education sciences

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Developing and Applying a Chinese Character Learning Game App to Enhance Primary School Students' Abilities in Identifying and Using Characters

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Abstract: The Chinese language is the mother tongue that most students in Singapore need to master. However, for many local students, due to the use of English as the main language in Singapore's families and the living environment, the time and frequency of using Chinese and the exposure to Chinese characters are relatively insufficient, which leads to a high forgetting rate, confusion of the characters and the improper use of Chinese characters. This study attempts to develop an app of a Chinese character learning game for Singapore primary school students, aiming to stimulate students' interest in learning Chinese, increase their frequency of contact and use of Chinese characters, and ultimately strengthen their ability to remember, understand and use Chinese characters. By collecting the data from students' questionnaire surveys, teachers' questionnaire surveys, students' literacy tests, and classroom observations, the research team found that the designed app can enhance the interest of lower grade primary school students in learning Chinese and strengthen their ability to memorize and use Chinese characters.

Keywords: app development; Chinese learning; Chinese character literacy; game-based learning; learning game

Citation: Lin, Y.-S.; Lim, J.N.; Wu, Y.-S. Developing and Applying a Chinese Character Learning Game App to Enhance Primary School Students' Abilities in Identifying and Using Characters. *Educ. Sci.* **2022**, *12*, 189. https://doi.org/10.3390/educsci12030189

Academic Editor: Huei Tse Hou

Received: 29 January 2022
Accepted: 3 March 2022
Published: 9 March 2022

1. Introduction

Chinese character literacy is the foundation of Chinese language learning and a key focus of primary education. Studies show that the difficulty of Chinese character literacy teaching in the lower grades of primary schools is mainly concentrated in the shape of the Chinese character, accounting for 54.4% of errors; in the category of common Chinese character errors, the lower primary students had up to 50% component errors. Therefore, we need to strengthen the teaching of Chinese characters in the lower grades of primary school, especially the teaching of Chinese character components. Compared with pinyin characters, Chinese characters are characterized by rich and complex glyphs. There are thousands of commonly used Chinese characters, which also constitutes the main difficulty in learning Chinese characters. However, through the analysis of the structural characteristics of Chinese characters and the rules of the use of Chinese characters, we can find that most Chinese characters are made up of two or more parts. Based on this characteristic, the "component teaching method" can be said to be a feasible method. "Component teaching" was first proposed by [1], who extracted 118 basic parts from 1000 common characters and divided them into character parts and non-character parts, according to the word structure of the parts. By mastering the pronunciation, shape, and meaning of these components, learners can further learn the combined characters. From the perspective of students' memories of Chinese characters, component structure teaching is an effective method to reduce memory load. In terms of teaching rules, the teaching of component structure follows the principle of simple to complex, step by step and cultivating solid basic skills. For the long-term purpose of Chinese character teaching, component structure teaching focuses

on the cultivation of students' abilities to correctly write Chinese characters and self-study Chinese characters [1]. Therefore, the recognition and memory of Chinese characters can be promoted by strengthening the contact and learning of the component structures.

In the information age, especially in the era of mobile Internet, game culture is becoming increasingly popular. The digital game has become a universal entertainment and education medium. Among them, digital learning games or educational games have the characteristics of games, meet certain educational purposes, and can stimulate the active initiative of the players and help them to acquire knowledge or cultivate their abilities in the process of the games. Digital games for learning are one of the research hotspots in the development of today's information society and are also considered as a major educational medium of the next generation, which will have a significant impact on teaching and learning methods [2]. The advantage of digital games is that they can effectively stimulate the "positive attitude", motivate learners to learn Chinese, and make the learning process easy and natural. The theory of "experiential learning" holds that in order to gain real knowledge, we must learn by "doing", through practical activities such as application, trial, and transformation. Digital learning games can create and simulate certain social situations and scenes, where learners can finish learning tasks and master relevant language skills joyfully, through the game experience links such as immersion, plot, acting, competition, task, action, creation, and exploration. The integration of interactive, competitive, and cooperative game models in digital learning in Chinese teaching can highlight the status of students' independent learning and achieve good learning results.

The objectives of this study:

(1) Develop a Chinese characters learning game app for lower grade primary school students.
(2) Strengthen lower grade primary school students' abilities to memorize and use Chinese characters using the app.

The research questions of this study:

(1) Whether the use of the developed app can enhance the interest of lower grade primary school students in learning Chinese?
(2) Whether the use of the developed app can strengthen the ability to memorize and use Chinese characters learned by lower grade primary school students?

2. Literature Reviews

Applications (apps) in education, built or installed in mobile devices such as smartphones, tablets, etc., have been regarded as assistance for teaching and learning. To make the teaching more deliverable and to make the learning more accessible, app development takes responsibility for connecting learners and teachers with knowledge-based content.

Mobile devices including apps are widely adopted in school learning and broadly used by young learners. In school learning, game-based apps and related development are valued when innovating the educational environment; even novel tools and technologies are involved, such as augmented reality. Augmented reality technology incorporating apps, mentioned above, can engage language learners in learning content, and contribute to student learning [3]. The learning environment, with the intervention of game-based apps, is believed to bring interesting learning experiences to students that can increase motivation and improve learning outcomes. The survey research [4] found that gamified apps have been introduced in various levels of school education and shows that school learning tied to the use of game-based apps can influence students' positive attitudes towards their learning, promoting their knowledge and hands-on digital experience acquisition. Another research [5] reported the learning effects of educational apps on young learners, children from 2 to 5 years old, that the mobile apps in school learning can aid in literacy development for many subjects, such as mathematics, science; even though there is a limited understanding of the impact on young learners. For young adult learners or students, the educational apps make them more willing to join the class activities, stimulating their initiative in learning [6].

