

A SYSTEMATIC REVIEW OF GAMES FOR LEARNING CHINESE

Angelina MAKSIMOVA

Peking University, Graduate School of Education, China

ABSTRACT

Education has become more digitalised, especially during the Covid-19 pandemic, and learning Chinese language is not an exception. Educational games, some of them based on artificial intelligence, have been designed for learning languages. This systematic review aims to examine recent (from 2017 to 2022) research published in Science Direct and Scopus databases on the use and impact of educational games, specifically in Chinese language learning. The in-depth review of 28 studies shows that games are effective tools for Chinese learning that impact students' motivation, self-efficacy progress, and learning satisfaction. However, more in-depth research should measure this impact.

KEYWORDS

Chinese language learning, games, educational games, artificial intelligence.

1. INTRODUCTION

Learning has become increasingly digitalised, and learning languages is not an exception. Computer games, not only educational ones, have proven to expand a learner's vocabulary, boost motivation and satisfaction, and affect interaction with peers. In most cases, games developed by researchers for classrooms or experiments are aimed at students and are effective according to pre-test and post-test results. This review thus aims to fill the literature gap and review which games are used in learning Chinese precisely and what their effects on students are, based on reviewing publications from 2017 to 2022 from databases ScienceDirect and Scopus.

The research questions are as follows:

- (1) Which games have been used so far in learning Chinese?
- (2) What characteristics (motivation, self-efficacy, progress, effectiveness, learning satisfaction) enhance games for learning Chinese?
- (3) What is the future research in this field?

2. METHODOLOGY

The methodology of this paper represents a systematic review of the research papers from ScienceDirect and Scopus. The review was performed from 2016 to May 2022 using the following keywords: Chinese language AND game, Chinese language AND gamification. Most of the papers were found in ScienceDirect – 6 649 studies (Table 1). In the Scopus, 173 papers were detected. Thus, altogether 6822 publications were detected in two databases. Since most papers focused on the use of games in learning in general, the titles, abstracts, and introductions were reviewed, and only 26 papers focusing on Chinese language learning were analysed. Therefore, the paper was included if it matched the corresponding period, i.e., from 2016 up to

May 2022; if the intervention involved the use of a game or gamification; if it focused on the learning of Chinese language; if the study was written in English; and if it could be accessed through ScienceDirect and Scopus database. If the study was not accessible with the institutional login of Peking University, it was not included in the review. If the study was found in both databases, it was counted only once as a ScienceDirect study.

Table 1. Numbers of studies by the database and searched words.

	ScienceDirect		Scopus	
	All results	Studies selected for deeper analysis	All results	Studies selected for deeper analysis
Chinese language AND game	6377	4	155	15
Chinese language AND gamification	272	5	18	2
	6649	9	173	17

As is seen from Annex 1, most studies focus on students' motivation (five studies measure motivation specifically, but with different techniques). Seventeen studies address effectiveness, thirteen - self-efficacy, ten - students' progress, and eight - learning satisfaction. Xu et al. (2021) address all five issues. The analysis of the included studies is consistent with the previous research on games and gamification in language learning: (1) games have been actively used in Chinese language learning (2) the majority of studies address students' motivation; (3) most studies are about effectiveness, self-efficacy, students' progress, learning satisfaction. Based on the overall findings, games are compelling and motivating tools for language learning, also Chinese, but more in-depth research should measure the effect of games on students' characteristics.

3. LITERATURE REVIEW

In language learning, games help to interact, and dive into the language learning environment (Chen et al., 2020). Gamification has been used in the Massive Open Online Courses (MOOCs) (Metwally&Yining, 2017). Studies designed for experiments in classrooms are aimed at proving gamification effectiveness, games' impact on students' motivation and attitude towards learning (Aguilar et al., 2020; Yu&Tsuei, 2022), peer learning and social interdependence (Yang et al., 2015; Wang et al., 2020), students' achievement and emotions (Lei et al., 2022). Gamification and new technologies like artificial intelligence (AI) or virtual reality may make teaching theory more exciting (Kriz et al., 2021).

