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# Novel micro-learning-based mobile-assisted language app for Mandarin Chinese

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## **Abstract**

Mobile-assisted language learning (MALL) was first introduced in 1993 and became a sub-area of the growing field of mobile learning research. It has inspired learners to make use of the "anytime" and "anywhere" technology, the key concepts in MALL. Though some mobile apps for Mandarin learning are available, many challenges of the current MALL technology have been recognized.

In order to tackle these challenges, we (author and her colleague in Computer Science Department) have designed a mobile app (Android and iOS) as a Mandarin supplementary learning tool, using microlearning theory. Learning content can be easily customized as needed according to the textbook, which allows both seamless alignments with college curriculum and more quantitative study of MALL technology, with a large group of students over a long period. In addition, the data of students' behaviours and performances, including how often the student used it and what the results are, can be traced. The analysis of these data allows the use of micro-learning for both students and instructors, which facilitates the language learning. We will pilot the app and conduct various experiments in multiple sections of Chinese I in our college to assess the effectiveness of the proposed app for free. The app can be also applied to other foreign languages with little effort.

### Introduction

While Mandarin is considered one of most difficult languages (according to the language difficulty rankings by US Foreign Service Institute), it is also one of the most popular foreign languages in the world. It is spoken by over 1 billion people worldwide. There are 873 million native speakers of Mandarin Chinese, and a further 178 million secondary speakers (Austin, 2020). One of the hardest is mastering the tones of Mandarin. Another thing that makes Mandarin unique is its writing system, there is no alphabet in Mandarin. Due to Mandarin being a tonal language, it is very easy to cause misunderstandings when you are a new learner. However, unlike other foreign languages, US schools lack enough qualified instructors and supplementary teaching materials (Wen, 2017).

## What is Mobile-assisted language learning (MALL)?

Mobile technology has become an essential element of our daily life. It has changed our lifestyle, and more importantly, our learning style. Mobile-assisted language learning (MALL) was first introduced in 1993 and became a sub-area of the growing field of mobile learning research (Stockwell, 2014; Burston, 2014; McCarty, 2017). We have implemented this technology in our new teaching tool – a novel micro-learning-based mobile-assisted language app and apply these new learning trends in Mandarin Chinese acquisition. MALL has been considered an ideal solution to overcome language learning barriers in terms of time and place (Miangah, 2012). It has inspired learners to make use of this "anytime" and "anywhere" technology, which utilizes a micro-learning concept to deliver language learning materials to the students (Thornton & Houser, 2005).

## What is micro-learning?

Microlearning is about getting maximum benefits through minimal input. It deals with small learning topics and short-term learning activities, and has been widely used in language acquisition. It delivers small quantities of information that leave a lasting impression (Wu & Li, 2015). Micro-learning can facilitate self-directed lifelong learning, as short activities can be easily integrated into everyday activities. Language learning needs daily learning, more practice, more improvement.

The micro-learning concept has been implemented in training and learning for a long time. But since recent decades, it has combined with technology to provide many web applications and mobile apps, and also has been adopted by the proposed Mandarin learning mobile app.

## Literature review

Mobile-Assisted Language Learning (MALL) deals with the use of mobile technology in language learning. In contrast to classroom learning, in MALL there is no need for the learners to sit in a classroom or at a computer to get learning materials. In fact, MALL can be considered an ideal solution to language learning barriers in terms of time and place Mobile-Assisted Language Learning (MALL) deals with the use of mobile technology in language learning. In contrast to classroom learning, in MALL there is no need for the learners to sit in a classroom or at a computer to get learning materials. In fact, MALL can be considered an ideal solution to language learning barriers in terms of time and place.

#### The theoretical foundation of MALL

As early as 1885, the famous Ebbinghaus forgetting curve theory was born. The theory states that humans start losing the memory of learned knowledge over time, in a matter of days or weeks, unless the learned knowledge is consciously reviewed time and again (Ebbinghaus, 1913). Statistics also show that humans forget approximately 50% of new information they encounter within an hour and an average of 70% within 24 hours. After a week, the average goes up to 90% (Kohn, 2015). How do you solve this problem? George Miller's Information Process Theory proposed a solution. It says a learner's attention span and short-term memory is limited to processing information in chunks (Miller, 1956). Chunking content into small, manageable sections makes learning more manageable and easier to integrate into longterm memory (Moran, 2016). This is the theoretical source of the micro-learning concept. Traditionally, micro-learning has been used primarily in a blended learning process, combining face-to-face instruction with micro-learning for follow-up and reinforcement (Elmlearning, 2021).