Teachers also prefer to adopt them in class to lift teaching quality and provide apps-based teaching and an evaluation method with feasibility and practicability, for mastering student learning status and adjusting teaching strategies. Furthermore, class management can be achieved more effectively and efficiently with the assistance of educational apps [7] when teachers try to manage the student's attendance and learning performance. They can access all the learning related data derived from the students more easily and give them advice or feedback about their learning outcomes more instantly. Therefore, the teacher's viewpoint and the user experience should be considered when developing apps for teaching/learning.

Language learners form the main part of educational apps' market share, so it makes sense that most of the educational apps rolling out into the market focus on language subjects. The download count and the use of language learning apps have grown greatly, meaning the popularity results in prosperity. In English learning, the introduction of educational apps brings ideas of innovation to the traditional English class, and the possibility of blended or virtual learning environments. Automated writing evaluation and guide-based writing assistance provide language teachers with more strategies in teaching [8].

For users of language learning apps, dictionary and lexical features appeared to be the most frequently used functions [9]. Language learners could be typically positive to adopting apps for learning a specific language, but their attitudes towards language learning with apps are significantly subject to what kind of apps they used [10]. Sentiment analysis is well known for its powerful performance in monitoring, analytical and alarm systems, as well as customers feedback. In language learning, sentiment analysis can bring an alternative way to master the emotional vocabulary of a sentence or paragraph, which is a difficult task for language learners. And this technology enables language learning apps easier to suggest more suitable content to learners [11]. Augmented reality technology incorporating apps, mentioned before, can engage language learners in learning content, and contribute to student learning.

At present, there are many Chinese learning games on the market based on different electronic platforms. In the Student Learning Space (SLS), launched by the Ministry of Education of Singapore in recent years, several digital games have been introduced for some Chinese language exercises, which are very popular among students [12]. There are also many Chinese character learning or game apps on the market. Researchers have conducted detailed studies and comparisons on various Chinese character literacy apps [13,14], including many that are based on Chinese as a second language. However, the current Chinese character learning game apps have the following shortcomings:

(1) Lack of components related to component structure learning.
(2) Insufficient attention to the consciousness of the glyph structure.
(3) The content does not match the local Chinese curriculum and is not designed according to the sequence of characters in the primary school textbooks.
(4) The program design is mainly for self-study after class, and not suitable for classroom teaching.

Chinese is the mother tongue language that Chinese students in Singapore need to master. However, for many local students, due to the use of English as the main language in their family and living environments, the time and frequency of using Chinese and exposure to Chinese characters are relatively insufficient, which leads to a high forgetting rate, confusion of the characters and the improper use of Chinese characters [15]. At the same time, these learning difficulties may harm students' interest in learning Chinese [16]. Mastering Chinese characters is the foundation of learning Chinese, especially in the lower grades of primary school. Mastering Chinese words and phrases is the foundation of reading and writing skills for attending middle and upper grades. Therefore, we must consolidate the ability to memorize Chinese characters in the lower grades of primary school [17]. For primary school students in the lower grades, to guide the students to have contact with and learn Chinese, we first need to stimulate their interest and make

good use of their interest in learning Chinese. Game apps are a way to attract students effectively [18–20].

This study attempts to develop an app of a Chinese character learning game for local primary school students in Singapore, aiming to stimulate students' interest in learning Chinese, increase their frequency of contact and use of Chinese characters, and ultimately strengthen their ability to remember, understand and use Chinese characters. This study aims to achieve the following objectives:

(1) Stimulate students' interest in learning Chinese.
(2) Improve students' abilities to recognize and remember Chinese characters.
(3) Consolidate students' abilities to understand and use Chinese characters.

By strengthening the ability of the lower grade students to remember, understand, and use Chinese characters, they can lay a solid foundation for their ability to write in Chinese as well as to master their reading and writing skills.

3. Materials and Methods

3.1. Conceptualization

Based on the investigation [4,5] of existing apps related to Chinese character learning, the research team reviewed the relevant research articles on Chinese character games and discussed them in many meetings. The design concept of this project can be summarized as follows:

(A) In accordance with the current Chinese textbooks, the content of the designed game will cover the words recognition list for each lesson of P1 and P2, students of the 1st and 2nd grades in primary schools.
(B) Following the principle of "Practice", "Evaluation", "Learning", the app is designed to help and promote the accumulation of knowledge based on "Learning" and consolidate the learning through "Practice" and "Evaluation".
(C) App functions will aim to strengthen students' memories, recognition, and use of Chinese characters' phonetic and shape correspondences, structural components, and the use of word groups.
(D) Combination of Preview and Review: The app will include two modules: preview and review. Before learning a new unit, students can have a preliminary understanding of the pronunciation, shape, and component structure of the characters to be mastered in the new lesson through "Preview". After learning the new lesson, students can read the pronunciation, shape, meaning, and use of the words through games in "Review" to further consolidate.
(E) The app will be suitable for individual students to use independently after class and for teachers to organize classroom learning activities. Teachers can organize game competitions in class to arouse students' interest in learning the new characters and strengthen their memorization and use of the new characters. Teachers can also let students use them after class to consolidate the newly learned characters.

