to motivate and/or entertain you to practice Hiragana	57.1%	42.9%
f. to remember the stroke orders of Hiragana	35.7%	64.3%
g. to improve the accuracy of Hiragana writing (shapes)	42.9%	57.1%
h. to practice reading Hiragana	35.7%	64.3%
i. to practice listening to the model’s pronunciations	7.1%	92.9%
j. to check their pronunciation of Hiragana	0%	100%

Note. The order of sub-questions is different from the actual questionnaire the participants answered. It is switched to make it easy to see the results.

Figure 9: Question 16) “Which Do You Think (Paper Worksheet or Mobile App) is More Effective?”



a. to practice writing each Hiragana. The showed 85.7% of participants (12 of 14) thought that paper was more effective for practicing writing each Hiragana character, and 14.3% (2 of 14) thought the app was more effective. Participants tended to prefer writing on paper, they practiced more with paper than the app, and this indicates they consider paper more effective. It may be because they think the goal of learning Hiragana is to become able to write on paper, not just to memorize how to write. This suggests that they felt more comfortable as described because they were given paper quizzes and tests in the class. Finger writing Hiragana with an app may also work on memorizing as well, but the experience of writing is not the same as paper. In terms of physical experience, apps cannot be a good substitute for the action of writing. Thus, if we test the participants in writing Hiragana on digital devices, but not paper, the results may vary.

b. to remember the shape of each Hiragana to write. The results showed 57.1% of participants (8 of 14) thought that paper was more effective for remembering the shape of each Hiragana, and 42.9% (6 of 14) thought the app was more effective. The results showed just a slight difference between the two groups, but it seemed that the participants recognized the apps' usefulness because of the data of sub-question a. highlighted that about 85% of the participants thought paper is more effective to practice writing. In spite of these results, still, about 40% of them thought the app helped them to memorize the shape of each Hiragana

c. to improve the speed of each Hiragana writing. The results showed 57.1% of participants (8 of 14) thought that paper was more effective in improving the speed of each Hiragana writing, and 42.9% (6 of 14) thought this of the app.

d. to remember each Hiragana reading. The results showed 57.1% of participants (8 of 14) thought that paper was more effective in remembering each Hiragana reading, and 42.9% (6 of 14) thought this of the app.

e. to motivate and/or entertain you to practice each Hiragana. The results showed 57.1% of participants (8 of 14) thought that paper was more effective in motivating and/or entertaining them to practice each Hiragana, and 42.9% (6 of 14) opted for the app in this matter.

f. to remember the stroke orders of each Hiragana. The results showed 35.7% of participants (5 of 14) thought that paper was more effective for remembering the stroke order of each Hiragana, and 64.3% (9 of 14) thought the app was more effective. Both paper and app tell learners how to write Hiragana with stroke orders, but the app can give them feedback when they write with wrong orders.

g. to improve the accuracy of each Hiragana writing (Hiragana shapes). The results showed 42.9% of participants (6 of 14) thought that paper was more effective in improving the accuracy of each Hiragana writing, and 57.1% (8 of 14) thought the same of the app.

h. to practice reading each Hiragana. The results showed 35.7% of participants (5 of 14) thought that paper was more effective in practicing reading each Hiragana, and 64.3% (9 of 14) thought this was true of the app.

i. to practice listening to the model's pronunciations of each Hiragana. The results showed 7.1% of participants (1 of 14) thought that paper was more effective in practicing listening to the model's pronunciations of each Hiragana, and 92.9% (13 of 14) thought this true of the app.

j. to check your pronunciation of each Hiragana. None of the participants thought that paper was more effective in checking their pronunciation of each Hiragana, and all preferred the

app in this regard.

For 5 of 10 questions, participants answered that the paper worksheet was more effective for learning, and for the other 5 questions, they thought the app was more effective. Although the results showed that the participants thought paper was more effective in half of the questions and the app more effective in the other half, this does not mean that paper is equally as effective as the app. Because the questions were limited, it is difficult to say that paper is as useful for learners as the app or that either paper or the app is more effective. These results suggest that both tools are effective in different ways depending on what aspect of Hiragana learning learners would like to focus on. Even though most of the participants preferred paper, and 35.7%, which is the second-highest number other than the 50% for “both” thought they would use paper worksheets in the future, the results show that most of the participants in some way recognized the effectiveness of the app.

RQ3: How much do students’ lifestyles affect the results of RQ1 and RQ2? We also asked participants about their preferences and tendencies in terms of study in the questionnaire. How did they usually study or use mobile apps in their daily lives? We picked out 5 from 14 participants to analyze how their lifestyles affected the results of RQ1 and RQ2. These 5 participants were selected to show the variety of their lifestyles: 1) which one they want to use for future learning, 2) which one they prefer, and 3) which one they used for practicing Hiragana longer. (see Table 5) For the analysis, the participants answered the following questions.

- 1) What is your first language? (If you are multilingual, please choose the one you can think deeply with.)*
- 2) What languages can you write?*
- 3) Have you ever been taught how to handwrite pretty or carefully?*
- 4) Do you like (or not hate) handwriting?*
- 5) How long do you usually use mobile apps for study in a day? (average)*
- 6) How long do you usually use mobile apps NOT for study in a day? (average)*

- 7) How long did you spend practicing Hiragana on papers out of class each day? (average)
- 8) How long did you spend practicing Hiragana on the mobile app out of class each day? (average)
- 9) Which one do you think you will use if you continue to study Hiragana in the future? (Paper/App/Both)
- 10) Which do you prefer to study Hiragana? (Paper/Paper if pick either/App/App if pick either)
- 11) Why do you think you like it? (choose from the list)

How do you like to remember new vocabulary/words/foreign languages? (1 to 10)

- a. Writing them (on paper) again and again
- b. Looking at them (on paper) again and again
- c. Reading them aloud (with paper) again and again
- d. Listening to the sounds of them (with paper) again and again
- e. Using paper flashcards again and again
- f. Writing (or typing) them (on mobile/tablet/PC app) again and again
- g. Looking at them (on mobile/tablet/PC app) again and again
- h. Reading them aloud (with mobile/tablet/PC app) again and again
- i. Listening to the sounds of them (with mobile/tablet/PC app) again and again
- j. Using paper flashcards again and again (on mobile/tablet/PC app)

Table 5: List of the Selected Participants

	Future learning	Preference	Used longer
Participant 3 of group 1	App	App	App
Participant 5 of group 1	Both	App if pick either	Same
Participant 6 of group 1	Both	Paper	Same
Participant 4 of group 2	App	App	Same
Participant 7 of group 2	Paper	Paper	Paper

Participant 3 of week 1: App, App. Participant 3 of week 1 has a habit of using apps not for study and spent more time on the app than the paper out of class for this study. Even though they like to remember new things with paper (see a. and c. to e.) more than apps, they chose the app for the future study and answered that they preferred the app if they had to pick either one. The daily experience of using apps may have made them feel comfortable about using the app for studying Hiragana even without the experience of using apps for study because they already knew of the advantages of apps as shown in 11).

Table 6: Answers 1 of Participant 3 of week 1

1) English	5) 0–15 minutes
2) Spanish (Intermediate)	6) 1–2 hours
3) Yes	7) 0–15 minutes
4) Yes	8) 15–30 minutes
9) App; <i>I chose the mobile app because it is easier and more convenient. If I continue to take Japanese as a class I will probably use it more.</i>	
10) App; <i>if I had to pick either, I would choose the mobile app because it is easier and more convenient. If I continue to take Japanese as a class I will probably use it more.</i>	
11) Easy to practice writing each Hiragana Easy to remember stroke orders of each Hiragana Easy to practice listening to the model’s pronunciations of each Hiragana Easy to check my pronunciation of each Hiragana Easy to practice each Hiragana again and again Can study anytime Can study anywhere	

Table 7: Answers 2 of Participant 3 of week 1

Paper					Mobile/tablet/PC app				
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
10	6	10	10	10	4	5	10	10	5

Participant 5 of week 1: Both, Paper if pick either. This participant usually uses apps for longer than other participants for both study and other matters. However, they answered that they preferred to use both paper and the app for their study with a comment of “*on campus and off campus at apt.*,” which may mean that they want to use either one depending on circumstances. They do not regard writing as important for the study of Hiragana (see a. and f.), unlike other participants who prefer to write repeatedly to remember new things. Based on this point, they might not think the paper is essential when choosing learning materials.

Table 8: Answers 1 of Participant 5 of week 1

1) English	5) 4 hours
2) Spanish (Beginner)	6) 4 hours
3) Yes	7) 1–2 hours
4) Yes	8) 1–2 hours
9) Both; <i>On campus and Off campus at apt.</i>	
10) App if I have to pick either; <i>It is the most streamlined and accessible</i>	
11) Easy to practice writing each Hiragana Easy to remember the shape of each Hiragana to write Easy to remember stroke orders of each Hiragana Easy to practice reading each Hiragana Easy to remember each Hiragana reading Easy to practice listening to the model’s pronunciations of each Hiragana Easy to check my pronunciation of each Hiragana Easy to practice each Hiragana again and again Can study anytime Can study anywhere	

Table 9: Answers 2 of Participant 5 of week 1

Paper					Mobile/tablet/PC App				
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
7	5	6	7	8	5	8	8	9	8

Participant 6 of week 1: Both, Paper. Even though this participant did not use either the paper or the app for long, they thought carefully about the usage of both and explained their thoughts in detail. They basically preferred paper for its texture and its ease of writing, while they recognized the merits of the app, which are its functions of sound and feedback. Given we can touch paper physically, which we cannot with apps, it is true that we can attain more information and stimulus from paper compared to apps when writing something again and again. It is not only the touch of paper but also the sound of the pen writing on it; the visual information on it, which is bigger than the screen of the electronic device; and maybe also the smell of the paper or the ink of a pen. (Apps can also provide more information that papers cannot contain, such as audiovisual feedback, but they are for feedback, not for writing itself.) With this additional information, we may say that paper is superior to apps when we write something to memorize it the same number of times with both papers and apps. The superiority of paper may change when much better qualities of electronic devices, just like the real papers and pens are available in the future. However, for now, the experiences of writing on paper with a pen and on an app with a finger or special pen for the device are totally different. Both paper and apps are great materials for learning, but they are used for different purposes. Apps are superior in “pockets of time,” mobility, and accessibility; as the participant answered, *“Sometimes I will be walking or I won’t have any worksheets, so I will use mobile app.”*

Table 10: Answers 1 of Participant 6 of week 1

1) English	5) 15–30 minutes
2) Chinese (Beginner), Spanish (Intermediate)	6) 45–60 minutes
3) Yes	7) 0–15 minutes
4) Yes	8) 0–15 minutes
9) Both; <i>Mobile app is convenient because I do it anywhere at any time, but I think paper just feels better for memory and physical feeling. If I have a desk, pencil, and worksheets, I will definitely use paper. Sometimes I will be walking or I won’t have any worksheets, so I will use mobile app or Duolingo.</i>	
10) Paper worksheet; <i>I feel like I remember thing better if I can write it down. However, if I</i>	

spend enough time on the app, they may be equal in helping me remember things. I think the app is very good for hearing the sounds and reading, but the worksheet is best for writing. Worksheet helps with reading and writing, but not really sounds. It doesn't give feedback either, but it leaves a deeper memory in my mind. App is great for feedback and being able to hear the pronunciation. I don't like writing with my finger though.