With the advancement and development of technology, especially the emergence of mobile technology, microlearning has become the theoretical basis for the perfect combination of learning and this technology. Especially for language learning, the use of Micro-learning to design apps has become a trend (Redondo, 2021).

#### **Advantages of the MALL**

Micro aspects refer to vocabularies, phrases, sentences and grammar rules, which are essentially the focus of curriculum of second language learning in American colleges (Power & Shrestha, 2009). Studies have commonly emphasized the mobility of MALL devices, which lets the users take advantage of these devices wherever and whenever they want to learn small language concepts. Learning is not restricted to four-wall classrooms in this type of learning. This unique feature of mobile devices results in many other advantages in language learning (Cherian & Williams, 2008, Chinnery, 2006, Kennedy & Levy, 2008, Kukulska-Hulme, 2009, Wishart, 2008). MALL can be formal or informal, and mobile devices may form a bridge connecting in-class and out-of-class learning. When learning takes place outside the classroom, it is often beyond the reach and control of the teacher. But it is also an opportunity to revitalize and rethink current approaches to teaching and learning (Kukulska-Hulme, 2012).

#### **Limitations of the current MALL**

A few well-recognized commercial language mobile apps, such as Rosetta Stone, Duolingo, Busuu, also adopted the concept of MALL and they prove to be effective to learn language (Rosetta Stone, Duolingo final report, Busuufinal report). These studies only target some languages and they do not target college students and the users are a very motivated group (only 45% of participants have completed the study and 70% of them have BA or higher degrees). These apps often require learners to learn topics in a certain order other than customization and it limits opportunity for real-world practice (Gobler, 2021). In addition, these apps are not easily adopted with college curriculum, because (a) the apps are designed for self-study and not for use within the context of a course and the curriculum in the apps cannot be modified, hence they cannot meet the needs of school students to review what they have learned in the class; (b) these language apps do not allow instructors to edit language content and customize exercises.

Some publishers, e.g. Pearson Inc and Cheng & Tsui Inc, provide both a Chinese textbook and an online workbook. These workbook exercises prove to be very helpful since they align with the textbook contents very well. It allows students review what they have learned in the class. However, they only provide a web-based interface and often require students to complete exercises on PCs, instead of mobile devices. Burston (2014) found that most materials in MALL are teacher-led and scheduled, not leveraging the anytime, anyplace mobile environment (Goodwin-Jones, 2011; Kukulska-Hulme & Shield, 2008). In other words, students in one class will complete the same exercises with the same schedule and requirements out of classroom. Language learning could be enhanced in new, innovative ways and can be improved with the assistance of mobile devices. Viberg and Gronlund (2014) suggested more study on user's time management using mobile apps which could potentially improve the effectiveness of the use the app. Hence, further research and understanding of technology may lead to better and more efficacy designs.

## **Research Problems**

To tackle the above issues, we designed and developed a mobile app for learning Mandarin (iChineseExercise or ICE app on Android and iOS). It includes two features: instruction-customized materials, which tackle the challenges that current MALL face. We are conducting preliminary experiments in some Chinese I class using the mobile app and received positive feedback from student participants for its ease of use and instant feedback.

Compared to the regular MALL apps, the proposed ICE app has the following unique features: (a) it allows instructors to customize learning materials, hence it can seamlessly align with curricula. The ICE app will automatically customize the exercise/review content and schedule for students, (b) it provides the attempts and time consumed in every questions, and these data are useful for students to review concepts, as well as instructors to analyze and understand students' learning performances on each concept (Figures

1a-b).

