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Effect of Using *ChineseSkill* on the Learning Achievement of Chinese as a Second Language Beginners

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Abstract

Since overseas Chinese as a second language (CSL) learning encounters huge challenges, *ChineseSkill,* a Chinese language learning app, was adopted in this study aiming to improve the achievement of CSL beginners. It was a quasi-experimental study that lasted approximately 10 weeks. Data were collected at a college in Malaysia using a purposive sampling method. The experimental and control groups consisted of 105 and 63 participants respectively. One-way ANOVA, independent samples *t*-test, and paired samples *t*-test were used to analyze the data. The insignificant difference between the experimental and control groups in the pretest indicates that the participants in the two groups had similar levels of Chinese proficiency before the experiment. The experimental group scored significantly higher than the control group on the post-test, suggesting that teaching with *ChineseSkill* outperformed the conventional teaching method. Both the experimental and control groups scored significantly higher on the post-test than on the pretest, implying that both the conventional teaching method and teaching with *ChineseSkill* can enhance CSL learning. Therefore, mobile apps such as *ChineseSkill* could be used to address the challenges of overseas CSL learning, enhance learners' comprehensive CSL skills, and complement formal and informal language learning activities.

Keywords: Chinese as a second language learning, mobile-assisted language learning, mobile apps, *ChineseSkill*

Introduction

Due to the increasing improvement in the economic, political, and cultural status of China, Chinese is becoming one of the most popular second languages apart from English in the world (Gong et al., 2020a; Ting et al., 2020). Although CSL learning has been developing rapidly in recent decades, due to various reasons, overseas CSL learning has encountered vast challenges.

First, the distinctive characteristics of the Chinese language, such as the complex shapes and structures of Chinese characters, the special intonation and multiple meanings of words, and the different grammar patterns, make it extremely difficult to learn for non-Chinese learners (Chua, 2020a; Qian et al., 2018; Ting et al., 2020). Second, most researchers and educators mainly focus on translating sentences, teaching grammar, and correcting learners' pronunciation, to some extent

neglecting the importance of learners' comprehensive language skills (Abdullah et al., 2019). Third, the lack of authentic language context, as well as the low frequency, short duration, and large scale of classroom teaching (Eubanks et al., 2018; Jiang & Li, 2018; Loh et al., 2018; Ting et al., 2020) shorten the time learners are immersed in the language and affect the acquisition of language skills (Abdullah et al., 2019).

In recent decades, technologies have been widely used to improve various language skills such as vocabulary, grammar, oral, listening, writing, reading, pragmatics, and intercultural competence (Wigham, 2020), which provided a great opportunity to solve the above challenges. Since mobile learning (m-learning) and mobile-assisted language learning (MALL) are less restrictive in comparison to other types of technology-enhanced learning (Kumar et al., 2016) and outperformed the computer-based method in teaching second language vocabulary (Yu & Trainin, 2022), m-learning and MALL have become even more prevalent (Ho, 2018). Therefore, mobile technologies such as mobile apps should be used in the classroom to improve teaching efficiency (Ch'ng et al., 2019).

The advocate of m-learning and MALL has theoretical support. According to Vygotsky's social development theory (Vygotsky, 1978), mobile technologies could be considered not only as a "more knowledgeable other" to support learners' self-directed learning activities but also to enhance interaction with peers and teachers through collaborative discussions and learning artifacts to assist learners make improvement within their zone of proximal development. Moreover, based on scaffolding theory, mobile technologies can also be considered as hard scaffolding (Brush & Saye, 2002), self-scaffolding (Holton & Clark, 2006), and technical scaffolding (Yelland & Masters, 2007) to facilitate language learning.

Although mobile technologies have been widely used to enhance the learning of various languages, most research is related to mobile-assisted learning of English as a second language (ESL) (Zain & Bowles, 2021). More attention should be paid to mobile-assisted CSL learning. Although many researchers have confirmed that mobile technologies could also play a major role in CSL learning, they have focused more on discovering the challenges of Chinese learning and finding solutions (Chua et al., 2020a) or investigating the effectiveness of mobile-assisted CSL learners' specific skills, such as reading, writing, speaking, vocabulary, Chinese characters (Zhou, 2020), and thus have hardly examined the effect of mobile-assisted comprehensive CSL skills. This study could contribute to filling this gap.

Furthermore, Liu et al. (2014) pointed out that not all teachers embraced this teaching approach. This was because it required extra time and energy to find appropriate materials and resources for teaching, adjust teaching strategies to make full use of mobile devices, and monitor students' assignments. Moreover, despite the fact that Generation Z learners prefer self-directed and self-determined learning styles and have amazing information seeking ability (Shatto & Erwin, 2016), they should be trained in an m-learning environment (UNESCO, 2013) to gain their attention, ensure the quality of information, and improve their problem-solving and critical thinking skills (Chang et al., 2010; Shatto & Erwin, 2016) to ensure they are not left behind by the rapid global technological revolutions (UNESCO, 2014). To some extent, this research could help teachers and learners select or learn with high-quality mobile apps.

This study aimed to investigate the effect of using *ChineseSkill* (a Chinese language learning app) on the learning achievement of CSL beginners. Specifically, four research questions of the research are developed as below.