Most games in language education are aimed at facilitating learning foreign languages (Su et al., 2021; Lai&Bower,2019), and only some are explicitly developed for Chinese learning (Hong et al., 2017; Wong&Hsu, 2016). Tsai et al.(2021) and Redfern & McCurry (2018) improved the Key-Image method - a novel mnemonic (memory aid) tool similar to *Chineasy* method, where characters evolve from a picture in the Chinese learning class. A similar technique was used for the *Second life* and *Sifteo cube* games by Yuan & Wang (2021). Li&Liang (2020) found that the effectiveness of games in Chinese learning comes with satisfaction from the learning process, deeper immersion, and joy in the language learning process. The collaborative mobile learning game *ToneWars* by Fan, Luo, & Wang (2017) connects Chinese learners with native speakers to improve their tone learning. The *Rensselaer Mandarin Project* in collaboration with IBM, aims at foreign language students learning Chinese in virtual reality using AI (Allen et al, 2019). Wang, Shi, & Li (2019) worked on *Wechat* mini games for Chinese learners. Poole et al. (2019) designed the *Mystery Forest* board game for Chinese learning at an elementary school in Utah,

during which students improve their Chinese language knowledge through communication with their peers. A Chinese matching game by Chen (2019) proved that teachers can design and use games in the Chinese teaching process. Jamshidifarsani et al. (2019) analysed papers related to gamification interventions. The game *Speed Mandarin* by Wang, Liu, & Zhang (2019) did not impact results from learning Chinese, but increased students' confidence in speaking. The escape-the-room game by Chou, Chang, & Hsieh (2020) on the tablets for young Chinese learners boosted their motivation and peer collaboration, although the progress of Chinese learning was hard to assess. Similar results got Cho, Andersen, & Kizilcec (2021) with their game *Delivery Ghost* for beginner learners of Mandarin. The *Questaurant* game group by Tang&Taguchi (2021) had a higher level of motivation than the online lesson group. Motivation has increased from games by Lau (2021) and (Fang&Yang, 2017) designed for classical Chinese and an ancient prose e-learning course. He&Loewen (2022) concluded that in case of low engagement in second language applications like *Memrise* teacher support is essential. Wen (2021), Fung et al.(2019) used augmented reality (AR) in the Chinese language learning games, which improved the self-learning of students and brought memorable and joyful results (Wei et al., 2020). Ying, Yulius, & Juniarto (2021), Ying et al.(2021) advocate the positive impact of the gamification of Chinese language teaching and interventions with mobile Chinese learning games.

4. DISCUSSION & CONCLUSION

Currently, education is undergoing a digital transformation. The current review aimed to explore games for learning Chinese by reviewing 2016 to 2022 studies from ScienceDirect and Scopus databases on Chinese learning using games. 6 822 publications from ScienceDirect and Scopus databases were retrieved from which 26 publications were analysed in detail. A few studies focus specifically on learning Chinese as a foreign language through games. Games described in the current review that might be useful to Chinese learners are: *Chineasy*, *Chinese-PP*, *Delivery Ghost*, *escape-the-room*, *Key-Image*, *Memrise*, *Mystery Forest Newby*, *Questaurant*, *Rensselaer Mandarin Project*, *Second life*, *Sifteo cube*.

While previous research has established the effectiveness of games without focusing on Chinese language, this study specifically reviews games for Chinese learning. The review of studies shows that the majority of authors focus on students' motivation, self-efficacy, students' achievements, learning effectiveness, or satisfaction, but a few measure them. Hopefully, this study may encourage researchers to reflect upon the different impacts games make on students, broaden their research questions to several characteristics enhanced by games, and not only describe but also measure the effect of games on students.

There are several limitations to this study. First, this review covered studies only from two databases – ScienceDirect and Scopus. Although there are the highest quality journals, but their number is limited. Secondly, the review is limited by a five-year time frame, from 2017 to 2022. Although the analysis is most relevant to new games, but there could possibly be more analysis made before 2017. Thirdly, reviewed studies are in English. Although some researchers are Chinese, but there is a high possibility that a lot of research on Chinese learning is done in Mandarin or other languages. Finally, only motivation, self-efficacy, students' achievements, learning effectiveness or satisfaction, and progress are reviewed in this study, but the impact of games on students is much broader.