As Figures 1 and 2 show, the proposed design for the app development contains four main functions: Preview (我先玩), Review (我再玩), Monopoly Game (我来了) and Collaboration (一起玩). From Figure 1, the functions Preview and Review will assign quizzes to users, students of P1 and P2, and the questions bank embedded in the app will randomly promote questions according to the textbook content of P1 and P2. The Monopoly Game is motivated by the commonly known board game for kids, and we adopted a similar concept from it for the app development. When playing the Monopoly Game, students will see a familiar road map to that they have seen before. The difference is that each cell of the roadmap represents a task of CL including a glyph, a word component and a phonetic quiz, etc. All the questions are also randomly assigned to each cell and developed according to the textbook content of P1 and P2. Another selling point for the designed app is collaboration, which means that users need to finish the task only with partners. This function allows users to create a team and answer/challenge the word component test.

We anticipate students' good sense of teamwork and teachers' willingness to adopt it as a learning activity in their class.

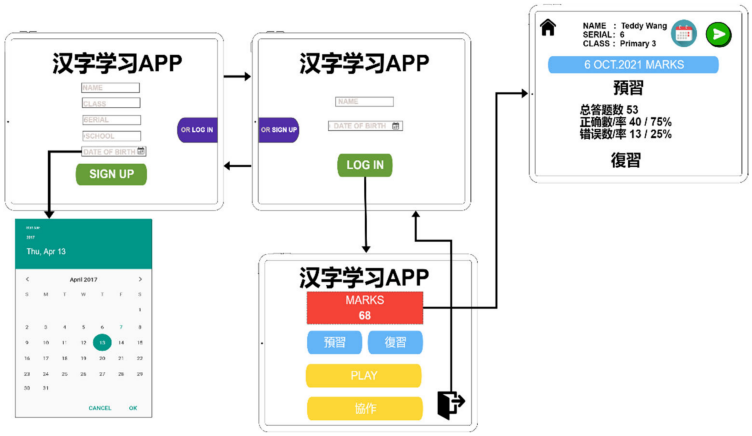
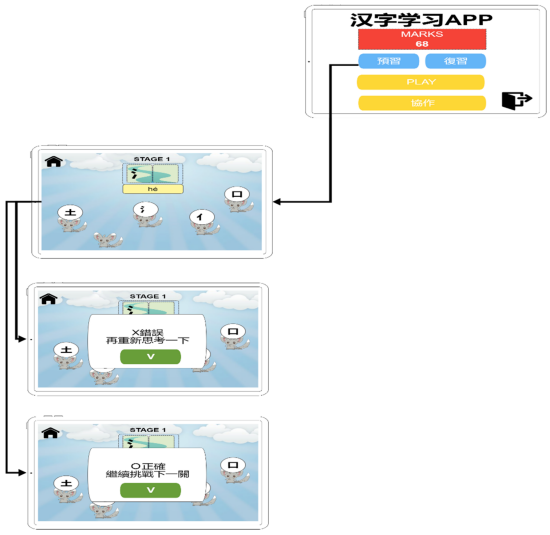
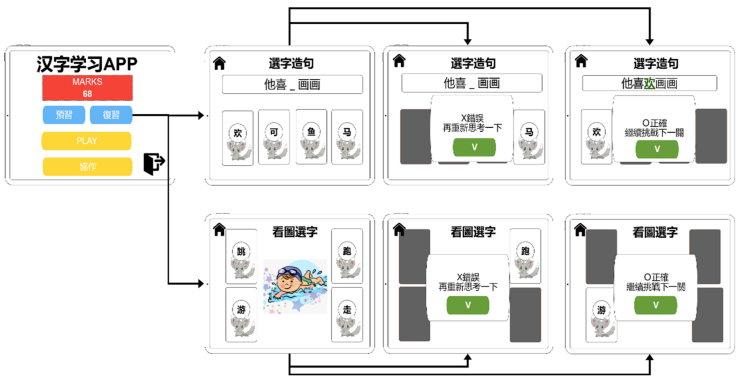


Figure 1. App wireframe 1 (user sign up, log in, sending result). From starting with the upper left sub-graph, the user can sign-up for the first time using the app and then shift to the login page. After entering the app in the user's account, a user interface would be displayed with the main functions: "Review", "Preview", "Play", and "Collaboration ". Besides, the main-function page also shows "Marks" indicating the score earned for the last game.