1. Is there a significant difference between the experimental group and the control group regarding the CSL learners' pretest achievement?

2. Is there a significant difference between the experimental group and the control group regarding the CSL learners' post-test achievement?

3. Is there a significant difference between the CSL learners' pretest and post-test achievement in the experimental group?

4. Is there a significant difference between the CSL learners' pretest and post-test achievement in the control group?

Literature Review

Advantages of mobile-assisted CSL learning

There are many benefits to learning with mobile technologies. For example, mobile technologies can support differentiated instruction and self-directed learning, save instructional time, reduce teacher workload, improve learner motivation, interest, autonomy, engagement, confidence, and attention, and connect the formal and informal learning contexts (Abdullah et al., 2019; Darmanto & Budi, 2016; Ho, 2018; Hoang et al., 2022; Kumar et al., 2016; Lu et al., 2014; Mahdi, 2017). It also allows learners to interact instantly with peers, teachers, and even native speakers (Jiang & Li, 2018; Jin, 2018).

As shown in Table 1, different types of mobile technologies can facilitate language learning activities (Mahdi, 2017). In this case, many researchers have integrated mobile technologies to facilitate CSL learning. For instance, the instant communication app *WhatsApp* was used by Kumar et al. (2016), *WeChat* was used by Qin (2015), Xu and Peng (2017), Jin (2018), Yang and Yin (2018), and Tong et al. (2022), and *Skype* was used by Luo and Gui (2019) to improve CSL learning. The camera of mobile phones and *Wiki space* have been used by Ying et al. (2017) to enhance the learning of Chinese idioms and conjunctions. *Facebook* was used by Wang and Vásquez (2014) to enhance CSL learners' writing skills. An Internet-based collocation retrieval tool was designed by Chen et al. (2016) to facilitate the learning of Chinese collocations. Different types of machine-based translation tools, online dictionaries, and search engines were used by Chang (2022) to facilitate translation from English to Chinese.

Table 1

Functions and representative learning activities with mobile technologies

Connection Status	Function	Representative applications	Examples of learning activities
Connection	Communication	Instant Messaging (IM), such as *MSN*, *Skype*, *Messenger*, *WeChat*, and *WhatsApp*	Learners can construct learning groups and use IM to get real-time help from the communities by text, audio or video chat; instructors can use the groups to share information, assign homework, and answer questions
		Non-Instant Messaging (Non-IM), such as e-mail and SMS	Users can use Non-IM to assign or hand over homework, or ask for help which is formal or not emergent
	Sharing Information	Such as *Facebook*, *Twitter*, *Blog*, and *Forum*	Users can post, comment, and exchange information

	Search Engine	Such as *Google Chrome*, *Firefox*, and *IE*	Users can search for information with search engines
	App Store	Such as *Google Play* and *Apple Store*	Users can upload, download, and install various kinds of applications which are not embedded in the phone
Non-Connection	Remainder	Such as note, clock, and calendar	Users can take notes and make arrangements
	Recording	Such as camera and recorder	Users can take photos, make movies and recordings, which can be used to record and share information
	Storage		Users can store and retrieve images, audios, movies, and documents

(Source: Adapted from Jeng et al., 2010, p.4.)

Meanwhile, many mobile apps are tailored for learners to study languages (Zain & Bowles, 2021; Puebla et al., 2022). As Abdullah et al. (2019) found, respondents had ample experience in learning with mobile apps, such as using e-dictionaries to look up unknown words, using search engines to search for related information, and using mobile apps such as *ChineseSkill* to learn Chinese, as well as other communication apps to interact with others in Chinese. They concluded that, in general, the convenience and usefulness of mobile apps in improving learners' Chinese language skills and performance were recognized.

Similarly, Wang et al. (2013) stated that CSL learners consider mobile apps to be more interesting and informative than traditional teaching methods. Besides, according to the research of Chua et al. (2020a), 13.8% of the 80 respondents had learned Mandarin using mobile apps and they indicated that mobile apps were helpful in improving Mandarin skills. Moreover, Liao (2022) pointed out that Chinese learning apps are beneficial for CSL learning and satisfy various needs of CSL learners. Therefore, mobile apps should be utilized to facilitate CSL learning.

Mobile apps assisted CSL learning

Mobile apps have been widely used to enhance different kinds of CSL skills (Zhou, 2020). For Chinese characters, Wong et al. (2017) compared teaching Chinese characters with cards and a mobile app. They reported that the respondents liked the phone mode better because they could see all the components held by other students on the screen with the phone. Qian et al. (2018) discovered several new learning strategies for learning Chinese characters, such as frequent self-testing and identifying new characters with *pinyin* input, which could improve Chinese character learning. Ho (2018) reported how two CSL learners who were physically separated used a mobile app to learn Chinese characters and stated that a mobile app could break down the boundaries between online and offline learning. According to the quasi-experimental studies conducted by Ch'ng et al. (2019) and Ting et al. (2020), the experimental group taught with mobile apps and the control group taught with the conventional teaching method made progress in learning Chinese characters, with the experimental group making greater progress. Besides, some researchers, such as Lu et al. (2014) and Ibrahim et al. (2017) have developed mobile apps to facilitate the learning of Chinese characters.

