Editorial

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Introduction

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The COVID-19 pandemic sparked an intense focus to be placed on at-distance learning in classrooms around the world (e.g., Burns et al. 2020; Gao 2020; Jin et al. 2021). This rapid and unprecedented switch to at-distance learning caused challenges worldwide, particularly for Chinese language educators due to the unique linguistic features of the language. Taking the writing script of Chinese as an example, learners are required to master the sound, shape, and meaning of a character despite a lack of grapheme-phoneme correspondence (Yan et al. 2020). In a recent book edited by Osborne et al. (2024), the authors delved into how lessons learned during the pandemic could pave the way for technology development and curriculum design when it comes to teaching and assessing Chinese characters in the current digital age. Specifically, the authors acknowledge the opportunity for certain aspects of Chinese to be prioritised when designing future sustainable curricula, while integration of technology, innovation, and access are of utmost importance. In general, the book highlights the need for continued empirical studies to advance research in the field.

In addition, as probably the oldest written language in the world, the long-standing tradition of rote memorisation (see Osborne 2020) has led to Chinese language education being criticised for being unmodern (Moloney 2013). Against the backdrop of digital transformation worldwide, the topic of typing Chinese characters became more widely debated (Chu et al. 2024; Lyu et al. 2021; Lyu and Qi 2020; Zhang 2021). Certainly, this is not a new issue, however, rather than pitting one approach against the other, it can be seen how incorporating both handwriting and typing could be beneficial to students in order to prepare them for the digital age (Osborne et al. 2024).

While the prevalence of online practices only intensified after the COVID-19 pandemic, several studies published both pre- and post-2020 describe the ways in which digital technologies are utilised by Chinese language classrooms worldwide,

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with major gaps in the area being highlighted. Firstly, a scoping review by Li and Li (2024) reported on the teaching models of online international Chinese language teaching and found that while a blended learning approach is often considered most effective, there are shortfalls such as technical issues, the increased demand on teachers, lack of knowledge of teachers, and limited assessment options. These findings reveal that there may be a more deep-rooted issue in that the field is ill-prepared for the digital age and perhaps trying to maintain traditional practices in a modern world with little flexibility. Worryingly, another study surveying 286 pre-service teachers in Mainland China uncovered severe gaps in their technological pedagogical knowledge and technological content knowledge (Qiu et al. 2022). Without addressing these issues in pre-service training, the future of Chinese language education would struggle to emerge from such traditional approaches. This, in turn, would certainly impact students' preparation for the digital age.

Despite the concerning findings mentioned, there have been steps taken by several researchers to incorporate more digital technologies into Chinese language education. Some studies include the exploration of virtual and augmented reality (e.g., Chen and Yuan 2025; DeWitt et al. 2022; Muangchan and Yanhua 2025), specific language tasks utilizing digital technologies such as WeChat (e.g., Tong et al. 2024; Wang 2023) and ChatGPT (Li et al. 2023; Liu et al. 2023), and broader reports on computer-assisted and/or mobile-assisted language learning in general (Li et al. 2022; Wang 2024). However, the research in this area is still relatively sparse in the context of Chinese language education, with other languages such as English being more heavily reported on. In addition, the available research focuses mainly on the incorporation of digital technologies into Chinese language education to enhance language skills, rather than also focusing on the development of digital skills of learners, as well as creativity and autonomy, that would advance their readiness for the digital age.

This special issue therefore shifts the focus away from the micro-level challenges in digital transformation, such as the handwriting versus typing debate when it comes to learning Chinese characters. Instead, the papers herein focus on the holistic use of digital technologies in Chinese language education. Taking inspiration from Salavati's (2016: 8–9) definition, the term *digital technologies* refers to: information, communication, and administration technologies and software; devices such as computers, laptops, tablets, and mobile phones; and whiteboards and projectors with or without interactivity. In terms of *digital transformation*, Vial's (2019: 118) framework describes this as a process whereby:

> [D]igital technologies create disruptions triggering strategic responses from organizations that seek to alter their value creation paths while managing the structural changes and organizational barriers that affect the positive and negative outcomes of this process.