REFERENCES

- [1] Mcclory, Jonathan, (2019) “The Soft Power 30”, Portland.
- [2] Maksimova, Angelina, (2021) “Soft power as a policy rationale for International Education in China”, Observatorio de la Política China.
- [3] Confucius Institute Headquarters, (2020) “FAQ”.
- [4] Center for Language Education and Cooperation. Chinese teaching, (2021) “Teaching”.
- [5] Hung, Hsiu-Ting, Yang, Jie Chi, Hwang, Gwo-Jen, Chu, Hui-Chun, & Wang, Chun-Chieh, (2018) “A scoping review of research on digital game-based language learning”, *Computers & Education*, Vol.126, pp. 89-104.
- [6] Lai, Jennifer W.M. & Bower Matt, (2019) “How is the use of technology in education evaluated? A systematic review”, *Computers & Education*, Vol.133.
- [7] Xu, Yi, Li Jin, Deifell, Elizabeth, Angus, Katie, (2021) “Chinese character instruction online: A technology acceptance perspective in emergency remote teaching”, *System*, Vol.100.
- [8] Chen, D, (2019) “Developing chinese matching games: From inception to completion”, *Journal of Technology and Chinese Language Teaching*, Vol.10, No.1, pp57-72.
- [9] Metwally, Ahmed Hosny Saleh & Yining Wang, (2018) “Gamification in massive open online courses (MOOCs) to support chinese language learning”. Paper presented at the Proceedings - 6th International Conference of Educational Innovation through Technology, EITT 2017, 2018-March, pp. 293-298.
- [10] Aguilar, Rocio, Santana, Monica, Larrañeta, Barbara, Cuevas, Gloria, (2020) “Flipping the strategic management classroom: Undergraduate students' learning outcomes”, *Scandinavian Journal of Educational Research*, Vol.65, No. 6, pp. 1-16.
- [11] Yu, Ya-Ting, & Tsuei, Mengping, (2022) “The effects of digital game-based learning on children’s Chinese language learning, attention, and self-efficacy”, *Interactive Learning Environments*.
- [12] Yang, Ya-Ting Carolyn, Wang, Chi-Jane, Tsai, Meng-Fang, & Wang, Jeen-Shing, (2015) “Technology-enhanced game-based team learning for improving intake of food groups and nutritional elements”, *Computers & Education*, Vol.88, pp. 143-159.
- [13] Wang, Jeen-Shing, Gamble, Jeffrey Hugh, Yang Ya-Ting Carolyn, (2020) “Mobile sensor-based community gaming for improving vocational students’ sleep and academic outcomes”, *Computers & Education*, Vol.151.
- [14] Lei, Hao, Wang, Chenxin, Chiu, Ming Ming, & Chen, Shuangye, (2022) “Do educational games affect students' achievement emotions? evidence from a meta-analysis”, *Journal of Computer Assisted Learning*.
- [15] Kriz, Anton, Nailor, Christopher, Jansen, Karen, Potocnjak-Oxman, Camilo, (2021) “Teaching-practice as a critical bridge for narrowing the research-practice gap”, *Industrial Marketing Management*, Vol.92.
- [16] Su, Fan, Zou, Di, Xie, Haoran, & Wang, Fu Lee, (2021) “A Comparative Review of Mobile and Non-Mobile Games for Language Learning”, *SAGE Open*.
- [17] Wong, Lung-Hsiang & Hsu, Ching-Kun, (2016) “Effects of learning styles on learners' collaborative patterns in a mobile-assisted, Chinese character-forming game based on a flexible grouping approach”, *Technology, Pedagogy and Education*, Vol.25, No.1, pp.61–77.
- [18] Tsai, Meng-Hua, Chang, Li-Yun, Chen, Hsueh-Chih, Chen, Lin, Chia-Ling, (2021) “Effects of key-image mnemonics on Chinese instruction for first-grade students’ achievement and interest toward Chinese learning”, *International Journal of Educational Research*, Vol.109.
- [19] Redfern, Sam & McCurry, Richard, (2018) “A gamified system for learning mandarin Chinese as a second language”, Paper presented at the 2018 IEEE Games, Entertainment, Media Conference, GEM 2018, pp.422-426.
- [20] Yuan, Huanhuan, & Wang, Zhiying, (2021) “A review of research on technology enhancing chinese learning”. *International conference on Internet, education and Information Technology*.
- [21] Li Ping, Liang, Huimin, (2020). “Factors influencing learning effectiveness of educational travel: A case study in China”, *Journal of Hospitality and Tourism Management*, Vol.42, pp.141-152.
- [22] Fan, Xiangmin, Luo, Wencan, & Wang, Jingtao, (2017) “Mastery learning of second language through asynchronous modeling of native speakers in a collaborative mobile game”, Paper presented at the Conference on Human Factors in Computing Systems - Proceedings, 2017-May 4887-4898.
- [23] Allen, David, Divekar, Rahul, Drozdal, Jaimie, Balagozyan, Lilit, Zheng, Shuyue, Song, Ziyi, . . . Su, Hui, (2019) “The renselaer mandarin project - A cognitive and immersive language learning