In terms of Chinese oral skills, Xu and Peng (2017) found that *WeChat* feedback can improve learners' oral skills and that they are willing to complete and continue this type of learning task.

Jiang and Li (2018) and Jin (2018) pointed out that *WeChat* can connect CSL learners with native speakers, enhance authentic meaning-based communication, provide various resources for successful communication, enable learners to communicate beyond their actual language proficiency and complement classroom instruction. Xie et al. (2019) found that mobile-based virtual reality significantly improved learners' CSL oral proficiency. Chua et al. (2020b) found that although the oral test score was not as good as expected, participants felt that their oral skills had improved. Besides, a situation-supported game app was designed by Tang and Taguchi (2020) to facilitate the learning of Chinese formulaic expressions.

Regarding learning Chinese vocabulary with mobile apps, Qin (2015) investigated the effect of using *WeChat* to enhance Chinese vocabulary. They found that mobile apps can improve vocabulary learning for CSL beginners. Yang and Yin (2018) reported that compared with the control group, m-learning was significantly better at promoting learners' short-term vocabulary learning. However, the delayed post-test showed that the difference was no longer significant after a certain period of time.

With respect to Chinese phonetics, Head et al. (2014) introduced *ToneWars* (a mobile learning game) into the CSL environment to enhance the acquisition of Chinese tones. This research showed that *ToneWars* was effective in helping CSL learners master the tones of Chinese through collaboration with native speakers. To assess the effect of using an app on Chinese reading skills, Chee et al. (2017b) conducted a quasi-experimental study, according to which they reported that the experimental group learning with *ChineseSkill* gained a better improvement than the control group learning with PowerPoint slides.

Meanwhile, some researchers such as Lu et al. (2014), Kumar et al. (2016), and Eubanks et al. (2018) have mentioned that mobile devices/apps could improve comprehensive skills, including vocabulary, Chinese character, writing, listening, reading, and speaking skills. Generally, the number of previous studies targeting the improvement of comprehensive CSL skills was obviously lower than the number of studies targeting the improvement of specific CSL skills with mobile apps.

Introduction of ChineseSkill

When evaluating the quality of mobile apps, Keller's (1978) ARCS motivational model could be used as a reference. The learning content provided by mobile apps should attract learners' attention, meet learners' needs and level, and increase learners' confidence and satisfaction. From Table 2, it can be seen that the design of *ChineseSkill* meets the requirements of all dimensions and sub-dimensions of the ARCS model. Besides, *ChineseSkill* is proved to be one of the most popular, qualified, and highly rated comprehensive apps that help both beginners and advanced learners improve all kinds of Chinese skills (Fang, 2016; Chee, 2017; Abdullah et al, 2019; Ch'ng et al, 2019; Ting et al., 2020). Therefore, *ChineseSkill* is selected as a representative app in this study. The version of the app used in this study was 5.1.2, downloaded from Google Play.

Specifically, *ChineseSkill* consists of four main sections, namely "Learn", "Review", "Challenge" and "Immersion" (Figure 1). The texts in the “Learn” section include tips, a few lessons, and speaking practice. By learning these parts, learners can enhance their grammar, listening, speaking, writing, and translation skills, and expand their vocabulary. The “Review” and “Challenge” sections allow learners to practice and review all the words, sentences, characters, and grammar they have learned through interesting games (Figure 3). In the “Immersion” section, learners can acquire knowledge that belongs to the elementary plus and intermediate levels. Other than that, the “Alphabet” section systematically introduces the basic knowledge of Chinese phonetics, which is very helpful for CSL beginners.

Since the participants in this study were all CSL beginners and the teaching time per class was limited, the participants in the experimental group only had to learn the content of *Pinyin* table (Figure 2) and the *Pinyin* games (picture 1 and picture 2 in Figure 2) for around 15 minutes at the beginning of each class. Using the *Pinyin* table, learners can choose the corresponding combinations of initials, finals, and tones and follow the audio to practice all the syllables of Chinese. By playing *Pinyin* games, learners can not only practice their pronunciation, but also improve their memory of the sound, meaning, and writing of the Chinese characters.

Table 2

The ARCS motivation model applied in Chineseskill design

Dimension	Sub-dimension	Description of *ChineseSkill*
Attention	A1 Perceptual arousal	Various kinds of games and quizzes, a clear and simple operating system, a systematic and professional introduction to all aspects of Chinese, which can not only arouse and maintain learners' interest and attention, but also enhance their oral, listening, writing, reading, vocabulary and grammar skills.
	A2 Inquiry arousal	The learning contents of *ChineseSkill* are arranged from easy to difficult by level, theme, unit, and learning ability to arouse learners' curiosity and challenge them.
	A3 Variability	The interface and presentation of *ChineseSkill* provide learners with a diversified visual pleasure. The systematic and professional grammar learning tips, the audio and video texts, the various kinds of games, and the repetition of different topics allow learners of different levels and needs to learn and practice step by step, just like with a real teacher, whenever they want.
Relevance	R1 Goal orientation	The design of all learning contents, including the practice games, is based on *Hanyu Shuiping Kaoshi* (HSK) test requirements and learners' levels to make learners achieve specific learning objectives. The learning objectives of each topic and text are presented in advance, which is beneficial for learners' goal setting.
	R2 Motive matching	As learners work through each question and part of the practice game, the immediate feedback and overall assessment can motivate learners to improve their understanding and move forward. They can also motivate themselves by comparing or competing with peers in their group.
	R3 Familiarity	The learning contents, texts, grammar tips, and practice games are based on certain topics, the types of practice games and quizzes are similar to the *HSK* exam, and the contents in the "REVIEW" part are

