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Promoting foundational linguistic skills for reading development in young Chinese language learners: A 1-year intervention study

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Background: Using a 1-year longitudinal design, we evaluated the effectiveness of an intervention programme to improve reading attainments among Chinese-as-a-second-language (CSL) learners. Using the simple view of reading as a theoretical framework, the intervention focused on students' orthographic knowledge, word reading and listening comprehension to facilitate reading comprehension.
Method: A total of 186 Grade 4 CSL students (mean age = 9.22, *SD* = 0.56) participated in the study and were grouped into the treatment ($N = 96$) and control ($N = 90$) groups. A range of Chinese language and literacy skills were assessed before and after the intervention.
Results: The path analysis showed that the intervention significantly affected orthographic knowledge, word reading and listening comprehension directly and reading comprehension indirectly through the three componential skills after controlling for nonverbal reasoning, vocabulary and autoregressors.
Conclusions: The findings suggest that orthographic knowledge, word reading and listening comprehension may be promising targets for instructing young CSL learners.

Keywords: Chinese-as-a-second-language (CSL), intervention, simple view of reading, Chinese orthographic knowledge

Highlights

What is already known about this topic

- The simple view of reading (SVR) has been successfully adapted as the theoretical underpinning of literacy research and intervention design.
- SVR has also been widely used in studying literacy development in native-speaking and Chinese-as-a-second-language (CSL) learners.
- Evidence supporting the contribution of orthographic and morphological skills, decoding and linguistic comprehension to Chinese reading development is established.

What this paper adds

- The results supported the effectiveness of the SVR model-based intervention in promoting orthographic knowledge, word reading and listening comprehension for CSL reading comprehension.
- Direct treatment effects on Chinese orthographic knowledge and word reading were established, suggesting the usefulness of instruction on orthographic and morphological knowledge for Chinese literacy learning.
- The significant treatment effect on Chinese oral comprehension skills indicated a close association with metalinguistic skills and considerably affected Chinese literacy.

Implications for theory, policy or practice

- The findings support the usefulness of the SVR model as both a descriptive theoretical model and a prescriptive intervention model for CSL literacy development.
- CSL curriculum for young learners would have a more balanced curriculum built on a listening comprehension foundation and with due emphasis on Chinese orthography.
- CSL teachers may consider adopting an explicit and systematic progressive approach to Chinese literacy instruction to promote orthographic and morphological skills for literacy.

Developing literacy skills in a societally dominant second language is crucial for young immigrant learners' social integration, academic achievement and long-term success in life (August & Shanahan, 2008). This is also true for ethnic minority students in Hong Kong who learn Chinese as a second language (CSL). Previous research has reported these students' poor performance and self-perceived ability in Chinese reading and writing, calling for providing better instructions to enhance their literacy skills (Li & Chuk, 2015;

Wong, 2019). Aiming to develop and evaluate an intervention programme for improving CSL reading attainments among these students, the present study was conducted on the knowledge base supported by the simple view of reading (SVR) model (Gough & Tunmer, 1986), SVR-informed intervention studies (Al Otaiba et al., 2022) and the findings of extant research on both CSL and native Chinese-speaking learners' orthographic knowledge and reading development (Wong, 2017; Yeung et al., 2013). These studies, including a substantial body of studies in Chinese literacy development using the SVR model (Peng et al., 2021), have informed the three-pronged intervention targeting three crucial linguistic skills, namely, Chinese orthographic knowledge, word reading and listening comprehension. The present study reports on the intervention's implementation in five Hong Kong primary schools and evaluates its effectiveness. Given that Chinese literacy acquisition is the greatest challenge for most CSL learners (Shen, 2013), our findings would have high impact values for worldwide CSL education.

Theoretical Framework: Simple View of Reading in Chinese

This study used the SVR as the theoretical underpinning of the research and intervention design. The simple view postulates that reading comprehension is the product of decoding, which is the ability to read words accurately and fluently, and linguistic comprehension, which is the ability to understand spoken language (Gough & Tunmer, 1986). The SVR is supported by a substantial body of research concerning native or foreign-language learners across different languages, including Chinese (Florit & Cain, 2011; Peng et al., 2021; Sparks, 2021). The research has elucidated that decoding pertains to successful word recognition and linguistic comprehension encompasses a wide range of oral language skills; the two processes are distinct but interactive, sharing some variances in predicting reading comprehension (Duke & Cartwright, 2021; Koh & Joshi, 2023; Nation, 2019; Tunmer & Hoover, 2019). Proposed as a framework to identify sources of problems in reading acquisition, the SVR is widely used as the theoretical basis of intervention and curriculum (Hoover & Tunmer, 2018; Stainthorp, 2020; Westerveld et al., 2020). Reviewing the SVR intervention studies, Melby-Lervåg and Lervåg (2014) found that interventions targeting decoding and linguistic comprehension for reading comprehension had small to moderate, statistically significant effects. In their recent 'review of reviews' on literacy interventions for children with reading difficulties, Al Otaiba et al. (2022) used the SVR as a conceptual framework and categorised teaching of skills as either code-focused (decoding) or meaning-focused (linguistic comprehension). The meta-analysis results demonstrated improvement in both types of skills. Referencing the intervention design of the existing SVR studies and tailoring the characteristics of the Chinese writing system, this study adopted an intervention aiming to enhance the CSL learners' (1) code-related Chinese orthographic knowledge and word reading skills and (2) meaning-related listening comprehension skills.

An account of the characteristics of the Chinese writing system is essential when deliberating these component skills. Chinese characters, as the basic units of the Chinese writing system, are morphosyllabic, roughly corresponding to morphemes in meaning and syllables in sound (Cheung et al., 2006). The graphemic form of Chinese characters is a combination of strokes in a two-dimensional spatial structure. These strokes, as the smallest units of Chinese characters, can be combined into radicals, either independently serving as one-radical simple characters or constituting compound characters with more than one radical. The radical is a key orthographic unit in Chinese: nearly 96% of the currently used

Chinese characters are compound characters, of which around 80–90% are ideophonetic characters with a semantic radical cueing its meaning and a phonetic radical, cueing its sound (Su, 2001). For instance, the compound character 花 (*flower*, /faa1/) has a top-bottom structure composed of ⺾ (a variant of 草, *plant*, /cou2/) as the semantic radical indicating its meaning (i.e., *flower*) and 化 (/faa3/) as the phonetic radical, indicating the sound (i.e., /faa1/). 環/环[1] (*ring*, /waan4/) has a left–right structure composed of the semantic radical 玉 (*jade*, /juk6/) and the phonetic radical 罒 (/waan4/). While the majority of Chinese characters can be used as words, most written Chinese words comprise two or more characters via compounding and have a transparent morphological structure (e.g., 花 and 環/环can combined to form the word 花環/花环, *wreath*, /faa1waan4/) (Su, 2001). In this study, we use word reading to denote both single- and multiple-character reading.