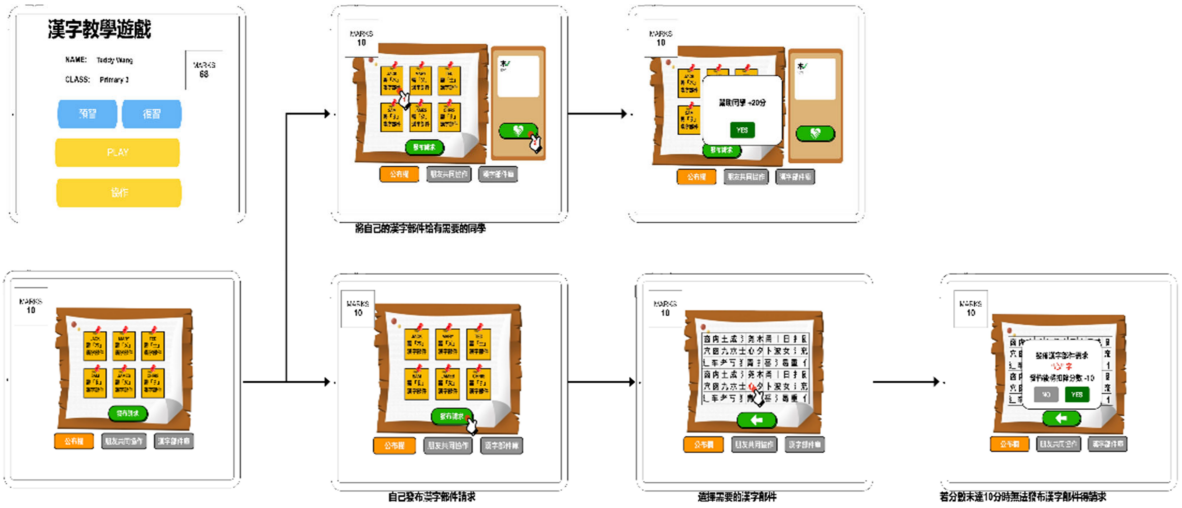


(a)



(b)

Figure 2. *Cont.*



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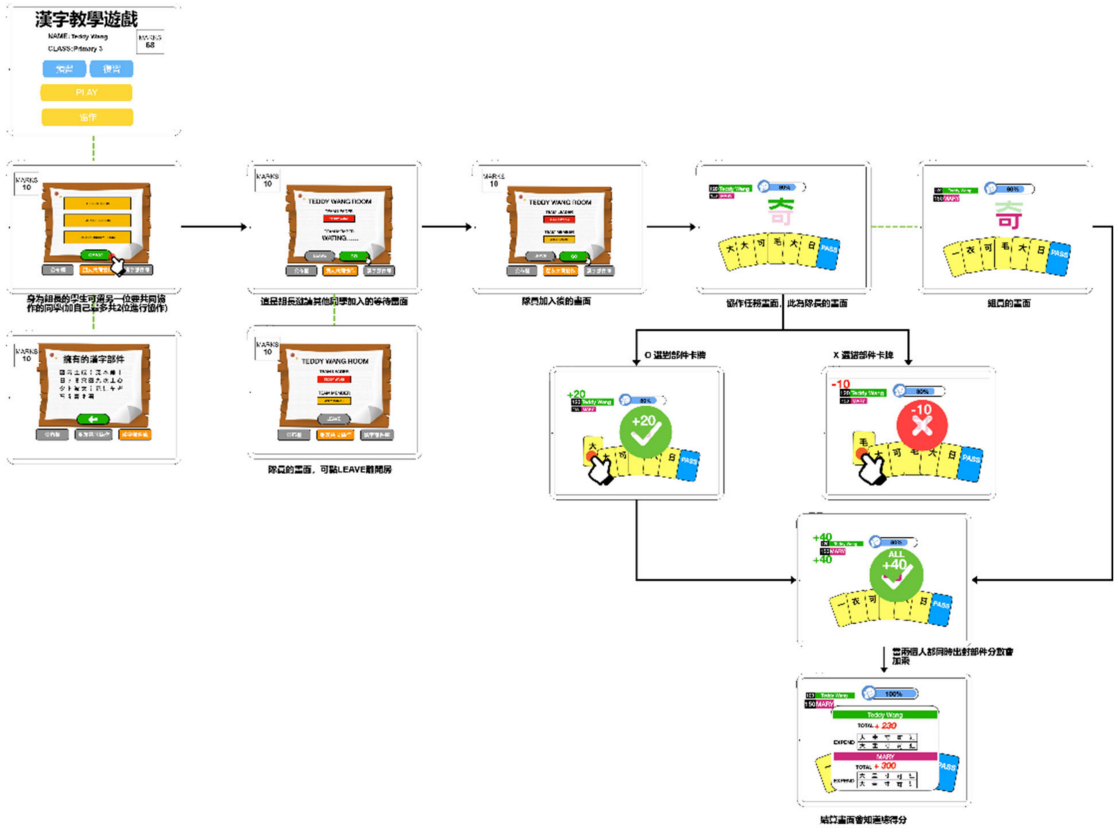

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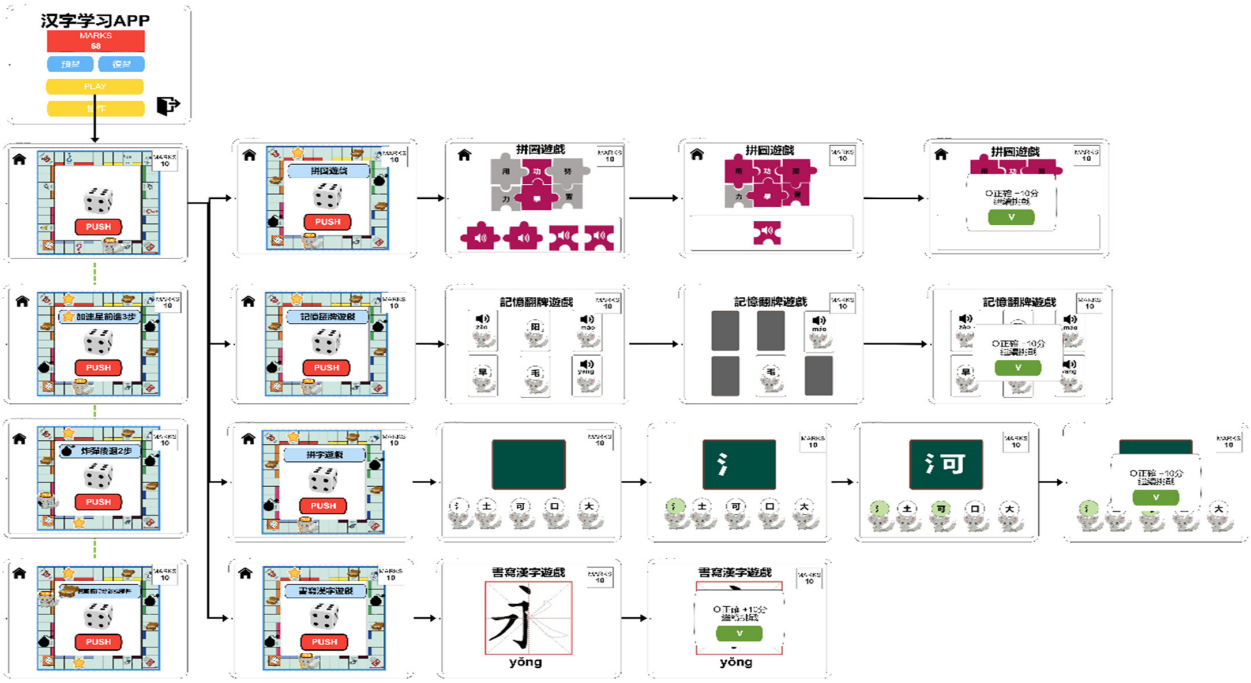
Figure 2. *Cont.*