11)

Easy to practice writing each Hiragana

Easy to remember the shape of each Hiragana to write

Easy to remember stroke orders of each Hiragana

Easy to remember each Hiragana reading

Table 11: Answers 2 of Participant 6 of week 1

Paper					Mobile/tablet/PC App				
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
9	4	10	10	8	8	4	8	9	8

Participant 4 of week 2: App, App. This participant is an app-friendly individual and prefers using apps to paper. They were the only respondent who answered that the mobile app was more effective than the paper worksheets for all questions from 16) (a. to j.). They answered that they used apps for study (5) with the comment, *“I prefer to learn characters using Quizlet, so I think I’ll use that to learn Katakana”* (9). As such, they may know better than other participants about using apps for study. In addition, they have a background in experiences with Chinese and Russian learning, which are both different writing systems from English, so they may have experience of learning foreign languages with apps and be able to use apps for this purpose effectively.

Table 12: Answers 1 of Participant 4 of week 2

1) English	5) 15–30 minutes
2) Chinese (Intermediate), Russian (Intermediate)	6) 30–45 minutes
3) Yes	7) 0–15 minutes
4) Yes	8) 0–15 minutes
9) App; <i>I prefer to learn characters using quizlet, so I think I’ll use that to learn Katakana.</i>	
10) App; <i>I just prefer using an app.</i>	
11) Simply I like it Easy to practice writing each Hiragana Easy to practice each Hiragana again and again Can study anytime Can study anywhere	

Table 13: Answers 2 of Participant 4 of week 2

Paper					Mobile/tablet/PC App				
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
3	8	1	4	1	9	9	1	8	10

Participant 7 of week 2: Paper, Paper if pick either. This participant is interested in studying that involves the routine use of the app. Even though they answered that they preferred to study with paper and would choose paper if they had to pick either, their learning style was more like a mixture of both. Having noticed the merits of the use of the app, they answered in 10), “*I prefer worksheet, but I like the audio features of the mobile apps.*” Thus, they liked to study with the paper while hearing the sounds of the app, which seems to be a good combination for studying. Although both papers and apps have merits for learning, we do not need to choose only one; we can use them together.

Table 14: Answers 1 of Participant 7 of week 2

1) English	5) 0–15 minutes
2) Chinese (Advanced), Spanish (Intermediate)	6) 45–60 minutes
3) No	7) 15–30 minutes
4) Yes	8) 0–15 minutes
9) Paper; <i>I prefer to use study with paper. After writing the characters and hearing the pronunciation from the mobile app, I can associate the characters I wrote with pencil with the sound.</i>	
10) Paper if I have to pick either; <i>I prefer worksheet, but I like the audio features of the mobile apps.</i>	
11) Easy to practice writing each Hiragana Easy to remember the shape of each Hiragana to write Easy to remember stroke orders of each Hiragana Easy to practice each Hiragana again and again	

Table 15: Answers 2 of Participant 7 of week 2

Paper					Mobile/tablet/PC App				
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
9	9	7	9	6	3	3	5	8	3

Before starting this study, there were certain possibilities that may have affected it: the participant's experience of learning handwriting from others or practicing, the consciousness of handwriting carefully and beautifully, and the preference of handwriting. It was easy to expect that those who have had a daily habit of handwriting with a pen or brush since they were children may have an attachment to paper. For example, a person who has a background in Chinese and can write Chinese letters (Hanzi), paying attention to the shapes of them, may have a strong preference for paper. In fact, some participants with Chinese letter backgrounds gave their opinions that handwriting with paper and a pen was what they were attached to, what they were used to, and what they liked. However, these kinds of opinions were not only by the students with backgrounds in Chinese letters but also by the students whose native language was English without Chinese background. It was estimated that the students who used the alphabet when they wrote in their native language were less attached to handwriting and paper compared to Chinese students. Contrary to expectations, because it is a totally different writing system, the participants seemed to crave the physical experience of looking carefully at, touching, feeling, and writing on paper. That may come from being less familiar with learning with apps and having more experience of the traditional way of memorizing with paper and pen. Even among college students who are always with their smartphones, playing games, and managing their schedules with them, the experience of "handwriting" on apps with their smartphones may not be widely accepted yet. Those who prefer to study with apps may usually use different types rather than the one used in this study, such as the flashcard apps "Anki" and "Quizlet," which are more focused on looking and reading rather than writing. Moreover, the participant's learning motivation is one of the largest factors for this study. Various participants had various reasons to join this Hiragana class. Some wanted to take a regular semester Japanese class but could not because of scheduling conflicts, and some who were willing to study abroad in Japan next summer tended to place a great deal of weight on paper rather than the app. They recognized the high value of the app, but they still thought paper and pen were more effective when they wanted to concentrate on the study while sitting on a chair with a desk. Meanwhile, some participants were interested in Japanese but could

not make enough time like the earlier participants did. Furthermore, the relatively light learners tended to think the app was more suitable for their lifestyles because they could not find sufficient time to focus on studying with paper.

RQ4: Do students practice more with the app? Question 9) asked *“how long did you spend practicing Hiragana on papers out of class each day (average)?”* and question 10) was *“how long did you spend practicing Hiragana with the app out of class each day (average)?”* From the data participants answered for these questions, only one participant practiced Hiragana for longer with the app than with paper. In Table 14, “Group1 (App->Paper)” means the class was introduced to the app for self-study on day 1 and paper on day 2. For “Group 2 (Paper->App),” the class was introduced to paper on day 1 and the app on day 2. Because participants used paper and the app as learning materials for self-study only for 1 or 2 days, it may be difficult to realize the quality of the materials for learning. Compared to paper worksheets on which it is easy to see what is written or drawn at a glance, the app is more complicated to know how to use effectively considering the various functions. Paper is still a common and traditional material of study, and many people are still around who have been familiar with the paper since elementary school. Likewise, the participants already knew how to use paper for learning and were more familiar with it than apps with an electronic device. Thus, it is quasi-natural to see the results that the participants spent more time practicing in the traditional way. They had spent thousands of hours concentrating on studying with paper. Moreover, college students tend to use apps to use time effectively when they have pockets of time rather than using them for long periods of concentration. What is more, because this Hiragana class is based on voluntary but not mandatory enrollments, the participants were well motivated to learn Hiragana. They seemed to be willing to spend more time studying in their rooms, so they might have preferred to study with the paper worksheets.

Table 16: Average Time Participants Spent on Studying Hiragana with the Paper or the App

Participant	Paper	App
Group 1 (App -> Paper)		
Participant 1-1	0-15min	0-15min
Participant 1-2	0-15min	15-30min
Participant 1-3	0-15min	0-15min
Participant 1-4	1-2hours	1-2hours
Participant 1-5	1-2hour	1-2hours
Participant 1-6	2-3hours	0-15min
Participant 1-7	45-60min	15-30min
Group 2 (Paper -> App)		
Participant 2-1	15-30min	15-30min
Participant 2-2	2-3hours	0-15min
Participant 2-3	0-15min	0-15min
Participant 2-4	1-2hours	0-15min
Participant 2-5	15-30min	0-15min
Participant 2-6	30-45min	15-30min
Participant 2-7	15-30min	0-15min

Figure 10: Participants' Self-study of Hiragana Outside of Class with Paper and App

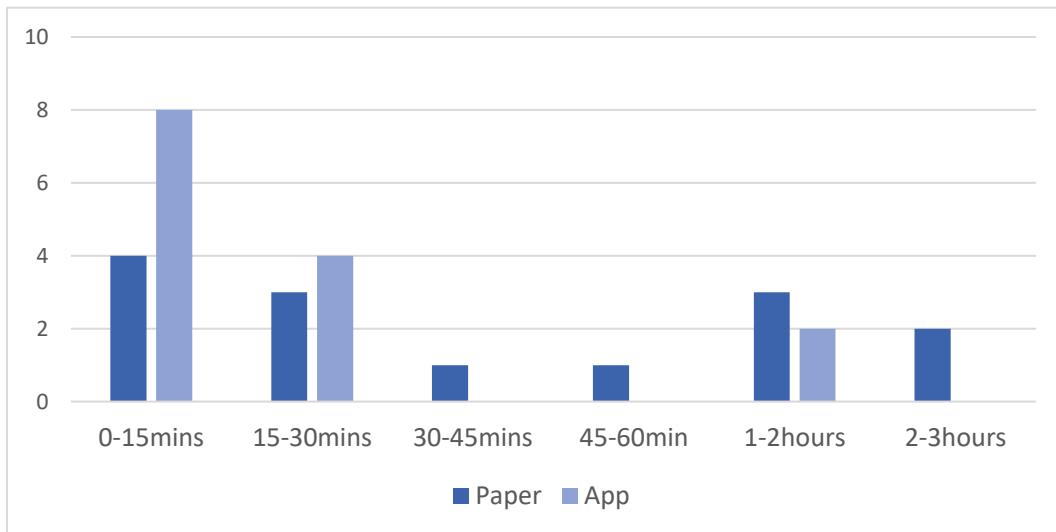
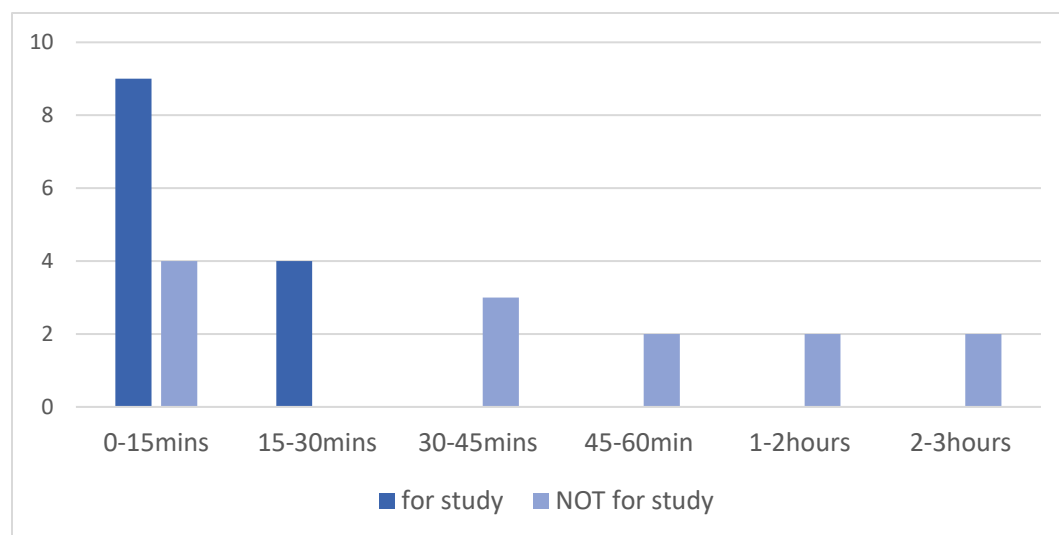