		what the learners have learned, allowing them to focus on their weaknesses and improve various skills.
Confidence	C1 Learning requirements	To increase the learning effect and progress step by step, learners need to complete the previous learning task to unlock the next one and complete all the contents of a text before moving to the next text. In addition, they cannot skip any part of the text or take quizzes while they are engaged with the text.
	C2 Success opportunities	There are no restrictions on learning time, scores, and ranks as long as learners complete the tasks. Besides, the quizzes and practice games are based on what they have learned, so it is easy for them to successfully complete all the learning tasks. Besides, instant feedback can help them complete the tasks smoothly.
	C3 Personal control	Learners can learn as visitors, synchronize their learning progress with the cloud, download learning materials to learn offline, and make some basic settings to meet their own needs.
Satisfaction	S1 Natural consequences	The learning duration and achievements are visually displayed in the form of numbers and charts. Also, learners are rewarded with virtual stimuli when they complete certain tasks, which increases their extrinsic motivation to some extent.
	S2 Positive consequences	The free learning content enables learners to achieve certain *HSK* levels and apply the knowledge in real social interaction, which could increase their satisfaction and intrinsic motivation.
	S3 Equity	*ChineseSkill* is a comprehensive learning app that can improve all aspects of Chinese skills for all levels of CSL learners with different learning requirements.