(**e**)

Figure 2. (**a**) App wireframe 2 (Preview); (**b**) App wireframe 3 (Review); (**c**) App wireframe 4 (Play); (**d**) App wireframe 5 (Collaboration); (**e**) App wireframe 6 (Collaboration).

3.2. Mock-Up and Prototype

The app, named "Han Zi Hunter", is mainly divided into four functions: Preview, Review, Play and Collaboration.

(A) Preview: This function is mainly for students to do a preview; students, according to the pictures of Chinese characters and pinyin prompts, find out the correct components. Complete three Chinese characters in a row to get one component; students can use the components collected in Play function. There is no score in this game since the purpose of this function is to help them practice rather than to challenge.

(B) Review: This function is mainly for students to review. There are two types of questions (look at the picture to choose words and choose words to make sentences), and students use review to consolidate their learning. Complete three questions in a row to get one component; students can use the components collected in Collaboration. There is no score in this game.

(C) Play: This function is based on the concept of Monopoly, so that students can learn through games to stimulate their interest in learning Chinese characters and consolidate their learning. This feature consists of four different mini-games (stroke order writing, finding the correct components, flipping the cards, and memorizing puzzles) and three different penalties and rewards (automatic two steps forward, forced two steps back, and components reward). The students will get 10 points for completing the map, and 20 points will be deducted for leaving the map. The purpose is to encourage students to stick to the map and finish their studies.

(D) Collaboration: This function is mainly for students to play collaborative games to stimulate their collaborative ability. The students use the components they have accumulated and cooperate with peers to complete the combination of Chinese characters. Each round of the game requires completion of a total of ten Chinese characters. Each correct combination of a Chinese character can get 20 points, and points will be deducted for wrong answers. In addition, students can also send help requests to

classmates to provide the components they need. Students who send requests will be deducted points, and students who assist classmates will be awarded points.

3.3. Implementation Process

The implementation process of this research project was divided into two main parts. The first was the development of the app. During the development process, the research team held several meetings with the developer and the teachers at the participating schools to discuss the content and functions of the app, and also involved the teachers in the pre-testing process of the app development to better understand students' needs and provide a better user experience. The research team and the developer adopted the feedback provided by the teachers as a reference to improve the app and made several modifications to get to the current version (version 1.8). Since this research project is targeted at Singapore students from Primary 1 and Primary 2, the app was developed to closely match the content of Singapore Primary 1 and Primary 2 Chinese language textbooks: Chinese Language for Primary Schools (CLPS).

After the development of the app was completed, the research team also conducted a trial experiment with students from Primary 1 and Primary 2, with the support and assistance of teachers. The research team conducted classroom observations through the online meeting tool, Zoom, to observe the classroom situations in which the teachers used (experimental classes) or did not use (control classes) the developed App for teaching. Details about the classroom observation will be explained in the following section.

3.4. Participants and the Scope

According to the research proposal, a total of 4 experimental classes (100 students and 2 teachers) and 4 control classes (100 students) from 2 schools were invited to participate in the project. Data collection arrangements were delayed due to the home-based learning arrangement during the COVID-19 pandemic and school holidays were also encountered, under the tight schedules of the teachers and students. Although the research team worked as closely with the teachers as possible, the planned number of participants was not able to meet the pre-setting amount due to the reasons stated above, and we were not able to hold the observation of the control class at the second school. The actual number of participants in this study is as follows:

3.5. Data Collection

According to the data collection plan, data from interviews with teachers, students' surveys, and classroom observations should be collected. In addition, to verify the enhancement effect of the teaching activities using the game App on students' literacy, literacy tests for the experimental group and the control group should also be collected. However, due to the COVID-19 pandemic, with the active efforts and the cooperation of the research team and the teachers, some adjustments have been made to the data collection process, so the research team have managed to collect the data from the following:

(1) Students' surveys as proposed.
(2) Teachers' surveys instead of teachers' interviews due to the teachers' tight schedules.
(3) Literacy tests (experimental classes) as proposed.
(4) Online classroom observations instead of physical classroom observations due to the regulatory limitations during the COVID-19 pandemic.