Figure 11: Participants' Daily Mobile Apps Use for Study and Not-Study



RQ5: If the app can help learners study better than paper worksheets, how does it work? From the participants' answers to question 16), what the app helps them study are the following. The results showed that the app was above the paper in 5 of 10 questions (f, g, h, i, j).

f. to remember the stroke orders of each Hiragana. The participants (9 of 14; 64.3%) considered that the app, which always shows each stroke order of Hiragana during handwriting practice, is more useful. The learners could see each stroke order after they drew each line of Hiragana, so they could tell which line went next. The interactive function may be good stimuli for memory. Soon after looking at the line that learners had to draw that the apps show as a model, they could draw the line by themselves. Even if they wrote Hiragana in the wrong order, the app could provide feedback later, which is a huge advantage. Learners may not be able to notice the mistakes by themselves during self-study without this function. Learners may also get feedback for their writing if they can submit what they practiced, but it may take longer to receive feedback, and teachers may not be able to find their mistakes because the teachers could not see how they wrote. The participants' comments are below:

“It corrects you if you're wrong.”

“The mobile app told me all the stroke orders and was very helpful.”

“The mobile apps lets you know if you did the strokes in the wrong order, and tells you to try again.”

“Both actually work in the fashion needed”

“App will yell at me if I get the order wrong. I learn the stroke orders on the app, but I like to practice writing on paper.”

“it tests your memory!”

“App can check.”

“It tells me if I did the wrong stroke order.”

“Because if my stroke orders are incorrect, a mobile app will give me feedback immediately. If I write on Paper worksheets and don't check my stroke orders carefully, I will not know if I make a mistake.”

g. to improve the accuracy of each Hiragana writing (Hiragana shapes). The participants (8 of 14; 57.1%) answered that the app is more helpful in improving the accuracy of each Hiragana writing. In the app, learners could see the model shown in the writing space and trace the gray-colored lines, paying attention to the stroke orders. Therefore, the participants may have felt more confident in writing accurately with the app. Moreover, the app could assess the accuracy of their writing in three grades: one star to three stars. From this feedback, learners may have been able to not only recognize the appropriate shapes but also be motivated. The participants' comments are below:

“It corrects you if you're wrong.”

“It was really cool that the mobile app had guidelines and figured out how close your drawing was to the guidelines. Making sure to get three stars every time helped me get more accurate with my hiragana.”

“Interactive stroke mode”

“App can check whether it is accurate.”

“It gives stars based on the accuracy of the character.”

“Mobile app can give me feedback.”

“The mobile app provides corrections”

h. to practice reading each Hiragana. Over 60% of the participants (9 of 14; 64.3%) thought the app is more useful to practice reading each Hiragana. The writing section has an audio function, and learners could listen to the sound of the target Hiragana to check its reading. This is one of the most important things for learning Hiragana and makes it easier to connect both the visual image and sound of Hiragana to memorize together (Miyagi, 1997). Besides, the app also has the reading quiz section, and learners could test themselves on what they knew and what they needed to practice more. These multifunctional characteristics represent the features of apps, and this is the uniqueness of apps that paper does not have. The participants' comments are below:

“the shapes of the hiragana and the sounds that they made.”

“The mobile app presented them all at once - although the paper chart was also did that.”

“The mobile app lets you hear a voice example, allowing you to practice correct pronunciation.”

“I think that either would work but the app I find to be more convenient and it has a listen button so that you can hear how it should be pronounced.”

“Mobile app can show me new words and test my reading ability, giving me feedback. The worksheet is very helpful if it can be graded.”

“The mobile app provided a variety of words to practice your reading, as well as quizzes to test yourself”

“I feel like a mobile app will allow me to practice reading better than paper worksheets due to the fact that I am able to access more reading resources and materials.”

“I personally like using tech more.”

“Mobile app has pronunciation.”

“The mobile app lets you try”

i. to practice listening to the model's pronunciations of each Hiragana. Like the answers to the previous sub-question, most of the participants (13 of 14; 92.9%) valued the multifunction of the app. To check the correct reading, listening to the model's pronunciation is a much better way because Japanese pronunciation is sometimes different from English even though it is natural for an English speaker to provide Hiragana reading as written in the alphabet: Hiragana “re” is written as a reading of “れ,” but actually Japanese does not have the sound of

“r,” and the exact pronunciation is different. The participants’ comments are below:

- *“The app had good, easy to access pronunciations.”*
- *“The mobile app lets you hear a voice example, allowing you to practice correct pronunciation.”*
- *“It has a listen button so that you can hear how it should be pronounced.”*
- *“Because the app gives one the correct pronunciation”*
- *“The paper worksheet can't speak :(but the app has a button for listening to the pronunciation!”*
- *“I can listen to the pronunciation in app but can't in papersheet.”*
- *“Paper can't say the characters.”*

j. to check your pronunciation of each Hiragana. All participants answered that the app helps them to check their pronunciation of each Hiragana since the function was only available in the app. Similarly, the participants appreciated the function of checking their pronunciation, although it was hard to tell whether they actually used it. As mentioned earlier, some Japanese sounds are not the same as English, but it is easy for learners to misunderstand because of the Hiragana reading spelled in the English alphabet. It is important for them to know how they pronounce and how accurate they are, and it makes it easier to record their own voice and feedback from the app. The participants’ comments are below:

- *“I'm guessing mobile app, because I didn't really check my pronunciation! I'm definitely going to check out the feature where you can speak into the mic and it checks your pronunciation of the hiragana.”*
- *“You can test your own pronunciation on the voice example, and if it does not sound the same you could adjust.”*
- *“Because you can hear it on the app”*
- *“It has a listen button so that you can hear how it should be pronounced and it has a microphone so that you can hear yourself pronounce the different characters.”*
- *“Neither because they don't give feedback to check if I am saying it correctly? However, I can try my best to model my pronunciation after the app. The paper can't speak :(“*
- *“Absolutely papersheet can't hear from me.”*
- *“I don't think it really matters for this one, but the app can check your pronunciation.”*

CHAPTER 6

CONCLUSION

We conducted this research for the purpose of examining how L2 learners perceive the use of mobile apps in comparison to the traditional paper worksheet in learning the first Japanese writing system, “Hiragana.” The study from RQ1 showed the overall preference of paper worksheets over mobile apps when both are available. This is also confirmed in RQ2, in which we asked the effectiveness and retention of learning Hiragana. Before this study, it was easy to estimate that the participants would prefer apps because they are of the generation whose ownership ratio of smartphones is exceedingly high, and they use apps on a daily basis. However, in fact, the participants chose the paper over the app. Similar to the results of Yoshimura and Kobayashi’s (2018) study, setting aside the difference between reading and writing, the paper is still firmly favored. The texture of the paper itself, and the feel and the sound that occur when writing, are its unique features that apps can never have. And yet, we may say that the writability and the feel of handwriting on digital devices such as smartphones are still below those of paper. As Kobayashi and Ikeuchi (2012) mentioned in their study, this may change in the future if people become used to handwriting on the devices more and more, and their experiences evolved. The reason is that the participants would have realized the advantages of the app, and they would not be negative or even positive about adopting it in their lifestyles despite the fact that they prefer paper.

Interestingly, the study from RQ3 revealed that just because college students tend to use apps frequently; in general, this does not mean that the participants also used the app for learning Hiragana in this study. However, as Steel (2012) described, in college life with a tight schedule, an app with great accessibility and mobility helps busy learners use their pocket time effectively. In addition, highly motivated learners are eager to spend their time practicing with paper in a place where they can concentrate. The study from RQ4 showed that the participants used paper as a learning tool for longer, whereas they always had their smartphones and used apps. Some of them

were highly motivated for various reasons, and they may have preferred focusing on the study with paper and a pen while staying in a calm place rather than having pockets of time. As evidence, the results of this study show that highly motivated participants spent more time working with paper, and those who had less motivation did not study for long with either paper or the app. However, the app's strength is the effective use of pockets of time. It is no surprise that total self-study time with the app is relatively short because it is also a desirable usage that learners practice with the app little by little and do not spend too long each time. That said, the participants might not have been able to determine how to use the app effectively during the class because the study took place in a very short and intensive schedule. Once they find out how and when to use it suitably for their lifestyles, they may use the app more because they know there are many intermittent and small pockets of free time in their daily lives. Smartphones with apps are considered to be superior in terms of their multifunctionality and mobility in general, and therefore people bring theirs with them wherever they go and whatever they do. For Hiragana learning, the app is multifunctional: listening to the model's pronunciations and checking the learner's own pronunciations, giving interactive feedback on the learner's output, and using quizzing and testing functions to help the learner's study. These are the app's uniqueness, and the participants accepted the usefulness.

Apps do not have physical limitations like paper, and learners do not need to prepare as many pieces of paper as they want to practice and physically make enough space for them. The app functions allow learners to repeat practicing writing endlessly without limitations. Rehearsal is one of the most important acts for human memory, and without repetition of the practice, the information coming from our eyes or ears cannot be kept in our memory for long. Writing, reading, listening and speaking over and over cause the temporary memory to be stored in the LTS and make it LTM. We can expect that apps facilitate the memorization of character shapes as visual information and the reading as sound information as a set together. The stroke order of Hiragana is one of the essential points to which learners should pay attention, and the app can show it to learners interactively and give feedback on its correctness at all times during writing practice. This may be one of the solutions to the problems of paper, which is a lack of feedback for learners

during self-study with paper or delay in feedback on paper homework because there is a time lag between learners and teachers. Moreover, we can also expect that learners can continue practicing while noticing fewer mistakes and therefore preventing fossilization. Apps have many attractive features that paper as a traditional learning tool does not contain, and it is not a good option for both learners and teachers not to make use of this new method. Needless to say, as mentioned earlier, a number of points are yet to be improved in digital devices. However, just as apps have advantages paper does not, the paper also has advantages apps do not. If we can use both in each strong area effectively, they may make up for each other's weak points, and therefore we can expect them to become more satisfying and effective learning tools.