Figure 1

The main interface of ChineseSkill

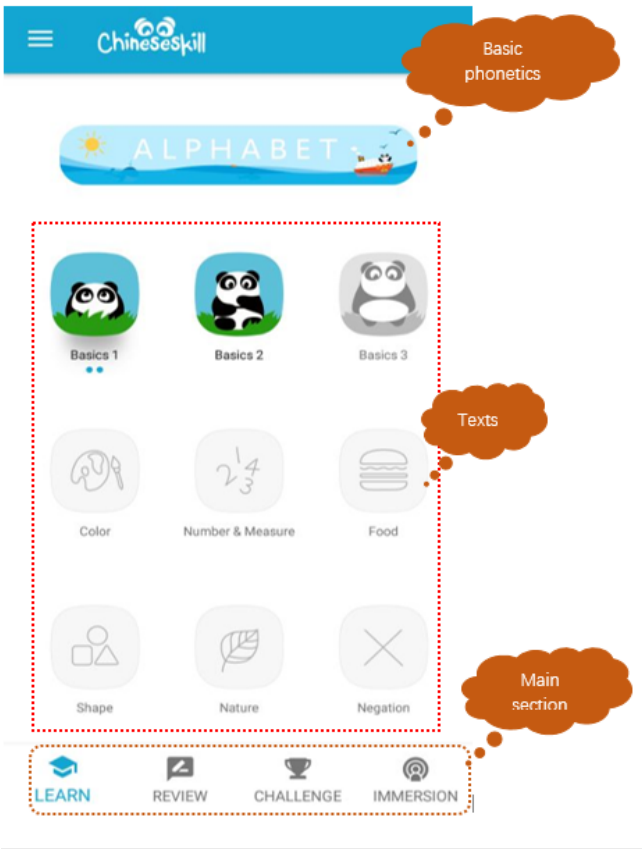


Figure 2
The main interface of Pinyin table in ChineseSkill

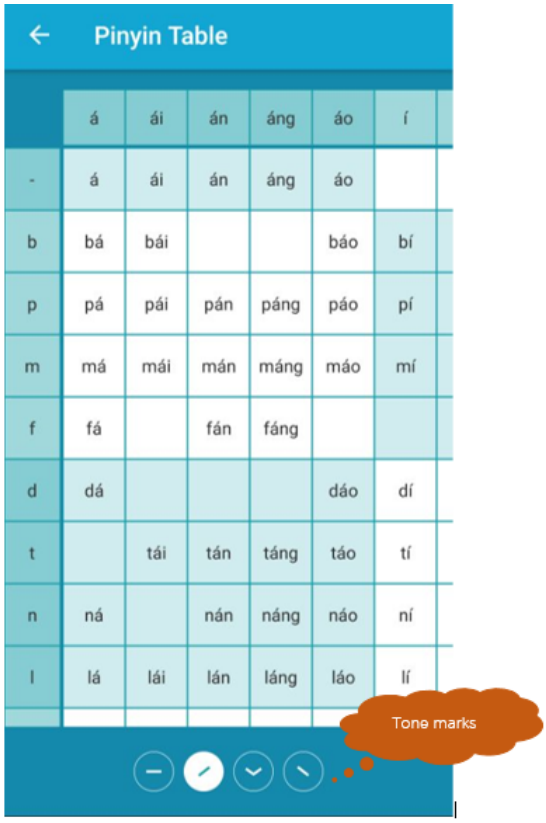
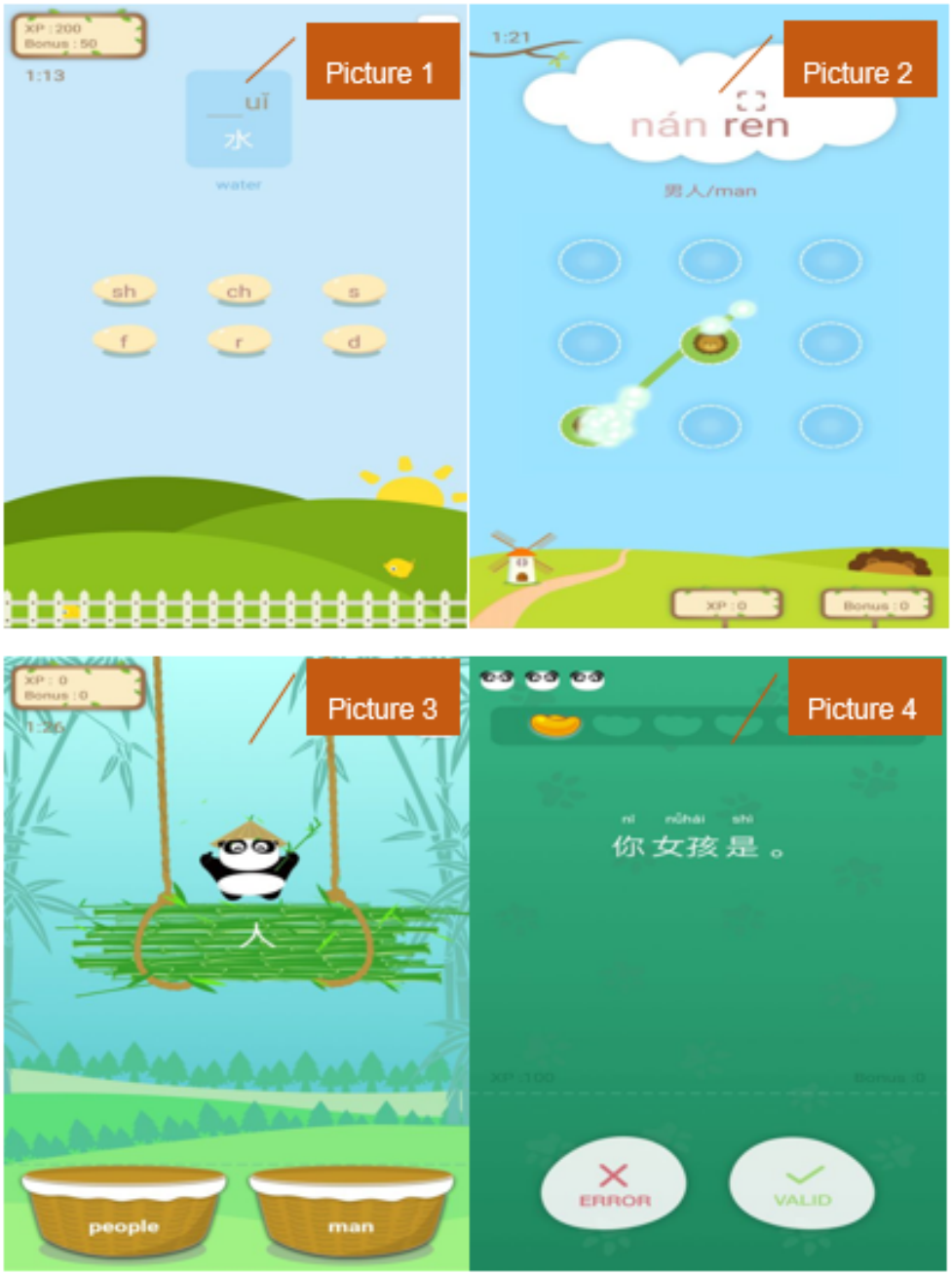

Pinyin Table
á ái án áng áo í
- á ái án áng áo
b bá bái báo bí
p pá pái pán páng páo pí
m má mái mán máng máo mí
f fá fán fáng
d dá dáo dí
t tái tán táng táo tí
n ná nán náng náo ní
l lá lái lán láng láo lí
Tone marks

Figure 3
The examples of games in ChineseSkill



Methodology

Research design

This research adopted the quasi-experimental design. Specifically, since respondents were randomly distributed to the experimental and control groups before the experiment, and both groups took the pretest and post-test, it was the pretest and post-test of quasi-experimental design according to the classification of Gibbons and Herman (1997).

Sampling method

Respondents from a private college in Melaka, Malaysia, were intentionally selected as a sample. This type of sampling procedure is called purposive sampling, which is defined as the selection of a group of people as respondents based on certain characteristics (Chua, 2016). The samples were selected because of the following reasons.