Development of Decoding Skills in Chinese

As for the complex Chinese orthographic features, a substantial body of research has applied the SVR model to evaluate the relative importance of decoding against linguistic comprehension for Chinese reading development. In their meta-analytic review of studies with native-speaking Chinese children, Peng et al. (2021) found strong support for SVR application in explaining Chinese reading development. Also, decoding, as an ability of character/word recognition, had a greater contribution, relative to linguistic comprehension, to Chinese reading comprehension in the early primary grades (Grades 1 and 2). Using the model to investigate CSL senior-primary students' reading comprehension, Wong (2019) found that decoding skills, comprising both orthographic knowledge and word reading, had a greater influence on reading comprehension throughout Grades 4 and 6. The prolonged, stronger decoding influences were attributed to the underdeveloped character knowledge of the CSL learners. As for the importance of decoding, one of the aims of our intervention was to develop the CSL students' code-related orthographic skills and morphological knowledge, identified by previous studies (McBride, 2016), to facilitate word reading.

Chinese orthographic skills, the ability to reflect on and manipulate the orthographic structures of Chinese characters (Wei et al., 2014; Yeung et al., 2013), are closely associated with reading development in CSL (Shen & Ke, 2007) and native Chinese-speaking learners (Cheung et al., 2006; Ho et al., 2003; Yeung et al., 2013). Among these skills, the learners' awareness and use of linguistic information carried by radicals have been particularly facilitative to their literacy development. CSL students displayed radical processing when reading Chinese characters (Tong & Yip, 2015). The students' radical knowledge is pivotal in their character learning and reading comprehension (Shum et al., 2014; Wong, 2017, 2019). Studies of alphabetic languages have found a close relationship between morphological knowledge and decoding skill (Nation, 2019). Similarly, research on Chinese literacy acquisition has highlighted the importance of morphological awareness, which involves the ability to analyse and use morphological information (McBride & Wang, 2015). Particularly, learners' ability to manipulate compound word structures and distinguish homophones/homographs accounts for variances in Chinese vocabulary (McBride-Chang et al., 2008) and word reading skills (Liu & McBride-Chang, 2014; McBride, 2016). Wong and Zhou (2022) found that orthographic and morphological awareness contributed directly to CSL learners' word reading and copying and indirectly to spelling. In sum, the findings of these studies consistently indicate the influential role of orthographic skills and morphological knowledge in Chinese literacy acquisition. These

findings align with the lexical consistency model proposed by Perfetti and his colleagues that the mental lexicon constitutes orthographic, phonological and semantic properties (Perfetti & Liu, 2006), whose quality is related to reading performance (Perfetti, 2007). Expanding the SVR model, Tunmer and Hoover (2019) also emphasised that beginning readers of alphabetic languages draw on alphabetical and morpho-phonemic knowledge to develop alphabetic coding skills for successful word recognition.

Developing Linguistic Comprehension for Chinese Reading

The linguistic comprehension component postulated in the SVR model refers to a broad spectrum of oral language skills, for example, vocabulary and listening comprehension, supporting the comprehension of both spoken and written materials (Duke & Cartwright, 2021; Nation, 2019; Tunmer & Hoover, 2019). This aligns with the understanding and research findings that oral language provides the essential foundation for early literacy acquisition and development in both L1 and L2 learners (Bialystok, 2007; Joshi, 2018; NICHID, 2005). As Peng et al. (2021) identified, the effects of linguistic comprehension on reading comprehension remained stable across primary grades in native Chinese-speaking children. For example, Joshi et al.'s (2012) study with Chinese primary students found that students' listening comprehension, a skill often taken as an operationalisation of linguistic comprehension, contributed to their reading comprehension across grade levels. Similarly, Wong (2017, 2019) found that CSL students' listening comprehension, against word reading, accounted for a unique portion of the variance in reading comprehension. Wong (2021) further discerned substantial reciprocal relationships between the CSL learners' reading and listening comprehension development from Grade 4 to 6: the two skills predicted each other uniquely and consistently throughout the 3 years as against their respective strong autoregressive effects. These findings suggest that listening comprehension, as an indicator of oral language skills for linguistic comprehension (Nation, 2019), is important for students' Chinese literacy development.

Intervention Studies Promoting Chinese Reading

Existing intervention studies support the effectiveness of promoting decoding and linguistic comprehension to facilitate reading development in native-speaking and CSL learners. As for the code-focused decoding skills, similar to phonics instruction and morphological analysis used by interventions in alphabetic languages (Al Otaiba et al., 2022; Silva-Maceda & Camarillo-Salazar, 2021), several interventions have been developed to enhance learners' Chinese orthographic and morphological knowledge. Due to the complexity of Chinese orthography, most of them emphasised explicit instruction on the radical's form and function and were thus referred to as the 'radical-based approach to literacy acquisition' in the literature (Ho et al., 2003; Ho et al., 2012). Particularly, for CSL learners, the presentation of compound characters sharing the same radicals in groups (Taft & Chung, 1999; Xu et al., 2014) and elaboration on the characters' structure (with highlights on the constituent radicals) (Chang et al., 2014; Shen, 2004; Wang et al., 2004) promote better character learning and retention. Apart from an analytic instruction approach, some researchers have established the usefulness of character copying exercises, through which Chinese learners could obtain a better understanding of characters' internal structures (Guan et al., 2011), in promoting Chinese literacy (Lau et al., 2020; Wang et al., 2018; Wang & McBride, 2017).

As for the transparent morphological structure of Chinese words, promoting morphological awareness is an effective instructional strategy (McBride, 2016). Other than copying exercises, both Lau et al. (2020) and Wang and McBride (2017) had elements of morphological knowledge in their programmes, including characters' orthographic shape-to-meaning instruction, morphological analysis of compounding words, and/or learning of words sharing the same characters, facilitating their word reading and writing. In Wu et al.'s (2009) study, Grade 1 students in the treatment group were taught not only the morphological word structures but also the grapho-morphological character structures (i.e., the position regularities and linguistic functions of semantic radicals). By Grades 2 and 3, they showed greater improvement in morphological knowledge and reading performances.