APPENDIX A

CLASS SCHEDULE

Schedule:

	Contents	Expected things to do after class
Day 1	1) Class introduction 2) Introduction of Japanese 3) Hiragana あ と と 4) How to do self-study?	- Review all Hiragana you learned in class - Practice Hiragana - Prepare for Hiragana Quiz on Day 2
Day 2	1) Hiragana Quiz あ と と 2) Hiragana な と ん 3) More Hiragana double consonants, long vowels, voiced consonants, contracted, etc.	- Review all Hiragana you learned in class - Practice Hiragana - Prepare for Hiragana Quiz on Day 3
Day 4	1) Hiragana Quiz な と ん 2) Review all Hiragana	- Review all Hiragana you learned in class - Practice Hiragana
Day 4	1) Hiragana practice 2) Hiragana test (will be returned in class) 3) Class questionnaire (please bring your laptop to class)	- Review all Hiragana - Practice Hiragana - Don't forget what you learned!

Please feel free to ask me anything about the class if you have any questions.



APPENDIX B
HIRAGANA CLASS QUESTIONNAIRE

*Questionnaire was done online using Google Forms.

1) Please write your name.

2) What is your first language? (If you are multilingual, please choose the one which you can think deeply with.)

- English
- Chinese
- Spanish
- Arabic
- Korean
- Italian
- French
- German
- Russian
- Other...

3) What are the languages you can write? If you choose "others," please write what it is in 3').

	Can't write	Beginner	Intermediate	Advanced	Native
English	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chinese	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spanish	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Arabic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Korean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Italian	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
French	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
German	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Russian	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3') For those who chose "Others" above, what are they?

4) Do you have a custom or habit of handwriting?

- Yes
- No

5) Have you ever been taught how to handwrite pretty or carefully?

- Yes
- No

6) Do you think your handwriting is good (or not bad)?

Yes

No

7) Do you like (or not hate) handwriting?

Yes

No

8) How do you like to remember new vocabulary/words/foreign languages?

a. Writing them (on papers) again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

b. Looking at them (on papers) again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

c. Reading them aloud (with papers) again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

d. Listening to the sounds of them (with papers) again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

e. Using paper flashcards again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

f. Writing (or typing) them (on mobile/tablet/PC App) again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

g. Looking at them (on mobile/tablet/PC App) again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

h. Reading them aloud (with mobile/tablet/PC App) again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

i. Listening to the sounds of them (with mobile/tablet/PC App) again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

j. Using flashcards (on mobile/tablet/PC App) again and again

Not really	1	2	3	4	5	6	7	8	9	10	Very much
------------	---	---	---	---	---	---	---	---	---	----	-----------

9) How long did you spend practicing Hiragana on papers out of class each day? (average)

- 0-15min
- 15-30min
- 30-45min
- 45-60min
- 1-2hours
- 2-3hours
- Others...

10) How long did you spend practicing Hiragana on mobile App out of class each day? (average)

- 0-15min
- 15-30min
- 30-45min
- 45-60min
- 1-2hours
- 2-3hours
- Others...

11) Which one do you think you will use if you continue studying Hiragana in the future?

- Paper worksheet
- Mobile App
- Both

11') Why do you choose it/them? What/where/when/how do you think you will use to study?

12) How long do you usually use mobile Apps for study in a day? (average)

- 0-15min
- 15-30min
- 30-45min
- 45-60min
- 1-2hours
- 2-3hours
- Others...

13) How long do you usually use mobile Apps NOT for study in a day? (e.g., SNS/videos/games/etc.)

- 0-15min
- 15-30min
- 30-45min
- 45-60min
- 1-2hours
- 2-3hours
- Others...

14) Which do you prefer to study Hiragana?

- Paper worksheet
- Paper worksheet if I have to pick either
- Mobile App
- Mobile App if I have to pick either

14') Why do you choose it? What/where/when/how do you think it is good to use?

15) Why do you think you like it (paper worksheet or mobile app which you chose in 14))?

<input type="checkbox"/> Easy to practice writing each Hiragana
<input type="checkbox"/> Easy to remember the shape of each Hiragana to write
<input type="checkbox"/> Easy to remember stroke orders of each Hiragana
<input type="checkbox"/> Easy to practice reading each Hiragana
<input type="checkbox"/> Easy to remember each Hiragana reading
<input type="checkbox"/> Easy to practice listening to the model's pronunciations of each Hiragana
<input type="checkbox"/> Easy to check my pronunciation of each Hiragana
<input type="checkbox"/> Easy to practice each Hiragana again and again
<input type="checkbox"/> Can study anytime
<input type="checkbox"/> Can study anywhere
<input type="checkbox"/> Other...

16) Do you think which (paper worksheet or mobile app) is more effective? Why do you think so?

a. to practice writing each Hiragana

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

a'. Why do you think so?

--

b. to remember the shape of each Hiragana to write

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

b'. Why do you think so?

--

c. to remember the stroke orders of each Hiragana

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

c'. Why do you think so?

--

d. to improve the accuracy of each Hiragana writing (Hiragana shapes)

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

d'. Why do you think so?

--

e. to improve the speed of each Hiragana writing

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

e'. Why do you think so?

--

f. to practice reading each Hiragana

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

f'. Why do you think so?

--

g. to remember each Hiragana reading

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

g'. Why do you think so?

--

h. to practice listening to the model's pronunciations of each Hiragana

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

h'. Why do you think so?

--

i. to check your pronunciation of each Hiragana

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

i'. Why do you think so?

--

j. to motivate and/or entertain you to practice each Hiragana

<input type="checkbox"/> Paper worksheet
<input type="checkbox"/> Mobile App

j'. Why do you think so?

--

k. others (If you have any other reasons to say that one of them is more effective, please write below.)

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17) Did you use any other learning materials other than worksheets and App introduced in class? If yes, please write what it was in "Other."

<input type="checkbox"/> No
<input type="checkbox"/> Others...

18) Was there anything inconvenience or you don't like with the paper worksheet or the app? Do you have any suggestions to make them better? (e.g., The app should sound to tell what the Hiragana is every time I try to handwrite Hiragana. etc.,)

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19) If you have any comments for this class, please write anything below.

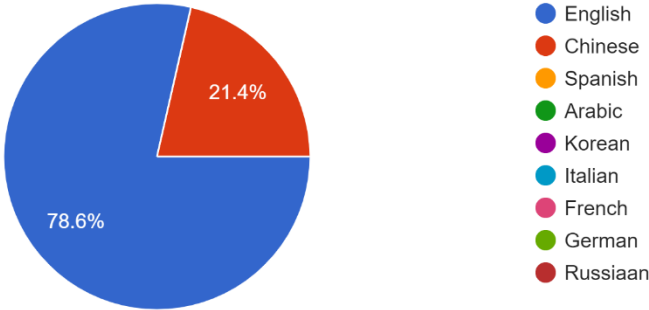
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APPENDIX C

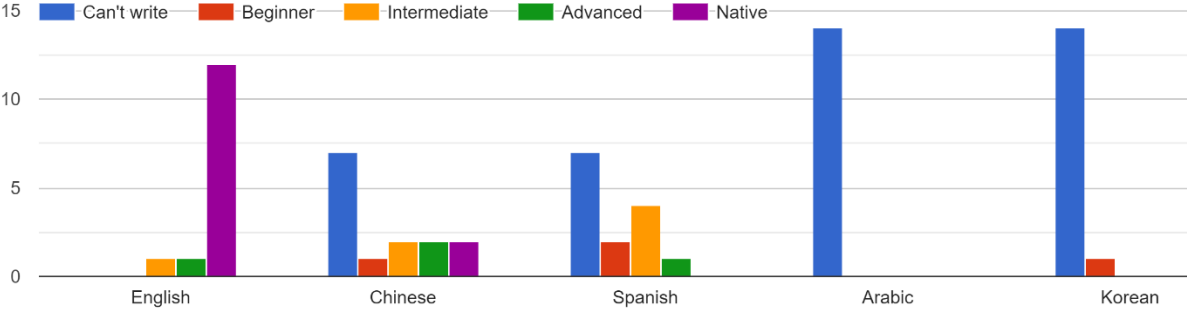
PARTICIPANTS' ANSWERS

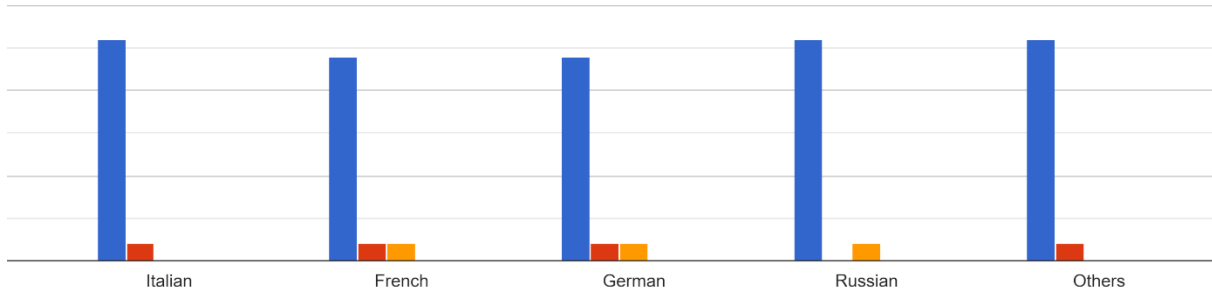
2) What is your first language? (If you are multilingual, please choose the one which you can think deeply with.)

14 responses



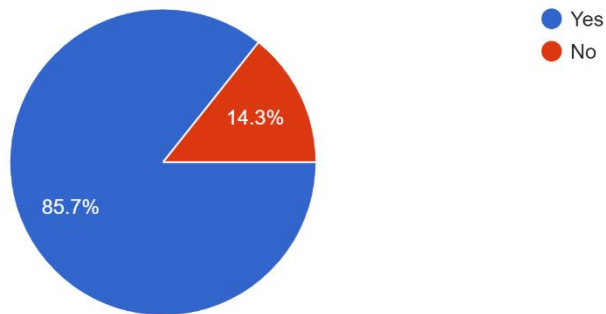
3) What are the languages you can write? If you choose "others," please write what it is in 3'.