Clearly, the COVID-19 pandemic exacerbated these technological disruptions in the Chinese language classroom thus leading to teachers' innovation in terms of teaching methodologies, assessment, and curriculum design. While these changes were made rapidly during the period of ERT (emergency remote teaching) (e.g., Chen 2022), researchers and practitioners should now begin to explore the use of digital technologies to holistically support the digital transformation of Chinese language education. Therefore, this special issue presents studies examining Chinese language education within the framework of Education 4.0.

The core of Education 4.0 as a method is to support and encourage students to develop literacy in new technologies, thereby extending beyond the formal classroom (Mukul and Büyüközkan 2023). In addition, Education 4.0 aims to develop skills of creativity and innovation in learners (ibid.). With this approach, Chinese language learners can be introduced to and become competent in using new technologies, while at the same time step into a more creative learning environment that differs significantly from traditional rote memorisation tendencies. As highlighted, in recent times, researchers and practitioners have begun to explore digital technologies within Chinese language education. However, it raises a question whether this research appears to relate more to Education 3.0, which refers to "interactive learning by using learning materials in digital and social media formats" (Mukul and Büyüközkan 2023: 2). As demonstrated, the focus is on enhancing language skills through digital technologies and does not necessarily address creativity, autonomy, or developing literacy in such technology. Another issue reported by the United Nations (2020) shows that half of learners worldwide (830 million) did not have access to a household computer when learning was transferred to the online-only space in 2020. At the same time, over 40 % of learners worldwide did not have access to the internet at home. This creates major accessibility issues that will no doubt lead to discrepancies in digital literacy. Additionally, Zeng and Jiang (2021) identify that in the context of Chinese language education, three layers of barriers exist to learners in Australia. These include the tool (digital technology) itself, the user (either teacher or student), and the supporter of the tool (such as the school or institution). As a result, it appears vital that classrooms are afforded similar opportunities when it comes to utilising digital technology in order to create a more equitable learning environment.

This special issue therefore looks to the future of Chinese language education through presenting studies specifically relating to Education 4.0. The aim is twofold: (1) to provide evidence-based insights on curriculum design, pedagogy, and evaluation of digital transformation in Chinese language education, focusing on preparing students for the current and future digital age through harnessing their digital literacy skills and (2) to advance Chinese language education further towards Education 4.0. It is also hoped that the studies reported herein will encourage future

studies, thus further aligning Chinese language education with key concepts of Education 4.0. The special issue contains three English-language papers and three Chinese-language papers written by eleven authors across predominantly Europe and also the United States.

In the first of three English-language papers of this special issue, Qi Zhang and Caitríona Osborne conduct a semi-systematic review of key studies examining the digital transformation of CFL (Chinese as a foreign language) conducted and published in 2020–2025. The authors identified 94 empirical studies from six databases (ERIC, JSTOR, Sage Journals, Oxford Academic Journals, Web of Science, and Scopus) which demonstrated that emerging digital technologies are less reported on, and instead, more established technology is investigated within teaching and learning CFL. This finding alone is further evidence that Chinese language education is perhaps currently more aligned with Education 3.0. Still, the authors report a steady increase in examining digital technologies within the context of teaching and learning CFL from 2020 to 2025, which at least suggests a willingness within the field to expose learners to and utilise an increasing number of digital technologies. While most studies come from tertiary level, there appears to be an even spread regarding proficiency levels, with most studies based in China or the United States. This special issue moves away from this trend and puts a spotlight on studies predominantly from Europe. Qi Zhang and Caitríona Osborne set the scene for the current situation of digital transformation in CFL and identify areas for further research, such as the inclusion of Chinese-language articles and more diverse research methods, two other factors that we are proud to present in this special issue.