In alphabetic language reading intervention studies, those targeting meaning-focused comprehension improvement typically include instruction on vocabulary, oral language and listening comprehension (Al Otaiba et al., 2022; Melby-Lervåg & Lervåg, 2014; Silva-Maceda & Camarillo-Salazar, 2021). Although there are fewer intervention studies on improving linguistic comprehension in Chinese learning, similar strategies have been found effective. For example, Liu (2020) identified the inadequacy of purely metacognitive strategy training in promoting adult CSL learners' listening comprehension, while Zhou (2021), using dialogic reading cum multisensory learning methods, successfully enhanced CSL kindergarteners' literacy skills by providing them oral language training and a meaningful linguistic context. Reviewing experimental studies aimed at improving the reading comprehension of students with specific problems in linguistic comprehension, Lee and Tsai (2017) established the effectiveness of using multiple strategies, including those targeting oral language and metalinguistic ability, to ameliorate the students' reading performances.

The Present Study

Given the above research findings, we developed an intervention programme to facilitate the Hong Kong CSL primary students' Chinese reading development by cultivating the above-stated foundational linguistic skills. The 'Foundational Literacy Skills Instruction', referred to as 'Foundational Instruction' hereafter, is a 'three-pronged approach' that teaches two SVR component skills, (1) code-focused word reading and (2) meaning-focused listening comprehension, combined with an additional emphasis on (3) Chinese orthographic knowledge to support word reading. Regarding the focus on orthographic knowledge, the instruction aligned with the 'radical-based' Chinese literacy instruction (e.g., Chang et al., 2014; Ho et al., 2012; Shen, 2004, p. 201), which stressed teaching the form and function of radicals and used it as a basis for developing an instructional package's learning content. The SVR model was adopted as the conceptual framework for the intervention development, emphasising a balanced approach to both code- and meaning-focused skills (Al Otaiba et al., 2022). As the two kinds of skills are related (Duke & Cartwright, 2021; Nation, 2019), the respective instructional components of the intervention were developed in a complementary manner, similar to SVR intervention studies in alphabetic languages (e.g., Silva-Maceda & Camarillo-Salazar, 2021). While no direct instruction on reading comprehension was provided, it was expected that the students' reading comprehension to be improved indirectly by their enhanced component skills, as per the SVR model.

This Foundational Instruction incorporates teaching orthographic and morphological knowledge identified as effective through research on Chinese literacy acquisition (Ho et al., 2012; McBride, 2016; McBride & Wang, 2015; see the above review of Chinese

intervention studies). This differs from the conventional approach adopted in Hong Kong's early Chinese literacy classrooms, relying on the 'look and say' method and copying exercises (Zhang & McBride-Chang, 2011). In the conventional classroom, the students receive short pieces of Chinese text containing some novel characters and words. They are then taught the meanings and pronunciations of the characters/words, accompanied by copying exercises and repeated oral recitations for consolidation, with little explanation of the orthographic structure (Lam & McBride, 2018; Li et al., 2019). Notably, there is no phonological coding system, such as *Hanyu Pinyin* for Mandarin used in Mainland China, provided in Hong Kong's Chinese language lessons, making repeated exposure to characters even more important for students in learning to read and write. This conventional approach was also widely adopted in the ethnic minority students' Chinese literacy instruction as most of their Chinese teachers were mainstream teachers without formal CSL instruction training. Most CSL teachers are reportedly unfamiliar with students from different linguistic backgrounds or with corresponding instructional techniques (Tsung et al., 2010).

Within this educational context, we introduced the Foundational Instruction in five primary schools enrolling a substantial ethnic minority student population. The students have been learning Chinese and English as second languages in the schools, both official languages in Hong Kong and taught as major subjects with ample instruction time. Compared with their native Chinese-speaking counterparts, the ethnic minority students are relatively strong in English but weak in Chinese. Hence, schools use English as the medium of instruction and develop a school-based Chinese language curriculum with simpler learning materials. Chinese literacy instruction usually adopts the conventional approach, as mentioned above. This study aimed to evaluate the effectiveness of the three-pronged Foundational Instruction against the conventional approach in promoting students' reading through the instruction focusing on Chinese orthographic knowledge, character recognition and listening comprehension. We would evaluate the pre- and post-test performance of students using a range of Chinese language assessments and analyse the direct and indirect treatment effects using an SVR path model. The findings would facilitate the development of effective CSL literacy instruction.

Methods

Participants

Participants comprised 186 Grade-4 ethnic minority students in Hong Kong recruited from five government-aided primary schools with a substantial proportion of ethnic minority students. The students, most of whose families had origins in South Asian countries, speak different native languages and have been learning both English and Chinese as a second language (see Introduction for the language education context of these schools). The schools designated the treatment group to fit their respective academic and curricular arrangements. Specifically, in each participating school, one class was chosen to incorporate the intervention in the Chinese curriculum while the other classes kept to the original curriculum with the conventional approach, particulars those presented above. The schools confirmed that they did not practice ability grouping, and there were no apparent differences in academic ability between the classes. Details about the intervention implementation are provided below. Table 1 presents the demographic data of the two groups. The two groups were comparable in terms of the number of students, age, gender distribution and ethnicity distribution (both groups had more than

90% of students of South Asian origin). One school (School B) had only one Grade-4 class, and thus, none were available to serve as the control.

Intervention Materials and Procedures

The Foundational Instruction is a three-pronged design aimed at enhancing the students' Chinese orthographic knowledge, word recognition and listening comprehension to facilitate their reading comprehension. The instruction was implemented in the treatment-group students' Chinese lessons, in a series of eight learning units, by their teachers for a school year. The instruction is radical-based (Ho et al., 2003; Ho et al., 2012; Xu et al., 2014), with the learning units developed from a core learning content of 28 simple characters, which are productive both as constituent radicals in generating compound characters and as constituent characters in generating compound words; 17 of them are among the 20 most frequently used semantic radicals (Zhou, 2018). The units have a similar structure whereas, as per unit, the learning content was developed progressively, in terms of linguistic units, from (1) three to four simple characters/radicals to (2) compound characters consisting of the radicals (three or four characters for each radical with a total of 9–16), (3) word compounds or phrases (three or four words/phrases for each character with a total of 9–16), and (4) orally presented passages incorporating some of the targeted characters, words and phrases. Key Chinese orthographic and morphological knowledge, details to be provided in the following, were included across the learning units. The whole set of simple characters/radicals and selected compound characters, words, phrases and orthographic and morphological knowledge are provided in Appendix A; while a written version of

TABLE 1. Demographic data of the treatment and control groups.