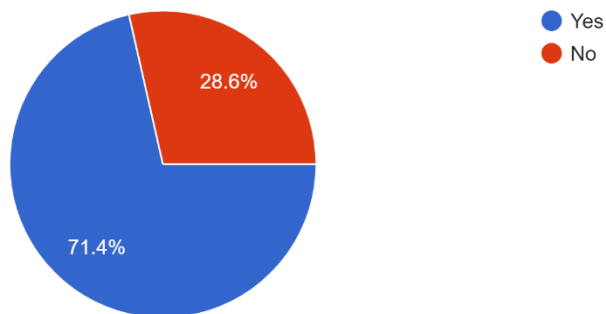
4) Do you have a custom or habit of handwriting?

14 responses



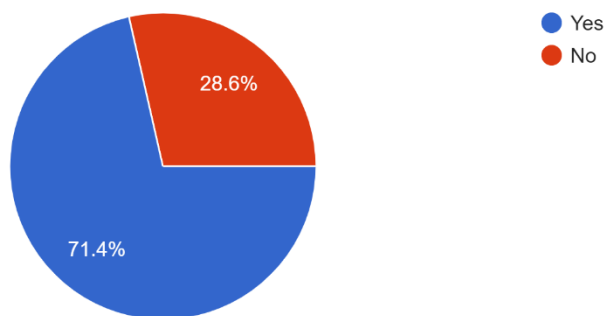
5) Have you ever been taught how to handwrite pretty or carefully?

14 responses



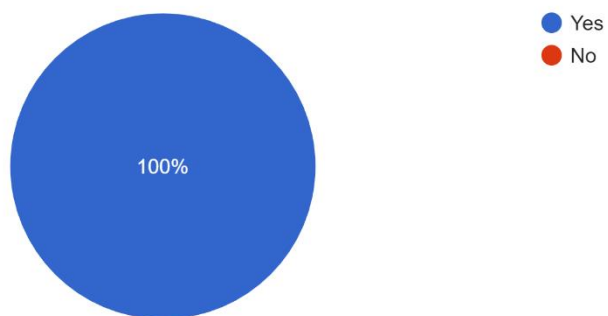
6) Do you think your handwriting is good (or not bad)?

14 responses



7) Do you like (or not hate) handwriting?

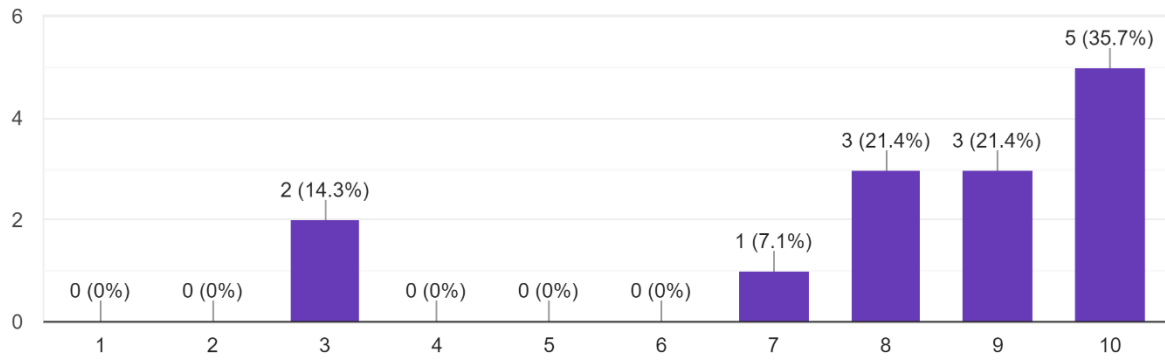
14 responses



8) How do you like to remember new vocabulary/words/foreign languages?

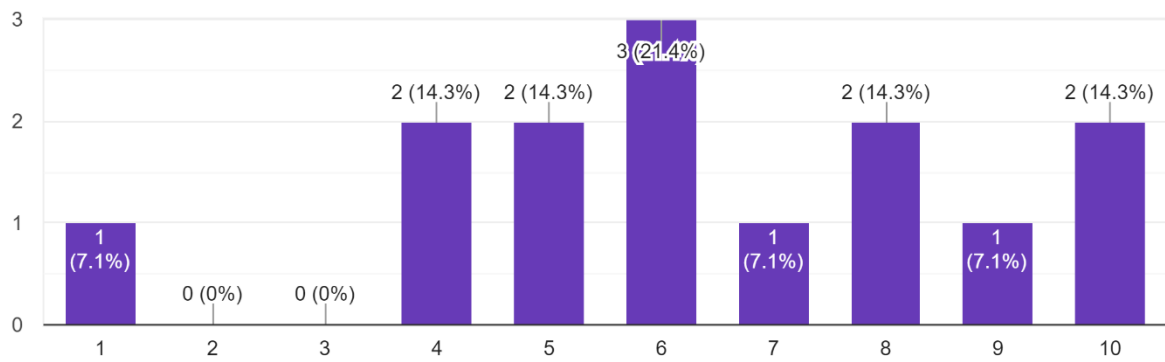
a. Writing them (on papers) again and again

14 responses



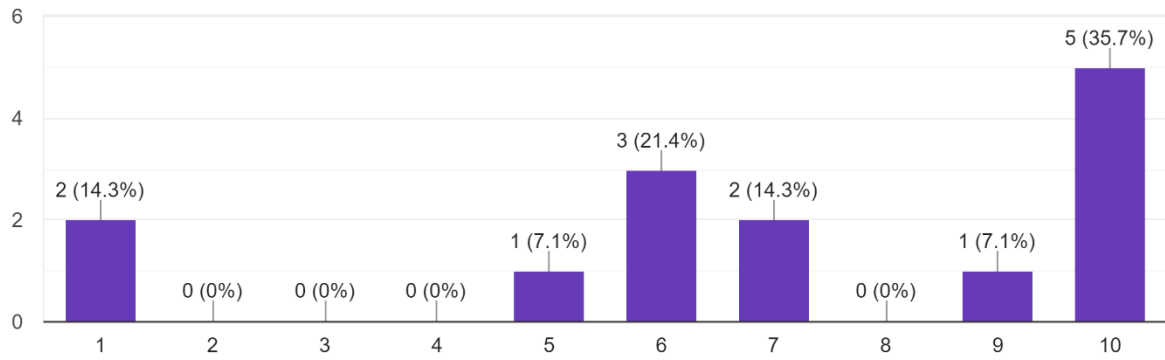
b. Looking at them (on papers) again and again

14 responses



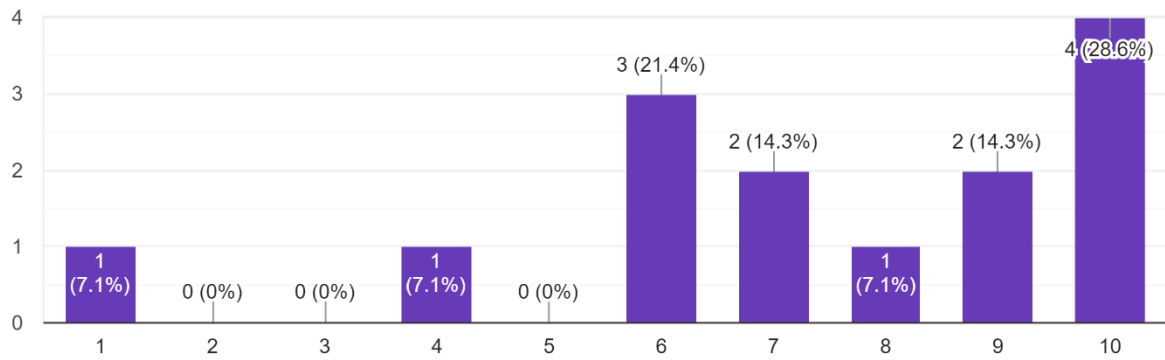
c. Reading them aloud (with papers) again and again

14 responses



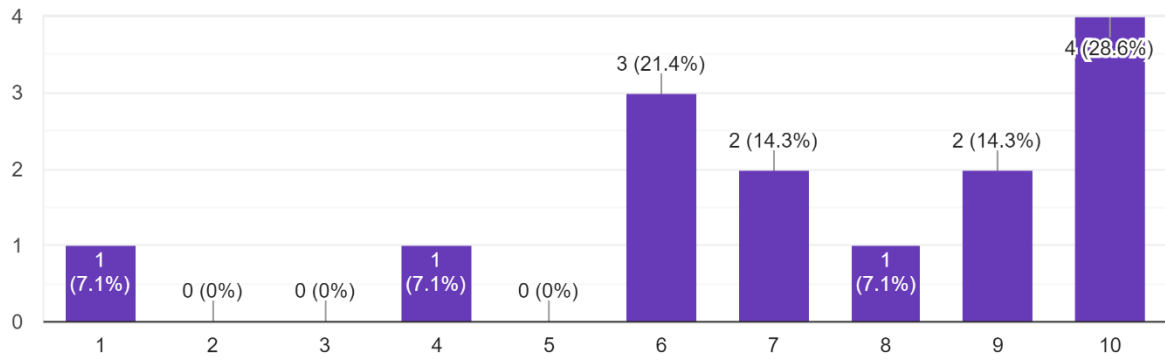
d. Listening to the sounds of them (with papers) again and again

14 responses



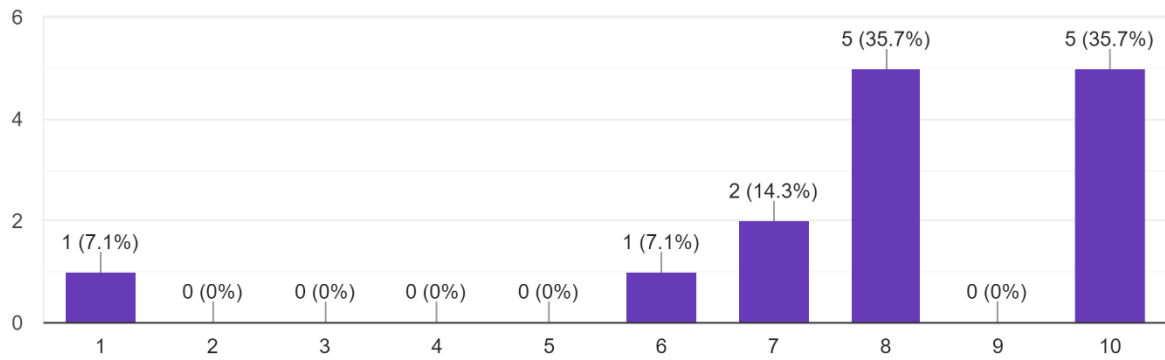
d. Listening to the sounds of them (with papers) again and again