- environment”, Paper presented at the 33rd AAAI Conference on Artificial Intelligence, AAAI 2019, 31st Innovative Applications of Artificial Intelligence Conference, IAAI 2019 and the 9th AAAI Symposium on Educational Advances in Artificial Intelligence, EAAI 2019, pp.9845-9846.
- [24] Wang, Xijie, Shi, Minyong, & Li, Chunfang, (2019) “Implementation of elementary chinese language learning application in WeChat mini programs”, Paper presented at the 2019 4th IEEE International Conference on Big Data Analytics, ICBDA 2019, pp.394-398.
- [25] Poole, Frederick, Clarke-Midura, Jody, Sun, Chongning, & Lam, Kyle, (2019) “Exploring the pedagogical affordances of a collaborative board game in a dual language immersion classroom”, *Foreign Language Annals*, Vol.52, No.4, pp753-775.
- [26] Jamshidifarsani, Hossein, Garbaya, Samir, Lim, Theodore , Blazevic, Pierre, Ritchie, James M., (2019) “Technology-based reading intervention programs for elementary grades: An analytical review”, *Computers & Education*, Vol.128, pp. 427-451.
- [27] Wang, Lih-Ching Chen, Liu, Xiongyi, & Zhang, Qianwei, (2019) “Gamification in american high school students’ chinese learning: A case study of using speed mandarin.”, *Journal of Technology and Chinese Language Teaching*, Vol.10, No.2, pp82-101.
- [28] Chou, Pao-Nan, Chang, Chi-Cheng, & Hsieh, Shih-Wan, (2020) “Connecting digital elements with physical learning contexts: An educational escape-the-room game for supporting learning in young children. *Technology, Pedagogy and Education*, Vol.29, No.4, pp425-444.
- [29] Tang, Xiaofei, & Taguchi, Naoko, (2021) “Digital game-based learning of formulaic expressions in second language Chinese”, *Modern Language Journal*, Vol.105, No.3, pp740-759.
- [30] Lau, Kit Ling, (2021) “Using E-learning activities to support classical chinese learning in the out-of-class context”, Paper presented at the Proceedings - 2021 International Symposium on Educational Technology, ISET 2021, pp65-68.
- [31] Fang, Pin-Chun, Yang, Shelley Shwu-Ching, (2017) “A Preliminary Study of Integrating an Action Role-Playing Game into an Ancient Prose”, *Advances in Human Factors, Business Management, Training and Education. Advances in Intelligent Systems and Computing*, Vol. 498.
- [32] He, Xuehong, Loewen, Shawn, (2022) “Stimulating learner engagement in app-based L2 vocabulary self-study”, *Goals and feedback for effective L2 pedagogy*, Vol.105.
- [33] Cho, Ji Yong, Andersen, Erik, & Kizilcec, Rene F, (2021) “Delivery ghost: Effects of language immersion and interactivity in a language learning game”, Paper presented at the Conference on Human Factors in Computing Systems – Proceedings.
- [34] Wen, Yun, (2021) “Augmented reality enhanced cognitive engagement: designing classroom-based collaborative learning activities for young language learners”. *Education Tech Research Dev*, Vol.69, pp843–860.
- [35] Fung, Ka Yan, Fung, K.-C., & Wan, S. W., (2019) “Augmented reality and 3D model for children Chinese character recognition - Hong Kong primary school education.” Paper presented at the ICCE 2019 - 27th International Conference on Computers in Education, Proceedings, pp1 673-678.
- [36] Wei, Xiaodong, Yang, Guodong, Zhang, Kai, & Li, Zhe, (2020) “Research on mobile AR language learning environment based on virtual avatar”, Paper presented at the Proceedings - 2020 9th International Conference of Educational Innovation through Technology, EITT 2020, pp229-234.
- [37] Ying, Yi, Susilo, P. M., Mei, F. R., & Rahardjanti, T, (2021) “The role of the mandamonic games in supporting mandarin learning at elementary school”, Paper presented at the *Journal of Physics: Conference Series*, Vol.1764, No.1.
- [38] Ying, Y., Yulius, & Juniarto, A, (2021) “Using online-game based platform to improve students’ mandarin skills”, Paper presented at the *Journal of Physics: Conference Series*, Vol.1764, No.1.
- [39] Spice, Byron, (2020) “New AI Enables Teachers to Rapidly Develop Intelligent Tutorings Systems”. Carnegie Mellon University
- [40] Chen, Xieling, Xie, Haoran, Hwang, Gwo-Jen, (2020) “A multi-perspective study on Artificial Intelligence in Education: grants, conferences, journals, software tools, institutions, and researchers”, *Computers and Education: Artificial Intelligence*, Vol.1.
- [41] Chen, Xieling, Zou, Di, Cheng, Gary, Xie, Haoran, (2020) “Detecting latent topics and trends in educational technologies over four decades using structural topic modeling: A retrospective of all volumes of *Computers & Education*”, *Computers & Education*, Vol.151.
- [42] Serban, Iulian Vlad, Gupta, Varun, Kochmar, Ekaterina, Vu, Dung D., Belfer, Robert, Pineau, Joelle..., Bengio, Yoshua, (2020) “A large-scale, open-domain, mixed-interface dialogue-based ITS for STEM”, *Proceedings of the 21st international conference on artificial intelligence in education (AIED 2020)*, Springer.