	Treatment group	Control group
Number of students	96	90
Average age by Time 2 (range)	9.24 (8.46–11.42) years	9.20 (8.46–11.19) years
Gender		
Female	50 (52.1%)	39 (43.3%)
Male	46 (47.9%)	51 (56.7%)
Born in Hong Kong	75 (78.13%)	66 (73.3%)
Ethnicity		
Indian	9 (9.38%)	16 (17.78%)
Nepalese	45 (46.88%)	25 (27.78%)
Pakistani	35 (35.42%)	41 (45.56%)
Others	7 (7.29%)	8 (8.89%)
School		
School A	18 (18.8%)	32 (35.6%)
School B	28 (29.2%)	0 (0%)
School C	14 (14.6%)	11 (12.2%)
School D	27 (28.1%)	43 (47.8%)
School E	9 (9.4%)	4 (4.4%)

an orally presented passage is provided in Appendix C. The learning content of the radical-based instructional package in terms of the three instructional focuses of the Foundational Instruction is presented in Table 2 and deliberated in the following.

Orthographical Knowledge

As a radical-based Chinese literacy instruction (Ho et al., 2003; Ho et al., 2012), our instruction adopted a systematic and analytic approach to improving students' knowledge of Chinese radicals. The students were introduced to a well-defined knowledge base of basic Chinese literacy. Simple Chinese characters with high learning priorities constituted the core content of the instructional package. These characters were productive as radicals to form a large number of compound characters. For example, 心 and its radical variant form 忄 (a heart, /sam1/) generates 態/态 (form/condition, /taai3/) and 快 (fast, /faai3/); 艸[2] and its radial variant form ⺾ (plant, /cou2/) generates 草 (grass, /cou2/) and 苗 (sprouts, /miu4/). Moreover, when the compound characters were introduced, the students received instruction on basic concepts and knowledge of Chinese literacy, including different formal structures of compound characters (e.g., left–right structure of 快 and top-down structure of 苗) and positional regularity of semantic/phonetic radicals within a character. Once these high-priority simple characters and basic concepts were taught, the students were instructed on the concept of the radical to facilitate learning the majority of the compound characters (e.g., 態/态, 快, 草, 蔭). Samples of the orthographic knowledge tasks are attached as Appendix B. Additionally, copying exercises, a learning activity found beneficial to Chinese reading (Guan et al., 2011; Wang et al., 2018), for all targeted characters were provided for consolidation.

Word Reading

The students' word reading was facilitated by instructions on simple and compound characters, along with orthographic and morphological knowledge. The orthographic part, as explained above, aimed to enhance the students' ability to identify and use the linguistic information carried by a character and its componential radicals. The morphological part includes instruction on the orthographic form-to-meaning connections and morphological analysis of words and phrases (Wang & McBride, 2017; Wu et al., 2009). The form-to-meaning connections were emphasised, given the Chinese orthographic feature that most high-learning-priority simple characters are pictograms. The students received pictorial illustrations (e.g., a picture of a heart for 心) and elaborations of the character form evolution, highlighting the orthographic forms useful in differentiating homophones. Regarding the morphological analysis, it was highlighted that most of these characters were also productive as morphemes in generating a large volume of compound words and phrases—another Chinese linguistic feature. For example, 心 generates 小心 (careful, /siu2saam1/) and 心曠/旷神怡 (refreshing, /saam1kwong3san4ji4/), while 草 generates 青草 (green grass, /cing1cou2/) and 樹/环苗 (sapling, /syu6miu4/). Activities and exercises were provided to strengthen the students' knowledge of morpheme and morphological construction awareness by comparing compound words/phrases sharing the same morpheme. Samples of the morphological knowledge tasks are attached as Appendix B.

Listening Comprehension

Teaching characters, words and phrases would support the students' listening comprehension by expanding their oral vocabulary. Moreover, in each learning unit, the students were

TABLE 2. Structure and content of the instructional package's learning units.

Unit Structure	Learning content		
	Orthographic knowledge	Word reading	Listening comprehension
1. Simple character/core radical (e.g., 心, 艸)	• Radical variant forms of the simple characters and their meanings	• Simple character reading • Orthographic form-to-meaning connections • Use of the linguistic information carried by radicals	• Simple characters as oral vocabulary
2. Compound character (e.g., 快, 苗)	• Formal structures of compound characters • Positional regularity of radicals	• Compound character reading	• Compound characters as oral vocabulary
3. Word compound/phrase (e.g., 小心, 樹/环苗)		• Word reading • Morphological analysis of words and phrases	• Words and phrases as oral vocabulary
4. Orally presented passage	• Linguistic context for orthographic knowledge	• Linguistic context for word reading	• Listening comprehension skills

orally presented with a story, provided with the written text for the teachers' ease of reference, containing most of the targeted Chinese characters and words of the unit. For example, incorporating words/phrases containing the simple characters of 日, 心, 草 and compound characters with their respective radiant forms as 日, 忄, 艹, a story entitled 'I love the countryside' (about a family joining a plantation activity held in the countryside) was developed. The written version of the story and the listening comprehension questions, with illustrations, are attached as Appendix C for reference. Referring to the effective strategies for enhancing linguistic comprehension in the literature (Lee & Tsai, 2017; Melby-Lervåg & Lervåg, 2014), the stories provided a context for the targeted orthographic knowledge and characters/words and served two learning purposes: (1) enhancing the students' listening comprehension skills and (2) exposing them to a range of oral vocabulary and phrases. Teachers were provided questions to assess if the students understood the meaning of the oral story and consolidate the learned oral vocabulary.

To facilitate the implementation, the teachers received packages of instructional and learning materials, such as lesson plans, texts, worksheets and PowerPoint slides (for classroom presentation). Each learning unit had an instructional time of a lesson of 30–40 min and two to three sets of exercises assigned to the students as homework. The learning time of the students was about 60 min per unit. The eight learning units were evenly distributed across the school year, with four units being taught in the first school term (from September to January) and the other four in the second term (from February to June). For the control group's classes, the original curriculum was used, and the business-as-usual instruction (conventional exercises/activities) was provided. We conducted several school visits during the school year to ensure intervention fidelity.