The ICE app includes two modules, the instructor web portal (Figures 1c-d) and the student mobile app (Figures 1a-b). In the mobile app, all the exercises will be available for students to preview, review and post-review. Currently, there are three simple games-based exercises available (Figure 1a). The instructor's web portal includes three different users: system administrator, instructor, and book administrator. The ICE app allows instructors to customize language materials, which includes vocabulary, sentences and grammar (Figures 1 a & d). These materials are organized by textbook, hence they can be seamlessly aligned with the curriculum. These materials will be automatically transferred to each exercise activity on the mobile apps.

We would like to use the App to be a new teaching tool to answer our research questions. Based on the above-mentioned literature review and our proposed Mandarin mobile app, the study aims to answer the following research questions:

- Does a mobile app customizing for a textbook improve Chinese I students' overall vocabulary proficiency?
- 2. Does a mobile app customizing for a textbook improve Chinese I students' overall syntactic accuracy in sentence production?



Figure 1: The interfaces of the mobile app and instructor web portal. (a) The main interface of the above, including three games; (b) grading book, including both grades, time-used and attempts; (c) main menu of the teacher's portal on web; and (d) web interface allows teachers to add new vocabulary and sentences for exercises.

## Methodology

We piloted the ICE App for two semesters and conducted both experiments and surveys. Given the ethical concerns to have one group of students potentially advantaged by the use or non-use of a technology, we give two different groups access to the ICE app at different times during the course (before and after midterm). Both groups of students have had access to the same technology. The timing in which this access occurs is necessarily going to have some kind of effect. Both groups will take midterm and final exams, which cover materials without overlap.

#### **Experimental design**

In order to answer the proposed research questions, we conducted separate experiments in the Spring and Fall terms of 2019, with and without the use of the app. Knowing a word involves more than knowing a word's definition (Johnson & Pearson, 1984). In fact, learning the vocabulary of a discipline should be thought of as learning about the interconnectedness of ideas and concepts indexed by words. The dimensions theory (Cronbach, 1942) is used to create vocabulary quizzes and exam questions to check the effect of the app:

- Generalization: The ability to define a word
- Application: Selecting an appropriate use of the word
- Breadth: Knowledge of multiple meanings of the word
- Precision: The ability to apply a term correctly to all situations
- Availability: The ability to use the word productively

The vocabulary quiz has been given after every lesson finished. Vocabulary knowledge is multifaceted. Students should be familiar with the meaning, know words related to the term (phrase and sentence), and have flexibility with using it in both written and oral form. The dates of the five quizzes were: February 27, March 18, April 3 and 22, and May 6, 2019 (15 students used ICE, 15 students did not use it). The tables provide assessment examples in the quiz (Table 1) and mid-term exam (Table 2).

Table 1: Sample quiz (please write down the corresponding Chinese character.)

1	2	3	4	5	6	7	8	9	10
You	I/me	fine/well	to be	She/her	teacher	student	also/too	he/him	not/no

## **Participants**

There are two groups' students participated in the research. They are all freshmen in level 1 Chinese class in a US college. To make a fair comparison, the authors selected students from two classes from the same level in two semesters (see Table 3).

Table 2: Design and examples of the mid-term questions

Dimensions	Generalization	Application	Breadth	Precision	Availability
Assessment goal	Vocabulary Sentence production		Vocabulary	Sentence production	Sentence production
Assessment methods	Vocabulary quiz	Select an appropriate assigned word for the sentence	Select an appropriate assigned word/phrase for the sentence.	Write a sentence using the assigned words	Write a paragraph/dialogue using the assigned words
Sample questions	Write Chinese character according to the English meaning: English: student Chinese:	Fill in the blank using the following words: 我喜欢	Select correct pinyin for the underline word. 人行道在银行的前面。 A. xíng B. háng	Rearrange the following words according to the English sentence. My friend is a New Yorker. 朋友/我的/人/是/纽约	Write a short dialogue using the following words. 宿舍/室友/进来/介绍/有/几个

Table 3. Participants in the experiment (before midterm)

•	Males using App	Females using App	Males w/o App	Females w/o App	Language level
Spring 2019	5	10	6	9	I
Fall 2019	4	5	4	5	I