The second paper, authored by Julia Renner, Stefanie Yu, and Andreas Guder, actively addresses concepts of Education 4.0 by investigating high-school CFL learners' spoken interactions with ChatGPT's Voice Mode, and importantly, their experience with such. This study is part of a larger project whereby the authors investigate how LLMs (large language models) can be integrated into the FL (foreign language) classroom as language partners. Overall, the authors report that ChatGPT's Voice Mode can serve as a complementary tool in the CFL classroom and noted that teacher support was necessary in both setting up tasks and resolving any issues. This study addresses multiple gaps previously identified, such as reporting from Europe (Austria), including high-school students as participants, and using diverse data collection methods. For example, the authors can see first-hand how participants interact with ChatGPT through audio and video recordings of the tasks, while at the same time, participant experiences are recorded through reflections conducted as soon as the task is complete. Interestingly, these reflections highlight mixed feelings towards using GenAI in the classroom. While some participants found the interactions less risky compared to human interactions, others found the interactions quite unnatural. This brings to mind a point highlighted by Burns et al.

(2020) previously, in that it is widely assumed that students are competent using – or even prefer using – digital technologies, but this is not necessarily the case. In addition, it further emphasises the importance of teacher and student training in digital technologies.

In the third and final English-language paper, Yi Xu also documents an aspect of a larger transdisciplinary course, *Chinese Language in Food Culture*, whereby participants uncover Chinese language use within the context of food. This paper describes how participants, who are five CFL learners, engaged in a self-directed corpus consultation task, thereby utilising authentic materials to engage in data-driven learning. Each participant chose their own keywords to investigate, and all demonstrated a range of cognitive and metacognitive skills in their individual tasks. Data within this study not only included student work (written assignments and a final project) but also interviews conducted once the course was completed. While the course design within this study demonstrates learner autonomy and creativity, a key element of this study is the fact that students were able to develop digital literacy skills at the same time as Chinese language skills, which encapsulates the essence of Education 4.0. The participant interviews also revealed that participants found this aspect to be quite enjoyable, despite their differing proficiency levels. This highlights that even with different levels of Chinese in one classroom, the autonomous and personal nature enables students to utilize cognitive skills, while their positive experience engaging with authentic materials further supports a data-driven learning design.

In the first of three Chinese-language papers, Lingzhi Nie and Sara Rovira-Esteva describe a study that also utilizes a corpus – Chinese Audio-Visual Corpus (CVC) – in the classroom. In this paper, however, the authors take the perspective of educators in introducing Education 4.0 concepts to CFL curricula, which is a vital angle given that pre-service teachers in China were reported to have severe gaps in their technological pedagogical and content knowledge (Qiu et al. 2022). Lingzhi Nie and Sara Rovira-Esteva indeed state that instructors are required to guide students to become autonomous learners while also ensuring that they themselves are equipped to adapt to personalized and digitalized teaching environments. This study utilizes CVC video materials with the aim of constructing a practical teaching model to teach high-frequency interrogative pronouns “wèishénme (为什么)” and “zěnme (怎么)” – traditional explanations of which often fail to describe clearly the contextual differences. Indeed, exploring the synergy between AI and multimedia corpora is encouraged by the authors as it could contribute to a more personalized learning environment for learners, a feature that is synonymous with Education 4.0. The authors suggest that future research should indeed explore this further, particularly in relation to long-term effects and large-scale application.

The second Chinese-language paper, authored by Fang Su, examines the utilization of AI to create learning materials, specifically, the impact of AI-generated songs on advanced CFL learners is investigated. The data gathered in this study comes directly from 30 CFL learners using a mixed-methods design. The 30 participants are split into two groups, with one group being introduced to an AI-generated song and the other learning without any AI-generated song. The instructor prompted ChatGPT to create the lyrics of the song to ensure key teaching points were included, while another programme – Suno AI – was employed to turn the lyrics into an audio file. Here, Fang Su's study directly addresses instructor knowledge of digital technologies as well as student experience with the AI-generated material. Results from students' final exam scores and questionnaires with some follow-up interviews demonstrate that the introduction of an AI-generated song to an advanced CFL curriculum increased learner motivation and classroom engagement, and also strengthened linguistic knowledge compared to a control group. Fang Su advocates that while the findings are positive, this does not mean that AI-generated songs should replace all instructional content. At the same time, it is noted that instructors remain vital for correcting the pronunciation and grammar, for example, of their students. The author calls for additional research to include a larger sample size and longitudinal tracking.