First, learners in universities usually have their own mobile devices and have skills to conduct m-learning. Second, unlike many universities in Malaysia that offer Chinese as an elective subject, Chinese is a compulsory subject for learners in some degree programs at this sample college, which ensures a relatively large sample size. Third, although the respondents were from different majors, they were all CSL beginners, as they were non-Chinese spoken learners and have never learned Chinese before. Fourth, they were of similar ages (around 21 years old) and were all taught by the same teacher. Therefore, the common confounding variables, such as age, Chinese language level, and teacher, could be controlled.

A total of 171 participants who attended the basic Chinese course were recruited for this research. The course was held once a week. Each class lasted three hours. The participants were separated into five classes according to the schedule of their Chinese course. According to Table 3, the number of participants in the five classes was 38, 34, 35, 32, and 32 respectively. Since the experimental group was included in the second phase of a larger study, the three classes with the most participants (classes coded in 1 to 3) were assigned to the experimental group, and the remaining two classes (classes coded in 4 and 5) with a smaller sample size were assigned to the control group.

Table 3

Frequencies of Chinese Language Classes

Class	Frequency	Percent
1	38	22.2
2	34	19.9
3	35	20.5
4	32	18.7
5	32	18.7
Total	171	100.0

Instrument

The examination paper was selected from the workbook which was attached to the textbook (the first volume of the *HSK* standard course) used by the respondents. The first three exercises in the workbook mainly focus on examining pronunciation ability. The exercises from lesson four were arranged in the same order and structure as the *Hanyu Shuiping Kaoshi* (HSK) test, which was intended to examine learners' listening, reading, pronunciation, and character skills (Table 4). Therefore, in order to examine learners' comprehensive Chinese skills, the fourth exercise was chosen as the pretest and post-test paper of the study.

As displayed in Table 4, there were 54 items in total and the full mark was 100. Since the contents in the pretest and post-test were identical, in case the respondents prepared in advance which would influence the credibility of the research, the examination paper was not given to the respondents before or after the examination. Besides, to examine the reliability of the examination paper, 37 students participated in the pilot test-retest study. The Pearson correlation coefficient was .866 (p<.05). In the formal test which included 171 participants, the Pearson correlation coefficient

was .725 (p<.05). Therefore, this examination paper is considered to have a high level of reliability (Chua, 2013).

Moreover, a one-sample Kolmogorov-Smirnov test was adopted to analyze the distribution of the data. Since the p values for pretest and post-test were .099 and .079 respectively, which were insignificant at the significance level of .05. According to Chua (2013), they were considered to be normally distributed.

Table 4

The details about the examination paper

Section		Number of items	Score
Listening	Part I	4	8
	Part II	4	8
	Part III	4	8
Reading	Part I	5	15
	Part II	5	15
	Part III	8	24
Pronunciation	Part I	8	8
	Part II	8	8
Character	Part I	4	2
	Part II	4	4
Total	/	54	100

Experiment procedure

Since the respondents were CSL beginners, to obtain a valid test result, the pretest was administered in the 6th week of the semester when the learners had already acquired some basic knowledge of Chinese. The post-test was conducted around the 16th week. Specifically, the experiment consisted of three phases, namely the pre-treatment phase, the treatment phase, and the post-treatment phase.

Table 5 displayed that in the pre-treatment phase, except for the introduction week, both groups had to learn the first four lessons of the textbooks from the second to the fifth week. In order to save class time, the participants of the experimental group were sent a link about the introduction of *ChineseSkill* and required to install the application in advance.

The treatment phase started in the sixth week. Both groups completed the pretest and then continued to learn lesson five. In addition, the experimental group participants were required to use *ChineseSkill* during this week. All respondents were taught the same contents provided by the textbook. The difference was the first 15-minute which aimed to review the pronunciation. The participants of the experimental group were instructed to review pronunciation with *Pinyin* games and *Pinyin* table in *ChineseSkill*. The control group participants were taught to review the pronunciation with the usual teaching method, e.g., robotically read after the teacher. The post-treatment phase occurred in the 16th week. At this time, the post-test was administered.

Table 5

The course plan for the experiment

Phase	Week	Control group	Experimental group
	1st week	Introduction week, no teaching plans	Introduction week, no teaching plans

Pre-treatment phase	2nd week to 5th week	Teach first four lessons of the textbook	Teach the first four lessons of the textbook; Send a link at the fifth week to introduce ChineseSkill and let the respondents in the experimental group to install in advance
Treatment phase	6th week	Pretest; Teach the fifth lesson of the textbook; Calculate the scores of the pretest	Pretest; Enhance students' pronunciation skills via *Pinyin* table in *ChineseSkill* around 5 minutes; Teach the fifth lesson of the textbook; Calculate the scores of the pretest
	7th week to 9th week	Teach the sixth and eighth lessons of the textbook	Let students play four *Pinyin* games for around 10 minutes at each class; Enhance students' pronunciation skills via *Pinyin* table in *ChineseSkill* around 5 minutes; Teach the sixth and eighth lessons of the textbook
	10th week	Mid-term break, no teaching plans	Mid-term break, no teaching plans
	11th week to 15th week	Teach the ninth to 14th lessons of the textbook	Let students play four *Pinyin* games for around 10 minutes at each class; To enhance students' pronunciation skills via *Pinyin* table in *ChineseSkill* around 5 minutes at each class Teach the ninth to 14th lessons of the textbook;
Post-treatment phase	16th week	Post-test and calculate the post-test scores	Post-test and calculate the post-test scores
	17th week to 20th	No teaching plans	No teaching plans

Results

Since there are more than two classes in this experiment, before performing the independent samples *t*-test and the paired samples *t*-test, the differences between the five classes regarding the pretest must first be examined. If there are no differences between them, respondents would be considered to have similar levels of Chinese at the pretest. Consequently, they could be divided into an experimental group and a control group before the experiment without any questions.