14 responses



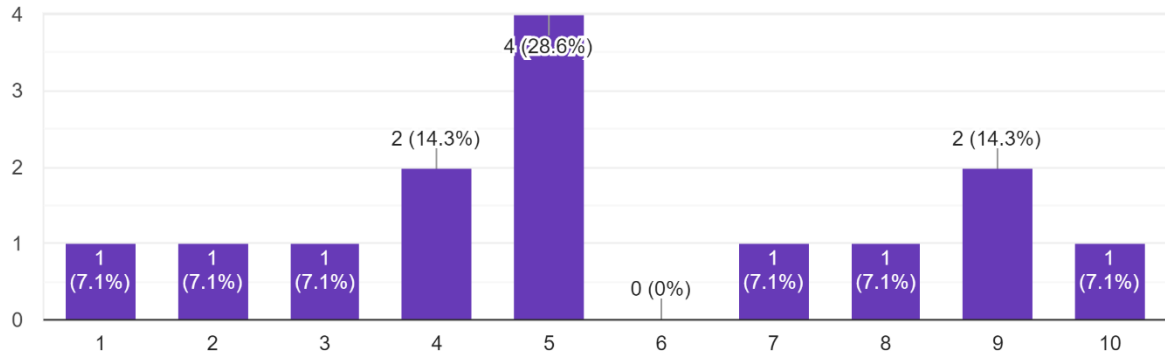
e. Using paper flashcards again and again

14 responses



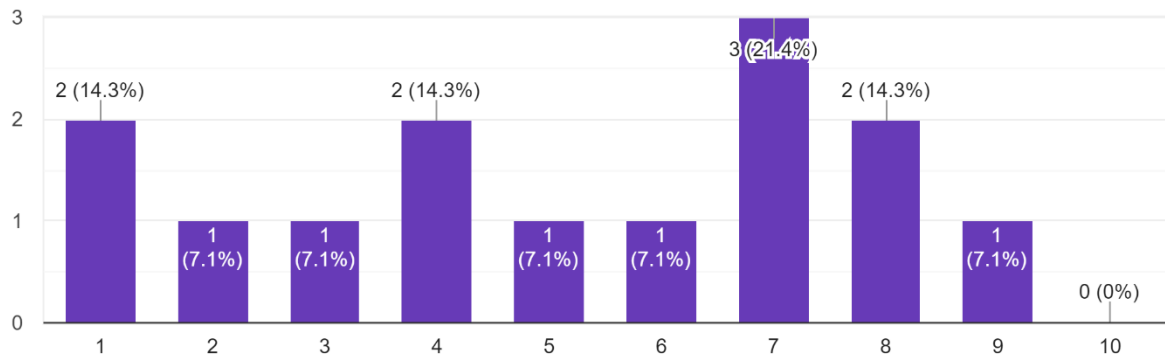
f. Writing (or typing) them (on mobile/tablet/PC App) again and again

14 responses



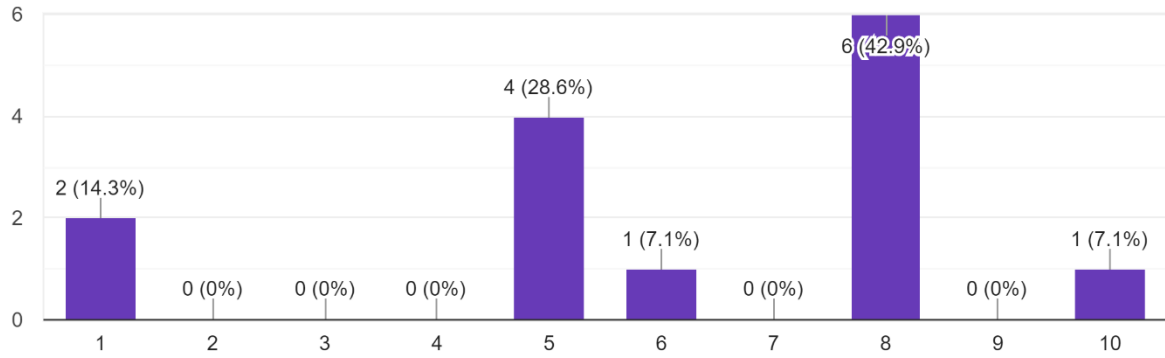
g. Looking at them (on mobile/tablet/PC App) again and again

14 responses



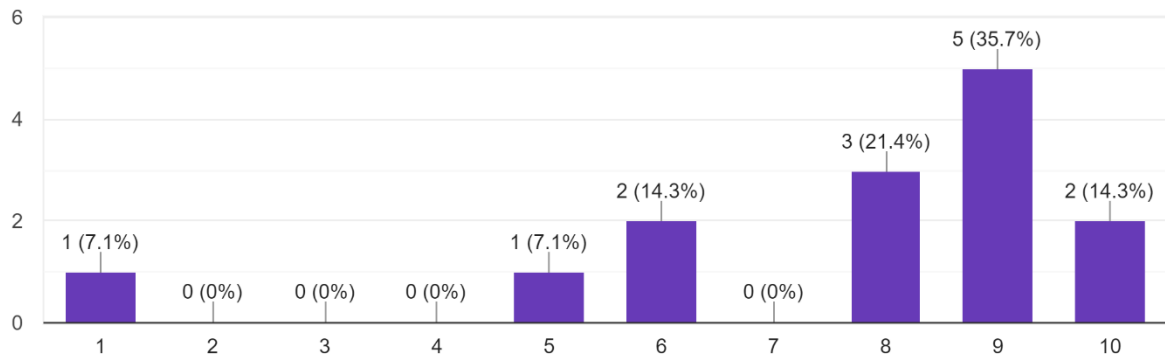
h. Reading them aloud (with mobile/tablet/PC App) again and again

14 responses



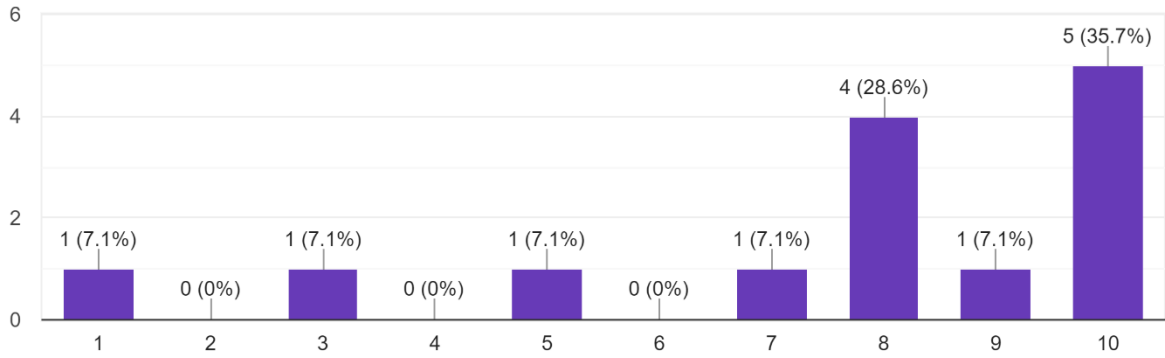
i. Listening to the sounds of them (with mobile/tablet/PC App) again and again

14 responses



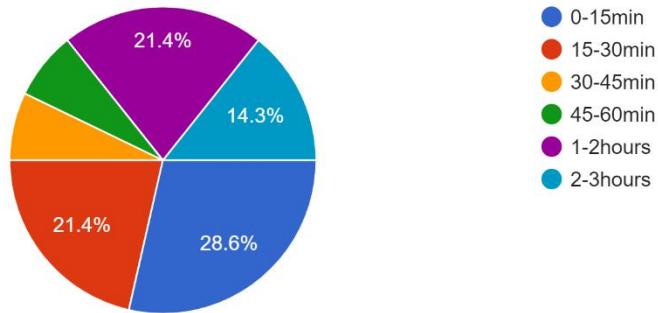
j. Using flashcards (on mobile/tablet/PC App) again and again

14 responses



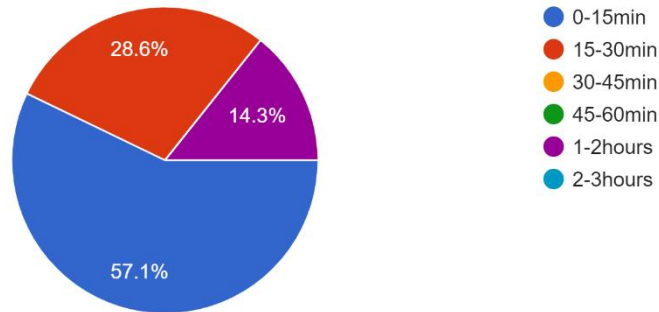
9) How long did you spend practicing Hiragana on papers out of class each day? (average)

14 responses



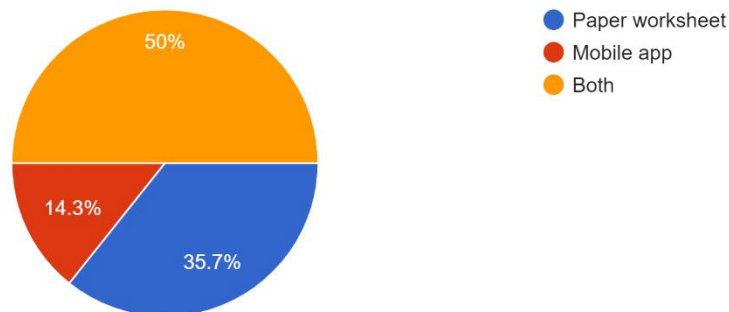
10) How long did you spend practicing Hiragana on mobile App out of class each day? (average)

14 responses



11) Which one do you think you will use if you continue studying Hiragana in the future?

14 responses



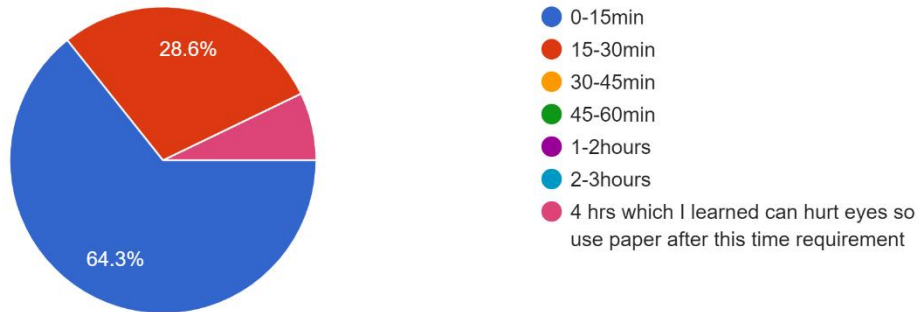
11') Why do you choose it/them? What/where/when/how do you think you will use to study?