Assessment Measures and Procedures

We administered a range of linguistic measures covering Chinese orthographic knowledge, word reading, listening comprehension and reading comprehension to both groups before and after the treatment as pre-post-tests. The Time-1 (T1) assessment was conducted at the beginning of the school year in September while the Time-2 (T2) assessment was conducted at the end of it from June to July. While the Foundational Instruction contained a component to enhance the participating students' morphological awareness for better word reading, we did not have a measure for morphological knowledge/skills; the effect of enhanced morphological awareness is assumed to be implicated in the students' word reading. We also assessed their nonverbal reasoning skills and vocabulary as the control variable only before treatment. The research team, led by the researchers and assisted by undergraduate students from the researchers' affiliated institution, conducted on-site data collection. The respective school teachers also helped administer the test. The data collection procedures were similar for both time points and lasted approximately 2 hours each day at each school. A Chinese orthographic knowledge test, a listening comprehension test, and a reading comprehension test were conducted first in a group, followed by individual tests, including Raven's test of nonverbal reasoning, a Chinese vocabulary test, and a word reading test. The written test items and instructions were presented in traditional Chinese script while the oral test items and instructions, such as those in the listening comprehension and oral vocabulary tests, were communicated in Cantonese. Clarifications in English were provided if needed.

Nonverbal Reasoning

The students' nonverbal reasoning was assessed using Raven's Progressive Matrices Test sets B and C (Raven, 1960). There were 24 multiple-choice items requiring the students to complete patterns with a missing element. The test was conducted in T1 only.

Vocabulary

A Chinese vocabulary test was developed per the Peabody Picture Vocabulary Test-Third Edition (Dunn & Dunn, 1997), assessing the students' receptive vocabulary by requiring them to match a picture with the meaning of an orally presented word (10 items), expressive vocabulary by requiring them to name a picture of an object or a scenario (12 items) and vocabulary definitions by requiring them to provide definitions to the orally presented words (10 items). In each part, the experimenter stopped the test if a student failed five consecutive items. The test was conducted in T1 only.

Orthographic Knowledge

The measures of orthographic knowledge have been adopted from a previous study with young CSL learners as participants (Wong, 2017). All targeted characters used in this test were rarely used and unknown to the students. The test comprises two sections. In section 1, the students' visual-orthographic sensitivity was assessed, and they were required to decompose a compound character into two immediate componential radicals, for example, to decompose 薪 into the semantic radical 艸 and the phonetic radical 新. In section 2, the students had to match a picture with a novel character, among four options, using their knowledge of semantic radicals. For instance, for the item with a picture of a sunrise, students should choose 曦 (sunrise, /hei1/) with the semantic radical 日 (indicating the sun) instead of the other two options, 羲 (name of an emperor, /hei1/) and 犧 (sacrifice, /hei1/), which share the phonetic radical 羲 (/hei1/) with the target character but do not match the picture. The orthographic awareness tests used in T1 and T2 had the same format and item distribution but contained different items.

Chinese Word Reading

We used the Chinese word reading test that has been successfully used in CSL studies (Wong, 2019). This test uses a total of 100 characters, with 50 single-character items and the rest forming 25 two-character word items. According to Pan and Kang (2003), all Chinese characters chosen are at the Grade 1 level of Hong Kong primary schools. In addition, all words used are at the grade one/two level according to a basic Chinese word list for Hong Kong primary students (Chinese Language Education Section of the Hong Kong Education Bureau, 2008). We tested the students individually. They were asked to read out each item under the test administrators' instructions. The word reading tests used in T1 and T2 had the same format and item distribution but different items.

Listening Comprehension

Listening comprehension tests assessed the students' Chinese linguistic comprehension ability. They were asked to answer multiple-choice questions based on listening materials. The T1 and T2 tests comprised different items picked up from two existing tests, that is, a local standardised test called the Hong Kong Attainment Test (HKAT) (Educational

Research Section of the Hong Kong Education Department, 1989a, 1989b) and a school-based test meant specifically for ethnic minority students in junior primary levels (Curriculum Development Institute of the Hong Kong Education Bureau, 2011). Considering the lower Chinese proficiency of the ethnic minority participants, we included items from the HKAT at Grade 1 or 2 levels of Hong Kong primary schools.

Reading Comprehension

The reading comprehension assessment evaluated the students' comprehension of literacy materials at both the sentence and passage levels. The sentence-level items were presented in multiple-choice or cloze format and required the students to complete sentences, whereas the passage-level items required the students to answer questions about short passages. Similar to the listening comprehension tests, both T1 and T2 tests comprised different items picked up from the HKAT and school-based test at Grade 1 or 2 levels (Curriculum Development Institute of the Hong Kong Education Bureau, 2011; Educational Research Section of the Hong Kong Education Department, 1989a, 1989b).

Statistical Analysis

We examine the intervention's treatment effects in two steps: first, pre- and post-*t*-tests for group differences and, second, a path analysis as the major assessment for treatment effects. The pre-test provided information on differences between the treatment-group and control-group students across the range of Chinese language and literacy abilities assessed by the study while the post-test provided an elementary evaluation of group differences for