- [43] Bhutoria, Aditi, (2022) “Personalized education and Artificial Intelligence in the United States, China, and India: A systematic review using a Human-In-The-Loop model”, *Computers and Education: Artificial Intelligence*, Vol.3.
- [44] Kashyap, Ravi, (2021) “Artificial Intelligence: A Child’s Play”, *Technological Forecasting and Social Change*, Vol.166.
- [45] Wang, Y.-H., (2015) “Could a mobile-assisted learning system support flipped classrooms for classical Chinese learning?”, *Journal of Computer assisted Learning*, Vol.32, No.5, pp391-415.
- [46] Chu, Tianshu, Tael, Paul, Hammond, Tracy, (2018) “Supporting Chinese character educational interfaces with richer assessment feedback through sketch recognition” *Proceedings of the 44th Graphics Interface Conference*, pp.50-57.
- [47] Goksu, Idris, (2021) “Bibliometric mapping of mobile learning”, *Telematics and Informatics*, Vol.56.
- [48] Hong, Jon-Chao, Hwang, Ming-Yueh, Tai, Kai-Hsin, & Lin, Pei-Hsin, (2017). “Intrinsic motivation of Chinese learning in predicting online learning self-efficacy and flow experience relevant to students' learning progress” , *Computer Assisted Language Learning*, Vol.30, No.6, pp552–574.
- [49] Hong, Jon-Chao, Hwang, Ming-Yueh, Tai, Kai-Hsin, Kuo, Yen-Chun, & Lin, Pei-Chun, (2017) “Confusion affects gameplay”, *Learning and Individual Differences*, Vol.59.