3.6. Classroom Observation

As stated above, the research team could not get to the schools to conduct the classroom observations due to the strict measures of the COVID-19 pandemic, so the research team adopted an online meeting tool, Zoom, to conduct the classroom observations, to observe the classroom situations in which the teachers used (experimental classes) or did not use the "Han Zi Hunter" Chinese character learning game app (control classes) for teaching. As Figures 3–5 show, the study received great support and assistance from the teachers

under the difficult circumstances; the teachers helped to set up laptops and/or iPads from different angles so that we could better observe the lessons, especially in the experimental classes.

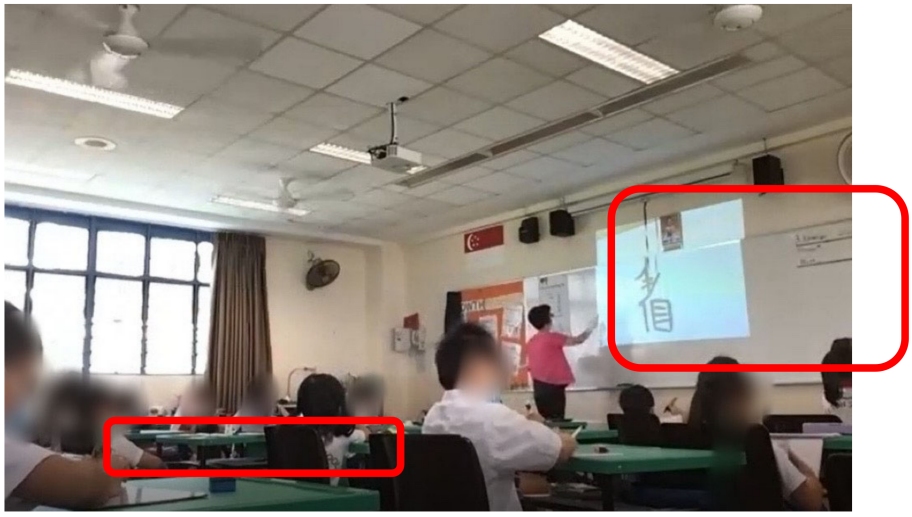


Figure 3. Control class students use little whiteboards to draw the new Chinese character they have just learned, and the teacher uses an object projector to present students' work.

Figure 4. Experimental class students are playing "我来了".

Figure 5. Experimental class students are having a discussion.

Through observation, the teaching tools used by the control classes are mainly learning portals like Blooket, little whiteboards, flashcards, and pen and paper games, while the experimental classes were focused on using the "Han Zi Hunter" app. The research team found that the students in the experimental classes were more active when using the "Han Zi Hunter" app; they took the initiative to play the games, they discussed and shared their learning progress with their classmates and teachers, and they also felt a sense of accomplishment and excitement. Some of the observations are shown below:

3.7. Data Analysis Method

Based on the above collected data, the team analyzed the data as described below. Firstly, qualitative analysis was conducted on the teacher questionnaires to understand the common points in the feedback of the teachers participating in the trial teaching, as the main reference for the game and the supporting design. Secondly, a quantitative analysis of the students' questionnaires was conducted to understand the students' views on the games, the classroom activities, and their effects on learning. In addition, the literacy test results were analyzed to see whether the literacy accuracy rate of the test group was higher than that of the control group, and there was a significant difference, to prove the effectiveness of the teaching activities using the game app. Descriptive statistics and statistical testing were used in the data analyses.

4. Results

According to the research questions mentioned above, the research team has analyzed research questions 1 and 3 here, based on the following collected data:

(1) Students' surveys as proposed.
(2) Teachers' surveys instead of teachers' interviews due to the teachers' tight schedules.
(3) Literacy tests (experimental classes) as proposed.
(4) Online classroom observations instead of physical classroom observations due to the regulatory limitations during the COVID-19 pandemic.

The research team conducted a questionnaire survey and a literacy test of P1 and P2 students in two primary schools. Under the COVID-19 pandemic regulatory limitations, a total of 77 student questionnaires and 53 student literacy tests were collected, as Table 1 shows.

Table 1. Total number of students who participated in the study.

	Experimental Class	Control Class
School 1	24 students 1 teacher	57 students 2 teachers
School 2	53 students 2 teachers	0 students 0 teachers

The research team conducted a quantitative analysis of the questionnaire survey. We found that although more than half of the P1 and P2 students mainly speak English at home, they are interested in learning Chinese. There are as many as 71.4% of P1 students and 95.9% of P2 students claiming that they like the learning game app, especially the Monopoly Game. In addition, most of the students think that it is very interesting for teachers to use the app in class, and the questions and contents in the app are appropriate. In general, students' reactions and feedback to the learning app are very positive. Table 2 shows the details of the students' feedback.

Table 2. Students' questionnaire survey feedback.

		P1(%)	P2(%)
1. What language do you mainly speak at home?	English	89.3	71.4
	Chinese	67.9	42.9
	Other	21.4	12.2
2. Are you interested in learning Chinese?	Yes	50.0	71.4
	Neutral	42.9	28.6
	No	3.6	0
3. Do you like the app?	Yes	71.4	95.9
	Neutral	25.0	4.1
	No	3.6	0
4. What is your favourite part of the app?	Preview	75.0	49.0
	Review	75.0	49.0
	Monopoly	96.4	77.6
	Collaboration	10.7	44.9
	None	7.1	0
5. Do you think the questions on this app are difficult?	Easy	64.3	69.4
	Neutral	32.1	30.6
	Difficult	0	0
6. Do you think it is interesting for teachers to use this app in class?	Yes	67.9	95.9
	Neutral	21.4	4.1
	No	3.6	0

In addition, as mentioned above, due to the impact of the pandemic and under the tight schedules of the teachers and students, the research team only conducted the literacy tests in the P2 of one of the schools. From the analysis results of the literacy test, we found that although the sample size of the experimental class was smaller than the control class, the average score of the experimental class was still slightly higher than the control class, and their value of standard deviation is lower than the control class. Table 3 shows the results of the literacy tests.