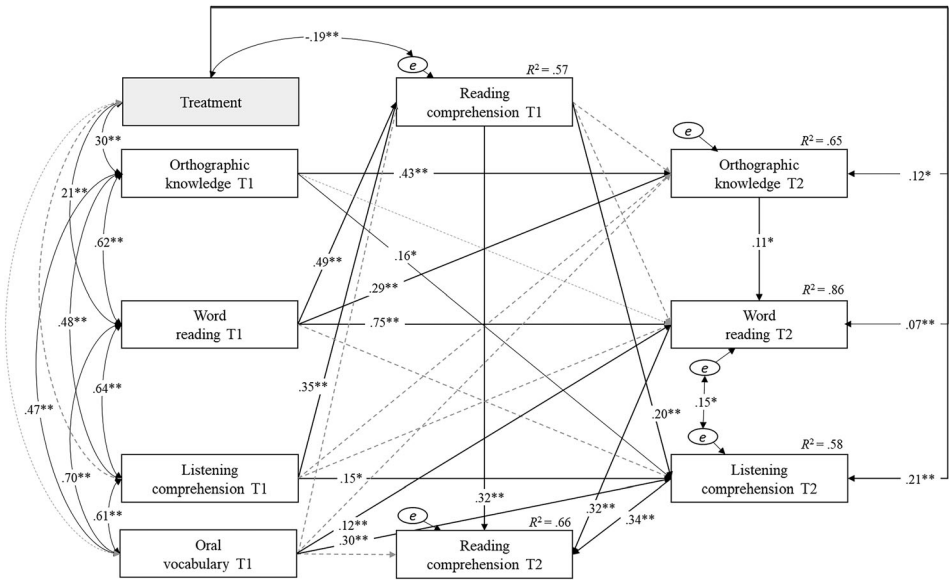

FIGURE 1. A path model of the treatment effects on Chinese-as-a-second-language reading development using the simple view of reading model. *Note*. Age and Raven's test for intelligence were entered as control variables in the model. T1: Time 1; T2: Time 2. For differentiation's sake, the statistically nonsignificant relationships are shown in grey, broken lines. $^{**}p < 0.01$, $^{*}p < .05$.

treatment effects. Next, as shown in Figure 1, a path model using the simple view of the reading framework was specified to examine the associations between the variables and evaluate the treatment effects. In both pre- and post-treatment points (Times 1 and 2), the students' reading comprehension performance was predicted by word reading and listening comprehension. As the code-related orthographic knowledge is postulated to support word reading, it was included in the model as a predictor that indirectly affects reading comprehension via word reading in Time 2. As for a lack of randomised design (the schools decided the group designation), all these variables' autoregressive and cross-lagged effects across the year were specified to control for confounding factors: the autoregressive effects are the effects of the students' respective competence level at Time 1 affecting their later performance at Time 2 (e.g., effect of Time-1 word reading on Time-2 word reading), while the cross-lagged effects specified the longitudinal effects across variables (e.g., effects of Time-1 orthographic knowledge and listening comprehension on Time-2 word reading) (Adachi & Willoughby, 2015; Selig & Little, 2012). Age, nonverbal reasoning, and vocabulary were included as control variables. The treatment effects were specified for all three target skills at Time 2 as a dummy variable (named 'Treatment'), designating the treatment group and control as 1 and 0, respectively.

Results

Descriptive Statistics and Correlations

Table 3 provides the descriptive statistics and Cronbach's alpha for the reliability of all measures. The reliabilities of the measures were generally acceptable; the comprehension tests had lower alpha values (ranging from 0.61 for T1 listening comprehension to 0.75

TABLE 3. Alpha values and descriptive statistics for all measures used in the study (N = 186).

Measures (max score)	Alpha	Range	Mean	*SD*	Skewness	Kurtosis
Raven's test (24)	.80	6–23	15.15	4.19	−.40	−.73
Oral vocabulary T1 (64)	.87	2–51	17.40	9.39	.79	.65
Listening comprehension T1 (32)	.61	2–28	12.37	5.40	.70	.22
Orthographic knowledge T1 (32)	.81	5–31	20.29	5.47	−.09	−.50
Word reading T1 (100)	.98	2–96	30.98	22.32	.88	−.03
Reading comprehension T1 (30)	.66	2–29	9.77 (3.59)[#]	4.19 (.91)[#]	1.69 (.82)[#]	4.39 (.54)[#]
Listening comprehension T2 (62)	.82	10–59	28.44	10.94	.65	−.19
Orthographic knowledge T2 (32)	.84	5–32	22.19	5.71	−.51	−.22
Word reading T2 (100)	.98	2–99	37.99	25.23	.43	−.92
Reading comprehension T2 (35)	.75	3–31	12.41 (3.96)[#]	5.25 (1.02)[#]	1.10 (.76)[#]	1.21 (.35)[#]

Note: T1: Time 1, T2: Time 2.
[#]The value in the blanket is after the square root transformation.

TABLE 4. Partial correlations among measures after controlling for Raven's test and age (N = 186).

Variables	1	2	3	4	5	6	7	8
1. Oral vocabulary T1	—							
2. Listening comprehension T1	.61**	—						
3. Orthographic knowledge T1	.48**	.46**	—					
4. Word reading T1	.71**	.64**	.61**	—				
5. Reading comprehension T1	.51**	.64**	.53**	.69**	—			
6. Listening comprehension T2	.62**	.57**	.55**	.62**	.56**	—		
7. Orthographic knowledge T2	.50**	.52**	.71**	.66**	.50**	.55**	—	
8. Word reading T2	.70**	.58**	.61**	.91**	.62**	.65**	.68**	—
9. Reading comprehension T2	.53**	.55**	.49**	.70**	.68**	.69**	.50**	.70**

**$p < .01$.

TABLE 5. Results of t-test on the differences between treatment and control group students' test performances.

	Group				t-test	
	Treatment (N = 96)		Control (N = 90)			
Measure	M	SD	M	SD	t (df = 184)	95% CI for mean difference
Time 1						
Raven's test	15.59	4.03	14.68	4.33	1.50	−0.29, 2.13
Oral vocabulary	18.33	8.47	16.41	10.24	1.40	−0.79, 4.63
Listening comprehension	12.86	5.06	11.84	5.72	1.29	−0.54, 2.58
Orthographic knowledge	21.75	5.04	18.73	5.51	3.90**	1.49, 4.54
Word reading	35.61	20.62	26.03	23.11	2.99**	3.25, 15.91
Reading comprehension	3.63	0.83	3.55	0.99	0.57	−0.19, 0.34
Time 2						
Listening comprehension	31.77	9.94	24.89	10.89	4.51**	3.87, 9.90
Orthographic knowledge	23.99	4.52	20.28	6.23	4.63** [1]	2.13, 5.30
Word reading	44.81	23.18	30.71	25.41	3.95**	7.07, 21.15
Reading comprehension	4.10	0.95	3.80	1.08	1.99*	0.002, 0.59

[1]t-Test of the mean difference without group equal variances (df = 161.70).
**$p < .01$,
*$p < .05$.

for T2 reading comprehension) while those of the other tests were at the higher end (ranging from 0.87 for T2 vocabulary to 0.98 for T1 and T2 word reading). As the distributions of both T1 and T2 reading comprehension scales were relatively positively skewed and leptokurtic, square root transformation was applied to fulfil the normalcy assumption. The transformed scales were used in subsequent analyses. Table 4 presents the partial correlations among all the linguistic measures controlling for age and nonverbal reasoning. All correlations were statistically significant at the .01 level.