Annex 1. Literature Review

Author	Game/TTS	Methodology	Motivation	Self-efficacy	Progress	Effectiveness	Learning satisfaction
Tsai et al.(2021)	Chinese radical (key)-image method	Achievement test, inventory	increased	N/A, but efficiency & efficacy increased			
Li&Liang (2020)	Chinese learning effectiveness	Surveys				0.807	0.802
Fan, Luo, & Wang (2017)	Acquiring Chinese tones through games	Pre- and post-test, survey, interview	gained through confidence			proved	present
Allen et al.(2019)	Rensselaer Mandarin Project learning & virtual travel (in development)	Descriptive creation of the game		self-govern			
Wang, Shi, & Li (2019)	Chinese Language Learning in WeChat Mini programs	Descriptive creation of the game				aimed at, but not measured	
Poole et al.(2019)	Collaborative board game	Audio collection & analysis	aimed at, but not measured	aimed at, but not measured		aimed at, but not measured	aimed at, but not measured
Chen (2019)	Chinese matching game	Descriptive creation of the game	aimed at, but not measured				
Jamshidifarsaniet al.(2019)	Technology-based reading intervention programs	Literature review	aimed at, but not measured	aimed at, but not measured	aimed at, but not measured	aimed at, but not measured	
Wang, Liu, & Zhang (2019)	Speed Mandarin computer program	Pre- and post-questionnaire	3.46-3.5	aimed at, but not measured		measured through competences	
Chou, Chang, & Hsieh (2020)	Escape-the-room game with tablets	Pre- and post-test, interview	aimed at, but not measured	aimed at, but not measured		aimed at, but not measured	

Tang&Taguchi (2021)	Questaurant game	Recognition & production test, questionnaire	61.33 for game players vs 52 for no players		mentioned in the questionnaire	aimed at, but not measured	mentioned in the questionnaire
Lau (2021)	E-learning activities in Classic Chinese reading	Pre- and post-questionnaire	3.19-3.78	3.13-3.43		aimed at, but not measured	
Fang&Yang, 2017	Avatars and Learning Companions in Studying Chinese Classical Literature	Pre- and post-questionnaire	aimed at, but not measured				
He&Loewen (2022)	Memrise	Pre- and post-questionnaire, survey	boosted by 34%			supported	
Cho, Andersen, &Kizilcec (2021)	Delivery Ghost	Pre- and post-questionnaire, survey	interactivity and immersion are less critical to learning at the beginner-level than a well-structured curriculum				
Wen Wen (2018)	Augmentedrealityenhancedchinesecharacterlearninggame	Recorded learning process, focus group discussions	engagement	aimed at improved self-learning, but not measured	aimed at, but not measured		
Fung, Fung, & Wan (2019)	Augmented reality and 3D model for children Chinese character recognition	Pre- and post-test, teacher & student focus groups	aimed at, but not measured	aimed at improved self-learning, but not measured	aimed at, but not measured		

Wei et al. (2020)	Mobile AR Language Learning Environment Based on Virtual avatar	Pre- and post-test, questionnaire	measured as learning attitude in min, higher with AR (10 min)				higher with AR (4.58 vs 3)
Ying, Yulius, & Juniarto (2020)	Chinese learning listening games	Questionnaires	aimed at, but not measured		aimed at, but not measured		
Ying et al. (2020)	Mandamonic games	Surveys	aimed at, but not measured			aimed at, but not measured	
Chen et al., 2020	Games, ITS powered by AI, e.g. Korbit	Literature review	mentioned in 0.91% publications	mentioned in 0.48% publications			
Serban et al., 2020	Korbit	Questionnaires	aimed at, but not measured		average student learning measured as correct answers with pedagogical interventions 39.14%	effective pedagogical interventions	"fun" according to students
Bhutoria (2022)	A systematic review of personalized Edtech using AI in the US, China, India	Literature review	aimed at, but not measured			aimed at, but not measured	
Kashyap, 2021	Chinese room argument	Literature review	aimed at, but not measured		aimed at, but not measured	aimed at, but not measured	aimed at, but not measured

Wang, 2015	Cross-device mobile-assisted classical chinese learning system fo flipped classroom	Questionnaires	enhanced to 4 in comparison to 3.33	aimed at, but not measured	aimed at, but not measured	aimed at, but not measured	
Xu et al., 2021	Chinese character online instruction	Questionnaires	aimed at, but not measured	aimed at, but not measured	aimed at, but not measured	aimed at, but not measured	aimed at, but not measured
Goksu, 2021	Bibliometric mapping of mobile learning	Literature review	aimed at, but not measured			aimed at, but not measured	
Hong et al., 2017	Game correcting writing in Chinese	Questionnaire	aimed at, but not measured	aimed at, but not measured			