Both
<ul style="list-style-type: none"> I can use app on my way home and use paper version to practice when I am in library.
<ul style="list-style-type: none"> Mobile app is convenient because I can do it anywhere at any time, but I think paper just feels better for memory and physical feeling. If I have a desk, pencil, and worksheets, I will definitely use paper. Sometimes I will be walking or I won't have any worksheets, so I will use mobile app or Duolingo.
<ul style="list-style-type: none"> On Campus and Off campus at apt.
<ul style="list-style-type: none"> Paper worksheet is good for memorizing, and mobile app is good for pronunciation.
<ul style="list-style-type: none"> The app helps me remember stroke order and pronunciation, and the paper worksheet helps me with my handwriting.

<ul style="list-style-type: none"> I really appreciated both! I find that writing them out helps to remember Hiragana better, but I really love that the app allows me to practice whenever and has a variety of features that allow me to practice pronunciation and listening. I feel that using both of them in conjunction is the best way for me to learn Hiragana!
<ul style="list-style-type: none"> I think it would be cool to write out my friend's names and such (for example, I wrote my friend Marrilyn or Merurin's name).
Paper worksheet
<ul style="list-style-type: none"> The mobile app that we used is good for the stroke order of Hiragana, but the worksheets--especially Hiragana to Romaji and back--help the meaning of the Hiragana sink in better, and I can still use the worksheets for stroke order. I will use the rest of the worksheets from this class--likely copying or imitating the Romaji conversion, too--and then have Julia find more worksheets for me. After, I will use the Genki textbooks and workbooks. I will study every night I can after work, for at least an hour, as I did in this class.
<ul style="list-style-type: none"> I find printing the hiragana over and over again to be most useful in remembering them. I try to do it whenever I get a chance (which is how I learned/continue to learn Hanzi in my study of Chinese). Something about the repetitive motion of handwriting helps me to remember.
<ul style="list-style-type: none"> What really helped for me was using the Anki app and then writing all the characters I guessed on paper.
<ul style="list-style-type: none"> I prefer to use study with paper. After writing the characters and hearing the pronunciation from the mobile app, I can associate the characters I wrote with pencil with the sounds.
<ul style="list-style-type: none"> I like writing the words down, it keeps it in my mind
Mobile App
<ul style="list-style-type: none"> I chose the mobile app because it is easier and more convenient. If I continue to take Japanese as a class I will probably use it more.
<ul style="list-style-type: none"> I prefer to learn characters using quizlet, so I think I'll use that to learn Katakana.

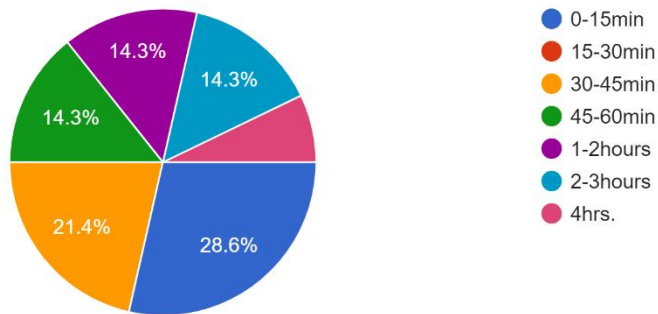
12) How long do you usually use mobile Apps for study in a day? (average)

14 responses



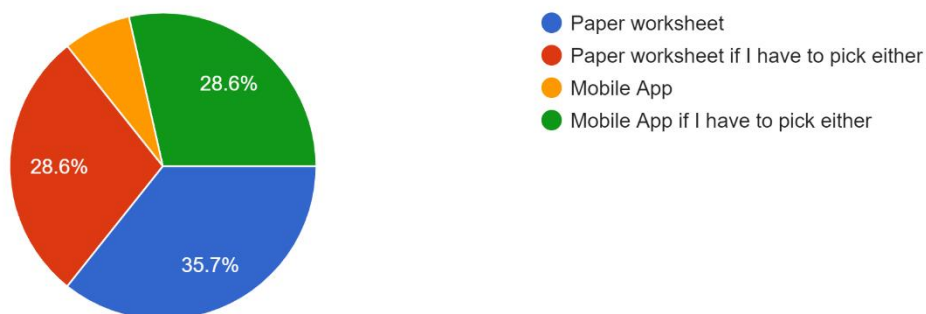
13) How long do you usually use mobile Apps NOT for study in a day? (e.g., SNS/videos/games/etc.)

14 responses



14) Which do you prefer to study Hiragana?

14 responses



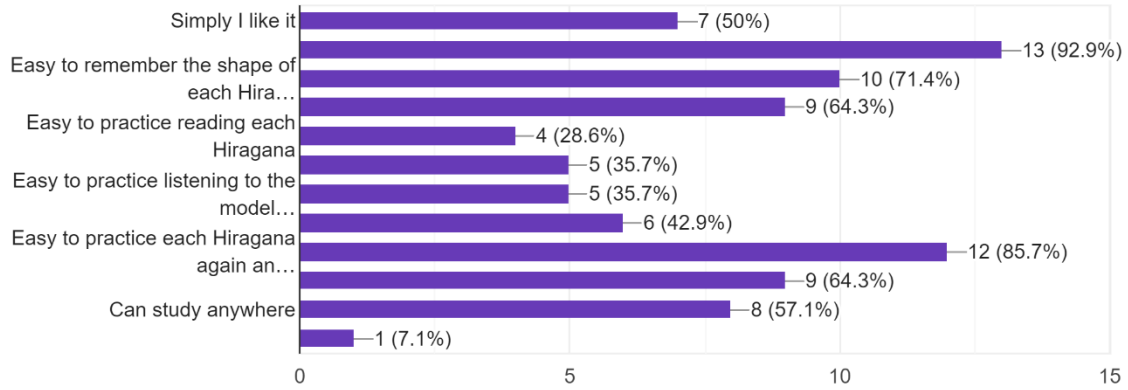
14') Why do you choose it? What/where/when/how do you think it is good to use?

Paper worksheet
I feel like I remember things better if I can write it down. However, if I spend enough time on the app, they may be equal in helping me remember things. I think the app is very good for hearing the sounds and reading, but the worksheet is best for writing. Worksheet helps with reading and writing, but not really sounds. It doesn't give feedback either, but it leaves a deeper memory in my mind. App is great for feedback and being able to hear the pronunciation. I don't like writing with my finger though.
The worksheets--especially Hiragana to Romaji and back--help the meaning (sound) of the Hiragana sink in better. I found that sometimes I couldn't convert Romaji to Hiragana, but once I saw the Hiragana I remembered the sound it made and could convert to Romaji. (So part of the challenge is remembering all of the Hiragana that exist, not just matching them to their sound.)
I like the repetitive motion of the worksheet. Also, I do not own a smartphone and can't access apps.
What really helped for me was using the Anki app and then writing all the characters I guessed on paper.
It keeps it in my brain
Paper worksheet if I have to pick either
Paper worksheet is a traditional way of memorizing.
With the paper worksheet I can get the muscle memory for the Hiragana, helping me remember their meaning as well as how to write them.
I found that writing it out myself (without tracing) helped me to remember the shape and stroke order of each Hiragana

I prefer paper worksheet, but I like the audio features of the mobile apps.
Mobile App
I just prefer using an app.
Mobile App if I have to pick either
App is more convenient.
I chose the mobile app because it is easier and more convenient. If I continue to take Japanese as a class I will probably use it more.
It is the most streamlined and accessible
It's convenient, but writing on paper makes me remember it better.

15) Why do you think you like it (paper worksheet or mobile app which you chose in 14))?

14 responses

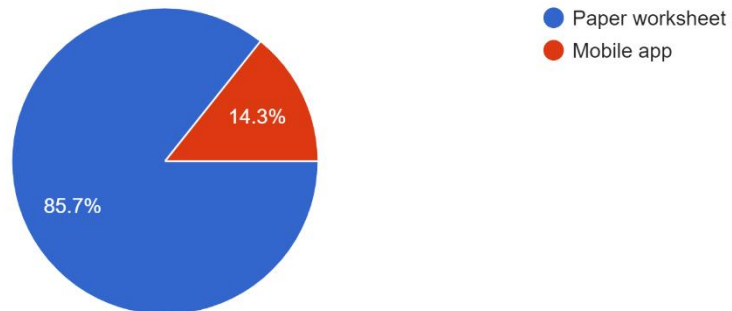


16) Do you think which (paper worksheet or mobile app) is more effective? Why do you think

so?

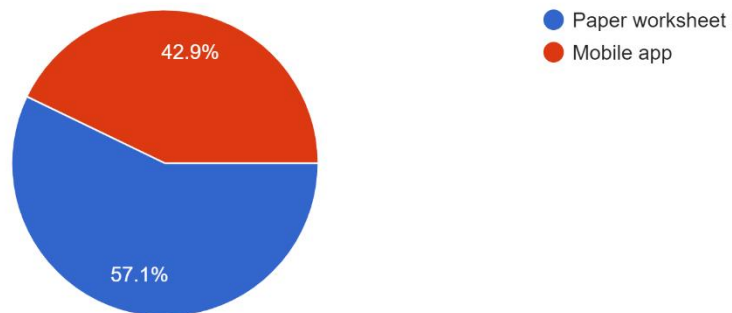
a. to practice writing each Hiragana

14 responses

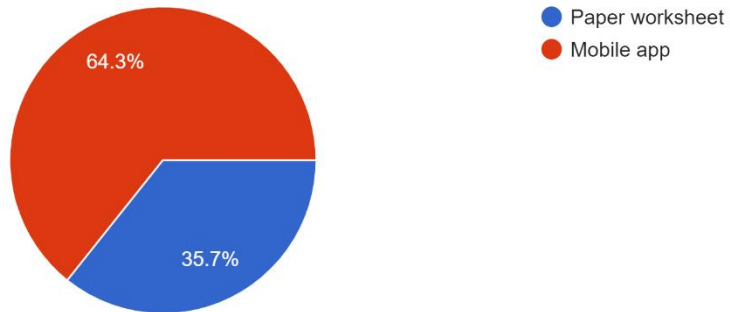


b. to remember the shape of each Hiragana to write

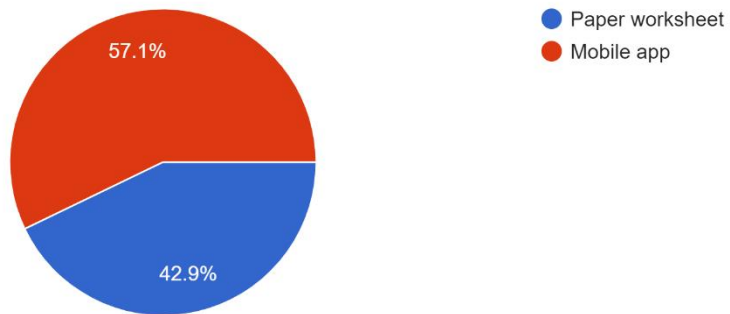
14 responses



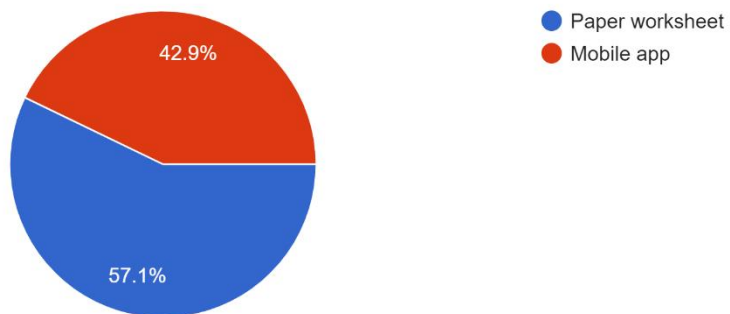
c. to remember the stroke orders of each Hiragana
14 responses