Group Comparisons

A series of *t*-tests evaluated the treatment and control groups' performances in pre-test Time 1 and post-test Time 2. Table 5 presents the results. By Time 1, the treatment group and control group were comparable in terms of nonverbal reasoning, Chinese oral language competencies (including oral vocabulary and listening comprehension), and reading comprehension; however, the treatment group performed better in orthographic knowledge and word reading. The results suggested that the two groups had comparable general intelligence and Chinese oral skills, but their differences in literacy skills at the character level had to be considered, such as controlling for their autoregressive effects (Adachi & Willoughby, 2015), when evaluating the treatment effects. As for a preliminary comparison between the performances of the two groups after a year, the T2 results showed that the treatment group outperformed the control group in all measures, including listening and reading comprehension. Notably, (1) the treatment-group students' advantages in orthographic knowledge and word reading remained substantial; (2) their progress in listening comprehension was remarkable compared with the control group, resulting in a substantial margin in test performance over the latter; and (3) their advantage in reading comprehension over the control group was modest but statistically significant.

Path Analysis for Treatment Effects

Next, a path model using the SVR framework was estimated to evaluate the direct and indirect treatment effects on the students' CSL reading development while controlling for all the variables' autoregressive and cross-lagged effects over the year (Figure 1). A statistically significant correlation between the error terms of T2 word reading and listening comprehension was present and specified in a remodelling. The finalised model showed a good fit: $\chi^2(7) = 10.42$, $p = .17$, comparative fit index (CFI) = 0.99, standardized root mean square residual (SRMR) = 0.01, root mean square error of approximation (RMSEA) = 0.05, 90% confidence interval (CI) [0.00, 0.11], PCLOSE = 0.42. The model explained 57% of the T1 reading comprehension variance and 66% of the T2 reading comprehension variance and provided support for the applicability of SVR to CSL reading comprehension (Wong, 2017, 2019). Moderate to strong autoregressive effects of all variables and significant cross-lagged effects between some variables were present. There were substantial cross-lagged/reciprocal effects (1) from T1 orthographic knowledge to T2 listening comprehension (β = .16); (2) from T1 word reading to T2 orthographic knowledge (β = .29); and (3) from T1 reading comprehension to T2 listening comprehension (β = .20).

The treatment effects were evaluated first by comparing the model with one that set the treatment effects at null, resulting in a major deterioration in model fit $\chi^2(10) = 34.42$, $p = .00$, CFI = 0.99, SRMR = 0.03, RMSEA = 0.12, 90%CI [0.07, 0.16], PCLOSE = 0.01. The model fits were significantly different between the two models, $\chi^2(3) = 23.99$, $p = .00$, indicating the presence of treatment effects. Given modest to strong autoregressive and cross-lagged effects between the linguistic variables, there were still statistically significant, positive direct treatment effects on all target skills (i.e., orthographic knowledge, word reading and listening comprehension) at Time 2. By design (Figure 1), there were indirect treatment effects on both word reading and reading comprehension in Time 2. A bootstrap estimation approach was adopted to evaluate these direct and total (including indirect effects) treatment effects in the model. Table 6 presents the results of the bootstrapping method with 2000 samples. Here, in terms of standardised regression effects,

TABLE 6. Standardised regression weights of the direct and total treatment effects in the path model.

	β	*SE*	95%*CI*	*P*
Direct effects				
Orthographic awareness T2	.12	0.05	0.02, 0.21	<.05
Character reading T2	.07	0.03	0.01, 0.13	<.05
Listening comprehension T2	.21	0.05	0.11, 0.31	<.01
Total effects[1]				
Character reading T2	.08	0.03	0.02, 0.15	<.01
Reading comprehension T2	.10	0.03	0.05, 0.16	<.01

Note. T2: Time 2.
[1]The total treatment effects on orthographic awareness and listening comprehension at Time 2 were equal to the respective direct effects.

the total treatment effects on Chinese orthographic knowledge (β = .12, 95% CI [0.02, 0.21]), word reading (β = .08, 95% CI [0.02, 0.15]), listening comprehension (β = .21, 95% CI [0.11, 0.31]), and, indirectly via these component skills, reading comprehension (β = .10, 95% CI [0.05, 0.16]) were all statistically significant. Listening comprehension had notable treatment effects while those on orthographic knowledge, word reading and reading comprehension were modest against their respective strong autoregressive effects. It should be noted that, as autoregressive models generally rendered a substantial reduction of effect magnitude for their controlling of past levels of the outcome (Adachi & Willoughby, 2015) and our model also controlled for these variables' longitudinal cross-lagged effects and the effects of age, nonverbal intelligence and oral vocabulary, these treatment effects, although small in size, were meaningful and significant.

Discussion

This study evaluated the effectiveness of the Foundational Instruction, a CSL intervention programme adopting the SVR model as a theoretical underpinning, in enhancing the reading attainments of young CSL learners by promoting their word reading and listening comprehension skills directly and reading comprehension indirectly. Aligning with findings of intervention studies in alphabetic languages (Al Otaiba et al., 2022; Melby-Lervåg & Lervåg, 2014), the results of both the *t*-test and path analysis supported (1) the usefulness of the SVR model as a conceptual framework in developing CSL reading instruction, and (2) given the substantial autoregressive and cross-lagged effects (Adachi & Willoughby, 2015), the effectiveness of the Foundational Instruction in developing students' Chinese reading comprehension by promoting its component skills as deliberated by the model, with a modest but meaningful treatment effect. To facilitate CSL learners' reading development, teachers may focus on the foundational skills vital to comprehension, including code-related word reading and meaning-related linguistic comprehension skills, at a certain stage of their learning and explicitly teach the structural properties of the Chinese language and use them as guiding principles for developing learning content.