Table 3. Students' literacy tests in the P2 of one of the schools.

	P2 (From One of the Schools)	
	Control Class	**Experimental Class**
Average score	16.48	16.58
Total number of students	29	24
Standard Deviation	3.76	2.39

To better understand the application of the "Han Zi Hunter" app in classroom teaching, we also surveyed the teachers to find out their opinions on the effect of the app in classroom teaching and their opinions and suggestions on the content and design of the game.

From the teacher survey results, we found that the teachers' overall evaluation of the app was very positive. Table 4 shows some of the feedback from the teachers' surveys.

For Table 3, we conducted statistical testing to examine the difference between the control class and the experimental class. The mean difference between them equals 0.1000 and the t statistic value is 0.0955; not sufficient to show the statistical significance considering the 95% confidence level. Despite the above statistical testing inference, we balanced the

concept with Table 2 and conclude the result: the implementation of the trial class might be affected by the social distancing measures amid the pandemic.

Table 4. Teachers' feedback on adopting "Han Zi Hunter" app as a teaching tool in their class.

Category	Teachers' Feedback
App contents	• The questions are appropriate and within the student's ability.
Students' interest in the app	• The games are fun, students look and listen to the phonics and find the Chinese characters. • The game itself is fine! Very good! Students like to play! • Students love it. • My students asked me if I could give them the name of the app and they wanted to download and play at home!
Teachers' perceptions of the app	• Great for consolidation and review. • The user experience and gaming experience offered at this stage are quite good!
Teachers' suggestions for the app	• The login and registration steps can be simplified. • I think it would work better if it was paced according to the words in the textbook and reviewed the words as you play! • Suggests the music of the game is played only when "我来了". Because there are listening questions in the game, the music is a bit disruptive.

The feedback in Table 4, has been collected from the schoolteachers and classified into four categories: app content, students' interest in the app, teachers' perceptions of the app, and teachers' suggestions for the app. For the content delivered by the app, the teachers who were involved in the trial class and adopted the app in their class thought the content was appropriate and suitable for the students' current abilities. To summarize the feedback about the students' interest in the app, observed from the teachers, pupils feel it is interesting and amusing when operating tasks assigned by the app function and listening to the phonics for matching a corresponding Chinese character. They enjoyed the game in the app in their Chinese class and expected to engage in it for the next class or after school. In teachers' viewpoints and perceptions, the app can appropriately help the implementation of consolidation and review for pupils' Chinese knowledge through the user experience and appropriate content. For the app's future development and revision, the teachers interviewed also provided several suggestions for the user interface, the adaptive learning content, and component refinement.

5. Conclusions and Discussion

In the research, we developed and proposed a game-based educational app for Chinese language learning, concerning primary school learning for pupils from grade 1 and grade 2. In content construction, we associated the graphics, words, sentences, and the corresponding quizzes with the textbooks of Singapore's primary schools. It is inevitable to arrange an adequate budget for content construction, including content creation, external material licensing, and proofreading, independent of the cost of developing the app

architecture. The developer needs to be aware of this when undertaking the development of an educational app.

We conducted trial class teaching with the assistance of our proposed app, "Han Zi Hunter", and collected user experience data and feedback from four classes of two primary schools. The data were collected through the questionnaire survey for pupils, literacy tests for pupils, interviews for teachers, and class observations, and the corresponding analyses were conducted.

For the research questions mentioned in Section 1, we can conclude the following points based on the results in Section 4:

(1) From the students' questionnaire surveys and classroom observations, the use of the "Han Zi Hunter" app can enhance the interest of lower grade primary school students in learning Chinese.
(2) From the results of the literacy tests, the research team believes that the use of the "Han Zi Hunter" app can strengthen the ability to memorize and use Chinese characters learned by lower grade primary school students.

During the app development, we concluded two suggestions for future developers devoted to educational apps.

Less requirement for operating knowledge can enable the intuitive operation for users to use the app more instinctively. Since the young students of P1 and P2 are the targeted users of our proposed app, they are not equipped with enough knowledge about information technology, such as internet connection through Wi-Fi, personal data security, and identity authentication for the app login, which they might be asked to do by apps but with which they are probably unfamiliar. Therefore, all the technical issues raised could concern IT knowledge and the environment required for user operation. Apps with less requirement for operating knowledge can benefit school pupils' instinctive use. Table 2 also provides the evidence to support this. More than 70% of the pupils like to use the proposed app and the support rate even gets close to 95% for pupils of P2. That means the adopted app is easily accessible because of less requirement for operating knowledge.

Age-centered content would make the learning more formative. Educational apps can provide good assistance for class teaching if the embedded app content is compatible with the textbook content. Suppose the app content is not developed according to the textbook content, a teacher will not be able to expect pupils' learning outcomes through the app and it will be a game app only for use after school. Age-centered content can enable the app to help class teaching. In Table 3, we found that the experimental class teaching with the intervention of our proposed app results in better performance than the control class. Based on the statistical testing result, we can also conclude that the app would not make the learning outcome of class teaching worse and could probably make it better, supposed with more observations collected.