Finally, the third Chinese-language paper authored by Wenlong Wang and Chong Qi investigates the feasibility of an online oral Chinese-language class in a university in France. Analysing recordings of the final oral exam of two groups of students – one being a control, in-person class, the other being an online-dominant class – there were no significant differences found between the two groups in terms of accuracy, fluency, or complexity. However, authors did note that the in-person class tended to use more advanced vocabulary and sentence structures than the online class. Therefore, the authors recommend utilizing AI to enhance real-time practice and immediate feedback in the online classroom, which would also allow for more learner autonomy. Specifically, it is recommended that the use of AI to design language tasks, create opportunities for interaction, and enhance pronunciation training are key areas to explore. In addition, the authors advocate for further exploration into blended teaching approaches between human instructors and AI, which would ultimately lead to autonomous learning associated with Education 4.0.

The semi-systematic review reported in the first paper of this special issue shows that most research within Chinese language education still relies on established technologies, rather than emerging technology. Additionally, it has been mentioned in this introduction that student literacy skills development tends to also be neglected in such studies. Across all six studies in this special issue, researchers present a multifaceted view of how digital and AI-enhanced tools can reshape Chinese language education. As per the aim of this special issue, the focus moves

away from micro issues (for example, typing versus handwriting Chinese characters) and instead takes steps to advance Chinese language education to Education 4.0. New technologies, such as multimodal corpora, online corpora, AI-generated learning materials, and voice-based large language models are expanding opportunities for language learning, while also allowing students the flexibility to be creative and autonomous during the learning process. At the same time, the papers in this special issue highlight the continued need for teacher mediation as well as improved AI capabilities and pedagogical models suited to online and hybrid environments. While this special issue represents a step away from Education 3.0, it is recommended that future studies continue to address Chinese language education within the context of Education 4.0, which would certainly further modernize the field.

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References

Burns, Danielle, Neill Dagnall & Maxine Holt. 2020. Assessing the impact of the COVID-19 pandemic on student wellbeing at universities in the United Kingdom: A conceptual analysis. *Frontiers in Education* 5. 1–10.

Chen, Mengtian. 2022. Digital affordances and teacher agency in the context of teaching Chinese as a second language during COVID-19. *System* 105. 102710.

Chen, Chen & Yifeng Yuan. 2025. Effectiveness of virtual reality on Chinese as a second language vocabulary learning: Perceptions from international students. *Computer Assisted Language Learning* 38(3). 397–425.

Chu, Chengzhi, Matthew D. Coss & Phyllis N. Zhang (eds.). 2024. *Transforming Hanzi pedagogy in the digital age: Theory, research, and practice [*电写时代的汉字教学—理论与实践*]*. Oxon and New York: Routledge.

DeWitt, Dorothy, Suet Fong Chan & Rhett Loban. 2022. Virtual reality for developing intercultural communication competence in Mandarin as a foreign language. *Educational Technology Research & Development* 70. 615–638.

Gao, Xiaoping. 2020. Australian students' perceptions of the challenges and strategies for learning Chinese characters in emergency online teaching. *International Journal of Chinese Language Teaching* 1(1). 83–98.

Jin, Li, Yi Xu, Elizabeth Deifell & Katie Angus. 2021. Emergency remote language teaching and U.S.-based college-level world language educators' intention to adopt online teaching in postpandemic times. *The Modern Language Journal* 105(2). 412–434.

Li, Jiahang & Chili Li. 2024. A scoping review of the research on the teaching models of online international Chinese language teaching. *Journal of Education and Learning* 13(4). 255–271.

Li, Fan, Si Fan & Yanjun Wang. 2022. Mobile-assisted language learning in Chinese higher education context: A systematic review from the perspective of the situated learning theory. *Education and Information Technologies* 27. 9665–9688.