According to Chua (2013), the ANOVA test instead of the independent *t*-test is the better choice to determine the differences between more than two groups. In this study, there are five classes involved. Therefore, the ANOVA is an appropriate analysis method. Since there is only one independent variable involved in the ANOVA test in this study, one-way ANOVA is chosen to examine the differences between the five classes in the pretest (Chua, 2013).

According to the one-way ANOVA test, since F (4, 163) = 2.336, p = .058 > .05 (Table 6), the homogeneity of variance was obtained. Besides, as displayed in Table 7, since F (4, 163) =

.888, $p = .473 > .05$, there were no significant differences among the five classes on the pretest. The robust tests displayed in Table 8, F (4, 150.170) = .896, $p = .468$, lead to the same conclusion.

Because the significant differences were not detected, there was no need to conduct the posthoc test, and the five classes would be considered to hold a similar level of Chinese proficiency regarding the pretest (Chua, 2013), based on which the three classes were coded from 1 to 3 in Table 3 were distributed in the experimental group, whereas the rest two classes, namely class 4 and class 5, were assigned to the control group. After deleting the outliers, namely *N*69, *N*71, and *N*108, the experimental group and the control group thus consisted of 105 and 63 participants respectively.

Table 6

Test of homogeneity of variances

Levene Statistic	df1	df2	Sig.
2.336	4	163	.058

Table 7

One-way ANOVA test result

		Sum of Squares	df	Mean Square	F	Sig.
pre	Between Groups	275.716	4	68.929	.888	.473
	Within Groups	12653.903	163	77.631		
	Total	12929.619	167			

Table 8

Robust tests of equality of means

	Statistic[a]	df1	df2	Sig.
Brown-Forsythe	.896	4	150.170	.468

a. Asymptotically F distributed.

If the two samples are not dependent on each other, the independent samples *t*-test can be used to compare the means (Chua, 2013). Since both the pretest and post-test of the experimental group and the control group are independent, this analysis technique is used to examine the differences between the pretest and post-test of the experimental group and the control group.

Based on Table 9, regarding the pretest, according to the results of Levene's test, equal variances were not assumed ($F = 5.744$, $p = .018$). The independent samples *t*-test for the pretest was insignificant ($t = 0.455$, $df = 157.222$, $p = .650$), indicating that there was no significant difference between the experimental and control groups on the pretest.

As for the post-test, Levene's test revealed equal variances ($F = .230$, $p = .632$). The independent samples *t*-test for the post-test was significant ($t = -3.085$, $df = 166$, $p = .002$). Thus, the difference between the experimental and control groups on the post-test was significant. The experimental group had significantly higher scores on the post-test than the control group, indicating that *ChineseSkill* was more effective and efficient in enhancing comprehensive CSL skills compared to the traditional teaching method.

Table 9

Independent sample t-test for experimental group and control group

	Levene's Test for Equality of Variances		*t*-test for Equality of Means					
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Effect size (r)
pre	5.744	0.018	0.455	157.222	0.650	0.597	1.312	0.035
post	0.230	0.632	-3.085	166	0.002	-3.241	1.051	0.233

In this research, the effect size of independent samples *t*-test was measured by the Pearson correlation coefficient. The equation was

$$r = \sqrt{\frac{t^2}{t^2+n1+n2-2}} \qquad (1)$$

In the equation, *t* represents the value calculated by the independent sample *t*-test, and *n* represents the sample size. The threshold values for small, medium, and large effect sizes are .1, .3, and .5 respectively (Gerald, 2018).

Based on Equation (1), the effect size for the difference between the two groups on the pretest was .035, which was trivial since it was less than the threshold value for the small effect size .1. The effect size for the difference between the two groups on the post-test was .233, which was a small effect size since it was greater than .1 but smaller than .3.

When the same respondent in the sample is tested twice with the identical instrument at two different times or in two different situations, the paired samples *t*-test can be used to compare the means of these two collected data (Chua, 2013). In this study, both the experimental group and the control group were tested twice within a given time period. Therefore, paired samples *t*-test was carried out.

Table 10 displayed that the pretest and post-test scores for the experimental group were 76.900 (*SD* = 9.626) and 86.114 (*SD* = 6.390) respectively. The mean difference between the two tests was -9.219 (t = -14.630, $p < .05$), which was statistically significant. Therefore, *ChineseSkill* was able to improve CSL students' achievement.