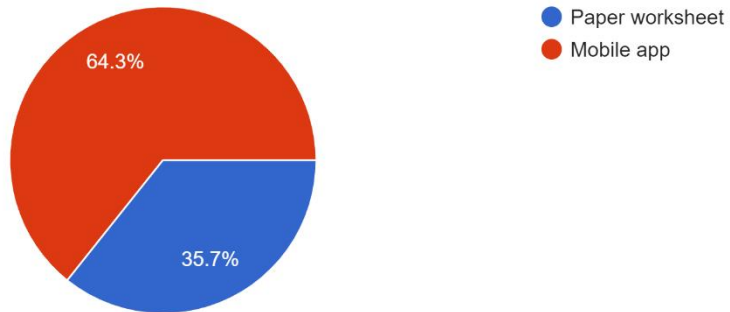
d. to improve the accuracy of each Hiragana writing (Hiragana shapes)
14 responses



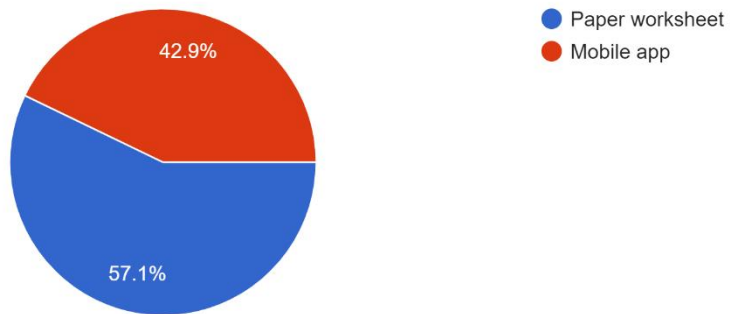
e. to improve the speed of each Hiragana writing
14 responses



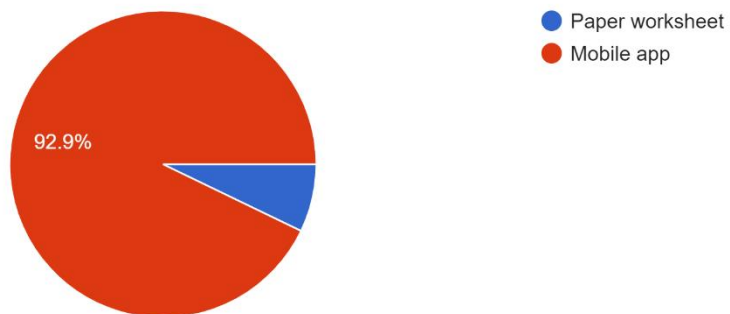
f. to practice reading each Hiragana
14 responses



g. to remember each Hiragana reading
14 responses

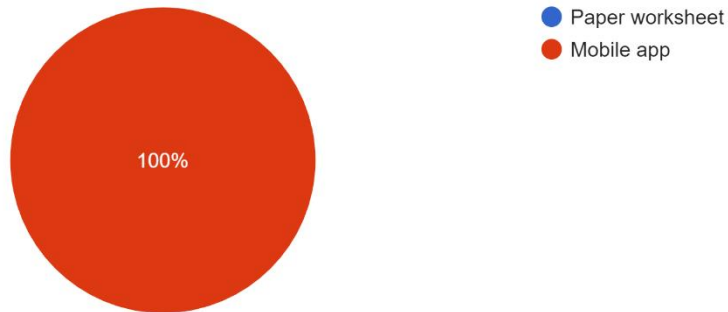


h. to practice listening to the model's pronunciations of each Hiragana
14 responses



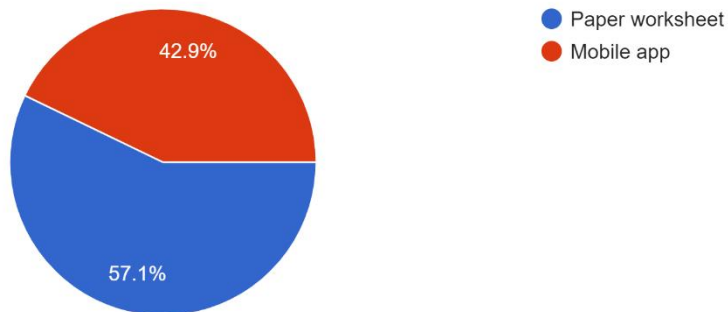
i. to check your pronunciation of each Hiragana

14 responses



j. to motivate and/or entertain you to practice each Hiragana

14 responses



j'. Why do you think so?

Paper worksheet
Paper worksheet can make people focus on the work.
A mobile app feels more like a widget, like the Weather app, so it's harder to pay attention to it for a long time - although I do like the audio pronunciation. The papers are more fun because there is a feeling of completion when I fill it out - I can see my progress.
I like writing.
The paper worksheet has examples of what words the Hiragana is used in, which can help you learn some new words that you can use.
I like the satisfaction of looking at all the hiragana I've written
I thought the big sheets of paper full of hiragana were very pretty, so writing them and filling in paper was very pleasing for me.
It is easier for me to write and I can look back on my work more easily.

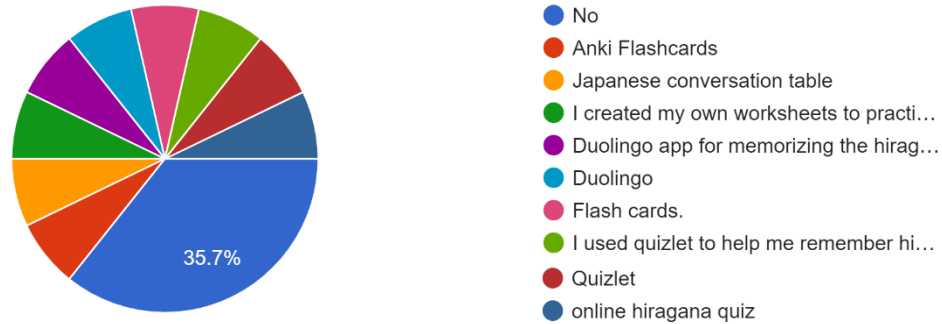
I just find it more fun and traditional!
Mobile App
I think the app is better because it is more convenient.
I like both. It feels very satisfying to complete the worksheets and also see the various vocabulary words on the worksheets. However, the app is like a game and has quizzes, which are fun sometimes.
the mobile app is really fun though uses a lot of screen time which is damaging to eyes
It was amazing that I could practice Hiragana anywhere thanks to having the app on my mobile! Plus, they had a variety of quizzes you could take to test your skills!
I can access it anytime.
I find that mobile apps are more engaging due to the fact that they don't give you the chance to stop. They just give you work after work and it is only up to you to stop, it almost becomes addicting as you want to practice it more and more.

k. others (If you have any other reasons to say that one of them is more effective, please write below.)

I prefer paper overall!
Attending class was the most important thing to use for the hiragana education
I find writing hiragana (or hanzi) over and over and over again to be relaxing
I enjoy using flashcards like quizlet to help me remember hiragana.

17) Did you use any other learning materials other than worksheets and App introduced in class? If yes, please write what it was in "Other."

14 responses



18) Was there anything inconvenience or you don't like with the paper worksheet or the app? Do you have any suggestions to make them better? (e.g., The app should sound to tell what the Hiragana is every time I try to handwrite Hiragana. etc.,)

The app was a little annoying when it tried to interpret what I was writing. Paper I'd say is easier for writing!
I didn't like that the app didn't have a flashcards functionality. I learn through lots and lots of repetition, and having that instead of just a visual guide would be helpful for me.
When doing the quizzes to practice, the mobile app does not tell me the right answer! I can't learn if it just tells what is wrong, and not also what is right.
The difference between the two O's was too clear so class was how I learned the difference.
I wish the app could show romaji and pronunciation. It only shows the hiragana and the definition, but not the romaji in one of the quiz sections.
I like the paper worksheet, but I am too lazy to walk to the library and print it out for myself.
I think that the app should have a non-tracing writing feature so you could practice writing without tracing
The strokes in app are just straight lines. I would like to draw brush-like stroke in app.
I found that the app was slightly outdated and I would prefer better UI or design. If it were better dated then I would love it.

19) If you have any comments for this class, please write anything below.

I loved this so much!! It was a blast to learn it with others and with such a fun and amazing teacher too :D Arigatou!
I'm super pleased with my progress in hiragana, and I'm definitely going to keep practicing my hiragana and learn some more Japanese in the future.
Domo arigato! This class was a good push for me to start learning Japanese. Now I know where and how to start.
I really enjoyed the class, thank you so much for the opportunity.
Though I did not do as good as I expected it is actually really fun to learn however as an artist I wish English looked this good when written. The letters flow in a way that English does not. I wish it was offered at my high school only Spanish and French.
I really enjoyed it!!! ありがとう ございます
Nope -- this class was excellent! Now I want to learn to read Japanese :-)
This class was great! Arigato gozaimasu Nakada-sensei!
I just want to say thank you! I absolutely loved this class and wish it was longer!!!
Good job for this class. If there is continued class, plz let me know haha.
Thank you so much for teaching! I cant wait to take Japanese next semester! Arigato!
Sending us the powerpoint of your class will be more helpful.

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