#### **Procedure**

In Spring 2019 (15 weeks), we chose a Chinese I class which was taught in a US college, including 30 students, to conduct our experiment. The class was split into two groups, each group had 15 students (see Table 3). One group was given access to the ICE app before the midterm exam. They used the ICE app to practice out of classroom and complete their homework; while another group was assigned regular homework and exercises. After the midterm, the two groups were switched. The exam scores of students using the ICE app before the exam were the results from the experimental group, the exam score of students without using the ICE app before the exam were the results of the control group. The midterm exam covered lessons 1-3 and the final exam covered lessons 4-6. The instructor gave feedback to students every week. So, students can know which questions they answered wrongly and what they need to do to improve. Teachers would announce the learning outcomes of the whole class to students, so that students can have a comprehensive understanding of their own learning situation of the whole class.

In Fall 2019 (15 weeks), we did another experiment. The experiment was conducted in a Level I class with 18 students. The experimental setup is the same as in Spring 2019. One group was given access to the ICE app at the beginning of the semester and they used the ICE app to practice out of classroom and complete their homework; while another group practiced out of classroom and completed their homework at the same time using the traditional method. After the midterm, the two groups switched. The midterm exam covers lessons 1-3 and the final exam lessons 4-6. The students received the feedback and statistical data too. One survey was conducted before the semester ended. Students of the above two groups completed the pre- and post- experiment survey in May and December in the Spring and Fall semesters of 2019.

#### **Results**

We have used two methods to do analyses: experiments and surveys. We present the results of the differences between the experimental and control groups in Spring and in Fall 2019 as well as the results from the two surveys conducted at the end of both semesters.

## **Experiment**

We collected all scores of the five quizzes and a midterm and used a box-and-whisker chart to compare the quiz scores of the two groups.

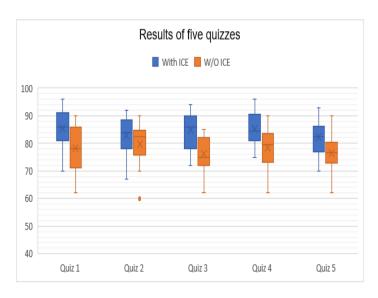


Figure 2: Results of five quizzes.

The results of the five quizzes from two groups show: the medians of the group using the ICE app and the group without using the ICE app are 82-85 and 76-78, respectively. The difference of medians between the two groups are 7.2, 3.1,7.6, 5.6, 5.7, respectively. The difference in values of quiz 2 is only 3.1, the reason is some words of Lesson 2 (Name) is based on Lesson 1 (Greeting). Unlike an alphabetic system, Chinese is a character-based writing system. One of the features of Chinese characters is radicals which are the base components of each character. Chinese radicals can hold information about the character's meaning and/

or sound. They often reflect some common semantic or phonetic characteristics. There are around 200 radicals in Chinese. Knowing common radicals can greatly help you learn new Chinese characters. For example: 您 (lesson 2) and 你 (lesson 1). "您" has the same meaning as "你", but is more polite and can show your respect for the person you are addressing. So "你" and radical "心" (means heart) form a new character "您". Another example: 她 (lesson 2) and 他 (lesson 1). "她" means she/her, "他" means he/him. The only difference of these two characters is the radicals. "她" has a radical of "女" (means female) , "他" has a radical of "人" (means male/human). Many Chinese characters are related, and the meaning or sound of the character can be found from the radicals and the same components.

Another feature of Chinese characters is the composition of phrases. For example: "英文" (means: English language) and "法文" (means: French language) in lesson 2 and "中文" (Chinese language) in lesson 1. They all consist of two parts: country name and language name. Maybe you do not know the exact meaning of this phrase, but if you know the meaning of "文", it will be easier to infer that this phrase must mean a language.

The result of the Chinese I midterm exam in Fall 2019 (a total 18 students (9 students used the ICE app, and 9 students did not use it) participated in the test on October 28, 2019) is shown in Figure 3.

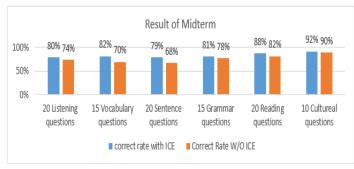


Figure 3: Result of midterm (Fall 2019).