Table 10

Pretest and post-test scores for the experimental group

pretest		post-test				
M	*SD*	*M*	*SD*	*t*	*p*	Effect size (Eta squared)
76.900	9.626	86.114	6.390	-14.630	.000	.673

In this research, based on the suggestion of Gerald (2018), the effect size of paired samples *t*-test was calculated with the eta squared, the equation of which is

$$Eta\ squared = \frac{1}{1+\frac{n-1}{t^2}} \qquad (2)$$

In which *t* represents the value calculated by the paired samples *t*-test, *n* represents the sample size. The threshold values of eta squared for small, medium, and large effect size is .01, .06, and .14 respectively (Gerald, 2018). Equation (2) yielded an effect size of .673, indicating that the effect of *ChineseSkill* on achievement was a large effect.

As displayed in Table 11, the pretest and post-test scores for the control group were 77.492 (*SD* = 7.275) and 82.873 (*SD* = 6.918) respectively. The mean difference between them was -5.381 (t = -8.545, p < .05), which was statistically significant. Therefore, the common teaching technique could also increase CSL students' achievement. Based on Equation (2), the effect size was .541. Although it was larger than the threshold value for the large effect size of .14, it was still smaller than that of the experimental group (.673).

Table 11

Pretest and post-test scores for the control group

pretest		post-test				
M	*SD*	*M*	*SD*	*t*	*p*	Effect size (Eta squared)
77.492	7.275	82.873	6.918	-8.545	.000	.541

Discussion

The purpose of this study was to evaluate the effect of using *ChineseSkill* on the learning achievement of CSL beginners. The data analysis revealed that *ChineseSkill* can effectively improve learners' comprehensive Chinese skills. This finding is similar to Head et al. (2014), Ho (2018), Jiang and Li (2018), Jin (2018), Lu et al. (2014), Qian et al. (2018), Wong et al. (2017), Xie et al. (2019), and Xu and Peng (2017), which proved that mobile apps can be used to improve various kinds of CSL skills. Besides, the traditional teaching method is considered to be effective as well. According to Chee et al. (2017), Ch'ng et al. (2019), and Ting et al. (2020), the achievement of the control group could be improved after a period of continuous learning, which is consistent with the finding of this research.

However, *ChineseSkill* was more effective and efficient in improving comprehensive CSL skills compared to the traditional teaching method, such as the robotic repetition method. The finding that the effect size in terms of paired samples *t*-test was higher for the experimental group than for the control group could lead to the same conclusion. This result could be confirmed by Chee et al. (2017), Ch'ng et al. (2019), Ting et al. (2020), and Yang and Yin (2018), who found that mobile apps behaved better than the traditional teaching method in improving various types of CSL skills.

These results could be supported by the social development theory of Vygotsky and the scaffolding theory, which provide the theoretical support that mobile apps have advantages in assisting language learning activities. Besides, other than the affordances which have been mentioned in the literature review, mobile apps could be custom-designed based on learners' needs (Puebla et al., 2022; Zain & Bowles, 2021), and the content of mobile apps such as *ChineseSkill* can follow the ARCS motivational model (Keller, 1987), resulting in the enhancement of learners' confidence and satisfaction, and the improvement of learners' language proficiency. In conclusion, since learners found learning with mobile apps more interesting, informative, convenient, and useful compared with traditional teaching methods (Abdullah et al., 2019; Wang et al., 2013), various kinds of mobile technologies should be adopted to enhance language learning (Mahdi, 2017), including the abroad CSL learning.

This research has made some contributions to the field of m-learning and MALL. First, other than the most frequently investigated topics, namely using mobile apps to assist ESL learning, this study was able to contribute to the domain of mobile-assisted CSL learning to some extent. Second, unlike most previous research that focused only on the effectiveness of mobile apps in improving

specific CSL skills, this research confirmed that mobile apps are effective in improving comprehensive CSL skills. Third, since some learners and teachers lack experience in using mobile apps for language learning, this study provided some tips for selecting high-quality mobile apps, such as following the ARCS motivational model and training learners by providing a link to thoroughly introduce the selected app in advance. In this scenario, teachers could save their teaching time and improve teaching efficiency. As for learners, in addition to formal learning contexts, learners of different levels interested in MALL can install appropriate mobile apps to facilitate the learning of different languages in informal learning environments, leading to an improvement in their problem-solving and critical thinking skills.

Conclusion and Suggestions for Future Research

This study found that not only conventional teaching methods, such as the robotic repetition method can effectively improve CSL beginners' comprehensive Chinese skills, but also mobile apps such as *ChineseSkill*. However, mobile apps outperformed conventional teaching methods. Therefore, mobile apps could be used to meet the challenges of overseas CSL learning, enhance learners' comprehensive CSL skills, and complement formal and informal language learning activities.

As for suggestions for future research, since most of the research was conducted in the formal learning environment, future researchers could focus more on the informal learning contexts. In terms of data collection, other types of data such as observations, interviews, and system logs could be collected in addition to test scores. Besides, a series of tests could be administered to assess ongoing changes in learner achievement. In addition, because the common variables such as gender and experience of using mobile apps might have an influence on the effect of MALL, which was neglected in this study, future studies could focus on respondents with other characteristics and also investigate the effects of some common mediators and moderators. Moreover, the sample sizes for the experimental and control groups were uneven. For future studies, it is suggested to choose as equal a number of samples as possible for the two groups.

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