Li, Jing, Xiaohui Ren, Xinliang Jiang & Chiu-Hung Chen. 2023. Exploring the use of ChatGPT in Chinese language classrooms. *International Journal of Chinese Language Teaching* 4(3). 36–55.

Liu, Yufeng, Songtao He, Hua Chen, Wenting Qing, Hong Su & Guiwen Deng. 2023. Investigation on response strategies for the impact of ChatGPT technology application on college Chinese language education. *International Journal of Educational Innovation and Science* 4(1). 156–164.

Lyu, Boning & Xuedan Qi. 2020. A review of research on technology-assisted teaching and learning of Chinese as a second or foreign language from 2008 to 2018. *Frontiers of Education in China* 15. 142–163.

Lyu, Boning, Chun Lai, Chin-Hsi Lin & Gong Yang. 2021. Comparison studies of typing and handwriting in Chinese language learning: A synthetic review. *International Journal of Educational Research* 106. 101740.

Moloney, Robyn Anne. 2013. Providing a bridge to intercultural pedagogy for native speaker teachers of Chinese in Australia. *Language Culture and Curriculum* 26(3). 213–228.

Muangchan, Pattanasak & Zhao Yanhua. 2025. Augmented reality technology in a basic Chinese vocabulary course: A study in a Thai university. *Cogent Education* 12(1). https://doi.org/10.1080/2331186X.2024.2446088.

Mukul, Esin & Gülçin Büyüközkan. 2023. Digital transformation in education: A systematic review of education 4.0. *Technological Forecasting and Social Change* 194. 122664.

Osborne, Caitríona. 2020. *The effects of focused memorisation, delayed character introduction, character colour-coding, and a unity curriculum on the character learning of beginner CFL learners*. Ireland: Diblin City University doctoral dissertation. Available at: http://doras.dcu.ie/24025/2/Thesis%20Jan%202020%20CO.pdf.

Osborne, Caitríona, Danping Wang & Qi Zhang (eds.). 2024. *Teaching Chinese characters in the digital age: Insights on current trends and future directions*. Switzerland: Palgrave Macmillan.

Qiu, Chun-an, Hui-xian He, Guo-li Chen & Min-xuan Xiong. 2022. Pre-service teachers' perceptions of technological pedagogical content knowledge in mainland China: A survey of teachers of Chinese as a second language. *Education and Information Technologies* 27. 6367–6391.

Salavati, Sadaf. 2016. *Use of digital technologies in education: The complexity of teachers' everyday practice*. Sweden: Linnaeus University doctoral dissertation.

Tong, Peiru, Zhaohui Yin & Linda Tsung. 2024. Student engagement and authentic language use on WeChat for learning Chinese as a foreign language. *Computer Assisted Language Learning* 37(4). 687–719.

United Nations. 2020. *Startling digital divides in distance learning emerge*. UNESCO. Available at: https://news.un.org/en/story/2020/04/1062232.

Vial, Gregory. 2019. Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems* 28(2). 118–144.

Wang, Xuan. 2023. Chronotope, technology affordances, and task design: Using WeChat to facilitate Chinese learning in the classroom. *Journal of China Computer-Assisted Language Learning* 3(1). 11–34.

Wang, Hongfei. 2024. *The design and evaluation of intelligent computer-assisted language learning tools for beginner learners of Mandarin Chinese*. Ireland: Trinity College Dublin doctoral dissertation.

Yan, Guoli, Zebo Lan, Meng Zhu, Yingchao Wang & Valerie Benson. 2020. Phonological coding during sentence reading in Chinese deaf readers: An eye-tracking study. *Scientific Studies of Reading* 25(4). 287–303.

Zeng, Yueying & Wenying Jiang. 2021. Barriers to technology integration into teaching Chinese as a foreign language: A case study of Australian secondary schools. *World Journal of Education* 11(5). 17–30.

Zhang, Phyllis Ni. 2021. Typing to replace handwriting: Effectiveness of the typing-primary approach for L2 Chinese beginners. *Journal of Technology and Chinese Language Teaching* 12(2). 1–28. http://www.tclt.us/journal/2021v12n2/zhangn.pdf.