Author Contributions: Conceptualization, Y.-S.L.; methodology, Y.-S.L. and Y.-S.W.; software, J.N.L.; validation, Y.-S.L. and J.N.L.; writing—original draft preparation, J.N.L.; writing—review and editing, Y.-S.W.; supervision, Y.-S.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Singapore Centre for Chinese Language and the Academy of Singapore Teachers, grant number CDF-2020/03-LYS.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Nanyang Technological University (protocol code IRB-2021-01-024, 24 January 2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to the Institutional Review Board protocol of Nanyang Technological University.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Zhang, W. From Chinese Character Components to Chinese Character Structure—On Teaching Chinese Characters to Foreign Countries. *Shijie Hanyu Jiaoxue* **1990**, *2*, 112–120. (In Chinese)
2. Ucus, S. Elementary school teachers' views on game-based learning as a teaching method. *Procedia-Soc. Behav. Sci.* **2015**, *186*, 401–409. [CrossRef]
3. Lee, S.-M.; Park, M. Reconceptualization of the context in language learning with a location-based AR app. *Comput. Assist. Lang. Learn.* **2020**, *33*, 936–959. [CrossRef]
4. Pellas, N.; Fotaris, P.; Kazanidis, I.; Wells, D. Augmenting the learning experience in primary and secondary school education: A systematic review of recent trends in augmented reality game-based learning. *Virtual Real.* **2019**, *23*, 329–346. [CrossRef]
5. Herodotou, C. Young children and tablets: A systematic review of effects on learning and development. *J. Comput. Assist. Learn.* **2018**, *34*, 1–9. [CrossRef]
6. Dong, H.; Wang, D.; Gao, Y.; Qian, F.; Wu, G. APP Based Teaching/Learning Mode and Quality Evaluation of MMT Course. In Proceedings of the IFToMM International Conference on Mechanisms, Transmissions and Applications, Dalian, China, 9–11 October 2019; Springer: Singapore, 2020; pp. 598–606.
7. Hisbullah, T.W.; Heru Supriyono, S. Tutor and Student Management and Learning Assistant in Pesma KH Mas Mansur Based on Android Studio App. Ph.D. Thesis, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia, 2019.
8. Qian, J.; Wang, Z. A Comparative Study on the Effectiveness of Online Automatic Scoring of English Writing in Juku Correction Network and Mosoteach APP under Blended Teaching Mode. *J. Phys. Conf. Ser.* **2020**, *1533*, 042082. [CrossRef]
9. Ho, W.Y.J. Self-Directed Language Learning: A Semiotic Analysis of a Language Learning App. In *Virtual Sites as Learning Spaces: Critical Issues on Languaging Research in Changing Eduscapes*; Bagga-Gupta, S., Messina Dahlberg, G., Lindberg, Y., Eds.; Springer International Publishing: Cham, Switzerland, 2019; pp. 295–327.
10. Nami, F. Educational smartphone apps for language learning in higher education: Students' choices and perceptions. *Australas. J. Educ. Technol.* **2020**, *36*, 82–95. [CrossRef]
11. Shakirov, B.; Khairullina, L.; Mingalieva, L.; Bronskaya, V.; Khabibullina, G.; Fadeeva, E.; Kharitonova, O. Using Emotional Evaluation of Text in a Foreign Language Learning App. In Proceedings of the III International Workshop on Modeling, Information Processing and Computing (MIP: Computing-2021), Krasnoyarsk, Russia, 28 May 2021; pp. 188–195.
12. Alison, C.S.M.; Kyoko, U.; Hironari, N. Student Learning Space: The Integration of Curriculum and Technology in Singapore. In Proceedings of the 2019 3rd International Conference on Education and Multimedia Technology, Nagoya, Japan, 22–25 July 2019; pp. 37–40.
13. Makoe, M.; Shandu, T. Developing a mobile app for learning English vocabulary in an open distance learning context. *Int. Rev. Res. Open Distrib. Learn.* **2018**, *19*, 208–221. [CrossRef]
14. Hu, R.; Xu, X. Mobile experience in learning Chinese: Review and recommendations. In *Impacts of Mobile Use and Experience on Contemporary Society*; Information Science Reference/IGI Global: Hershey, PA, USA, 2019; pp. 182–192.
15. Lee, C.L. Saving Chinese-language education in Singapore. *Curr. Issues Lang. Plan.* **2012**, *13*, 285–304. [CrossRef]
16. Chai, C.S.; Wong, L.H.; King, R.B. Surveying and modeling students' motivation and learning strategies for mobile-assisted seamless Chinese language learning. *J. Educ. Technol. Soc.* **2016**, *19*, 170–180.
17. Wen, Y. Chinese character composition game with the augment paper. *J. Educ. Technol. Soc.* **2018**, *21*, 132–145.
18. King, R.B. Learning and pedagogy: Asian perspectives. In *Routledge International Handbook of Schools and Schooling in Asia*; Routledge: Oxfordshire, UK, 2018; pp. 141–143.
19. Wang, M.; Zheng, X. Using game-based learning to support learning science: A study with middle school students. *Asia-Pac. Educ. Res.* **2021**, *30*, 167–176. [CrossRef]
20. Yukselturk, E.; Altıok, S.; Başer, Z. Using game-based learning with kinect technology in foreign language education course. *J. Educ. Technol. Soc.* **2018**, *21*, 159–173.