In the initial stage of Chinese learning, words and sentence patterns are the most important parts. When designing the midterm, we focus on the assessment of words and sentence patterns. As can be seen from the following table (Table 4), we assess students' mastery of words and sentence patterns from four aspects: listening, speaking, reading, and writing.

# Survey

After using the app in two semesters, we did a survey in each semester, both in Spring and Fall 2019. In total, 48 students participated. Figure 4 shows the results in five different aspects. From the survey, we tried to understand whether students liked the design and which part is their favorite activity. The most liked feature is the exercise feedback. It shows the data which includes how many attempts and how long it takes for each question, and the statistics of the whole class. The second favorite feature is the instructor's feedback. This is also the main reason why we designed this

Table 4: Assessment contents of each part of the midterm

Focus	# of questions	Assessment contents				
Listening	20	10 questions are on Pinyin.		10 questions are on vocabulary and sentences.		
Vocabulary	15	10 questions are on definitions.		5 questions are on writing and radical assessment.		
Sentence	20	10 questions are on grammar.		10 questions are on forming sentences.		
Grammar	15	5 questions are on part of speech.	5 questions are on measure words.		5 questions are on tense.	
Reading	20	This part is a comprehensive assessment, include vocabulary, grammar and sentence.				
Culture	10	This part is about the knowledge of Chinese culture.				

App, which allows students to request help from instructors after class. The other favorite feature includes the content of the app. 72.9% of students agree that the app helps to improve their grades. 39.6% of students said that they like the games in the app.

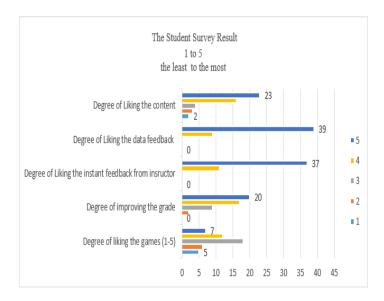


Figure 4: Survey of all students from two semesters.

From the results of these assessments, we can find:

- a While grammar and pronunciation are important in foreign languages, learning vocabulary provides the content of listening, speaking, reading and writing. Expanding your foreign language vocabulary is one of the crucial elements to master a new language. The major resource to design the ICE app is the vocabulary in the textbook. The games of the app are mainly based on vocabulary; hence students have more chances to practice them. We believe it's the reason that the difference of learning performance in the vocabulary quizzes (Figures 2 & 3), The more students practice, the more students master the vocabulary.
- b It is not easy to form sentences while learning a new language. This is a common challenge students face in their second language acquisition. We use the sentence structures which are taught in the class and let students practice using the ICE app since this app incorporates many exercises of sentence-forming. If the students have mastered the sentence structure (Grammar) and have practiced enough, the students' mastery of sentence formation will improve naturally (Figures 3 & 4).
- c The students like to get instant feedback from the instructors after class and adjust the difficulty of the exercise which is the unique feature of the App. For compulsory courses in universities, students focus on learning performance instead of the fun of the app (Figure 5). So this is an effective supplementary learning tool for the students.
- d The design of this app is based on a textbook, so it is very helpful for students to master the classroom learning content, and the testing results shows that students using the ICE app improve their grades (Figures 3 and 4). Today's technology offers numerous options for educators and students to improve their teaching and learning performances. To get started, think about one new approach that could be the catalyst for positive change in your classroom.

In looking at our learning environment, what could benefit our students the most? Collaboration and interaction during the classroom and out of the classroom are the most important. This app meets both of these requirements.

## **Conclusions**

Improving students' learning performance is the goal. In this paper, we focus on a study of learning performance using the proposed app. The experiment shows the app is an effective tool for both vocabulary and sentence formation. In fact, many data in this app can help teachers improve their teaching performance. For example, if the number of students' attempts of some questions were far more than others, the instructors should be aware whether the questions are explained clearly or if they need more clarification. In the

future, we plan to disseminate the software (the app and data analysis) to more instructors for free, collect more data and conduct data analytics to improve both students' and instructors' teaching and learning performance.

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