Intervention studies in alphabetic languages supported teaching code-focused skills, including orthographic and morphological knowledge, to enhance learners' word recognition

for reading comprehension (Al Otaiba et al., 2022; Nation, 2019; Tunmer & Hoover, 2019). Likewise, aiming at improving students' reading comprehension via better word reading, this study implemented the Foundational Instruction intervention by highlighting orthographic and morphological awareness as crucial components of Chinese literacy acquisition. Following the findings of the importance of orthographic skills for Chinese word reading (e.g., Wei et al., 2014; Wong, 2017, 2019), path analysis provided support for the effectiveness of the Foundational Instruction on orthographic knowledge, with a β coefficient of 0.12, 95% CI [0.02, 0.21], even after controlling for the substantial autoregressive effect of students' prior achievements (β = .43), the cross-lagged effect from T1 word reading (β = .29), and the effects of other variables such as T1 oral vocabulary and reading comprehension. Aligned with Tunmer and Hoover's (2019) elaboration on the SVR model and Perfetti's (2007) lexical quality hypothesis, the findings supported the indirect influence of orthographic skills on reading comprehension via word reading. The findings suggested that explicit instruction on orthographic knowledge improves students' awareness of manipulating the visual information and character structures, thereby enhancing their character learning and, indirectly, reading comprehension. This finding aligns with previous intervention studies on the effect of explicit orthographic instructions on native Chinese learners (Ho et al., 2012) and naïve and beginner CSL adult learners (Chang et al., 2014; Wang et al., 2004). Orthographic awareness can be acquired through repeated exposure to printed materials, explaining the aforementioned reciprocal influences of T1 word reading on T2 orthographic knowledge as shown in our model (see Figure 1). However, CSL learners benefit less efficiently from implicit learning (Wang et al., 2004). We observed as much in the young CSL learners in our study, who might be limited in their ability to acquire orthographic knowledge implicitly owing to their limited exposure to Chinese literacy. Hence, explicit instruction may be even more helpful.

In addition, the direct treatment effect on word reading (β = .08, 95% CI [0.02, 0.15], together with the findings of previous studies (Wang & McBride, 2017; Zhou et al., 2012), implied a potential contribution of morphological awareness to CSL learners' word reading. Although, as for word reading's strong autoregressive effect (β = .75) and the effect from oral vocabulary (β = .12), the total treatment effect was rather weak. Like orthographic skills, morphological awareness can promote word reading because of its contribution to learners' lexical quality (Liu et al., 2017; Nation, 2019; Perfetti, 2007; Wang & Liu, 2020). This is particularly true for Chinese language learners as for the language's transparent morphological structure (McBride & Wang, 2015). We recognised that the assumed enhancement of the students' morphological awareness extrapolates the results, as our study did not measure morphological skills. However, per the findings of intervention studies by Lau et al. (2020) and Wu et al. (2009), instruction on the characters' shape-to-meaning connections, grapho-morphological analysis of characters (i.e., knowledge of semantic radicals), and morphological analysis of words and phrases were beneficial to the students' word reading. As the participating teachers confirmed, the analytical approach to characters, words and phrases was especially facilitative in developing the CSL learners' repertoire of Chinese written expressions.

We also observed the facilitative effect of copying on Chinese literacy acquisition (Guan et al., 2011; Lau et al., 2020; Wong et al., 2023); character copying remains an important method for consolidating students' orthographic representations and character/word learning. It is important to note that the treatment-group students in our study had an advantage in orthographic knowledge and word reading, which may have resulted in a positive Matthew effect, where initial advantages lead to cumulative advantages in their reading

development (Stanovich, 1986). However, studies by Huang et al. (2014) and Kempe et al. (2011) suggest that the Matthew effects in reading development, especially in skills such as decoding and spelling at the word level, were limited. Additionally, our study mitigated the confounding effects of previous reading achievements by including autoregressive and cross-lagged effects of all variables. Unlike previous short-term intervention experiments (Chang et al., 2014; Taft & Chung, 1999; Wang et al., 2004), the present study verified a long-term systematic-progressive approach. Students learned from simple characters to compound characters and from characters to words based on orthographic and morphological rules. A well-defined basic Chinese literacy knowledge core should be enhanced first to prepare students to acquire compound characters and words later.

Among the reading comprehension components, the strongest treatment effect was observed in listening comprehension with a β-value of .21, 95% CI [0.11, 0.31]. However, it may be partially due to the weak autoregressive effect of listening comprehension. Nevertheless, given the substantial effects of T1 oral vocabulary (β = .30) and reading comprehension (β = .20), the treatment effect was still considerable. We attributed the improvement in listening comprehension to the effectiveness of the intervention in providing linguistic context for both language and literacy learning (Zhou, 2021) and teaching orthographic and morphological knowledge, which, as a kind of metalinguistic skill training, was found to facilitate oral language development (Lee & Tsai, 2017). It also suggested the beneficial effect of developing the instructional components in a complementary manner, reflecting the interactive nature of the two SVR componential skills (Nation, 2019). As for enhanced metalinguistic awareness, Wong (2021) attributed the reciprocal influence of reading to listening comprehension presented consistently in his three-wave CSL reading-listening developmental model. Our results provide further evidence for the reading-to-listening reciprocal effect and suggest that emphasising the Foundational Instruction on metalinguistic skills would be advantageous to both written and oral language development. The findings also underscore the importance of oral language, serving as a crucial foundation for literacy across languages and scripts (Bialystok, 2007; NICHID, 2005) and literacy development in the Chinese language. The path model in Figure 1 showed that the students' listening comprehension contributed substantially and consistently across the year: a β-value of .35 at Time 1 and .34 at Time 2, corroborating the findings of previous studies in native-speaking and L2 Chinese learners (Peng et al., 2021; Wong, 2017, 2019). Hence, consistent with the intervention design for early primary native Chinese-speaking learners by Ho et al. (2012) that listed oral language as a core component, the present findings suggested that oral language should also be stressed in the CSL curriculum and instruction.

The present study has several limitations. First, it lacked a randomised design. The treatment/control group designation was conducted per the schools' advice regarding alignment with their curriculum needs. Particularly, caution should be paid to the treatment-group students' superior orthographic knowledge and word reading over the control-group students, which might give them an edge in their Chinese literacy development. However, we believe any confounding effect was substantially reduced by using previous performance levels as autoregressors in the path analysis. Future research may consider using a randomised design to better evaluate the effectiveness of the intervention.

Second, we did not have an alternative instructional approach to be implemented in the control-group Chinese lessons; instead, a 'business-as-usual' kind of control group was adopted. This may give unduly advantages to the treatment-group students' Chinese

learning for the mere presence of novelty in the instruction. The use of a three-group design, that is, a treatment group implementing the targeted intervention, a control group implementing an alternative intervention, and another 'business-as-usual' control group, may be considered in future research. Lastly, as noted above, including a measure for the construct would facilitate our understanding of the treatment effect on the students' morphological awareness.

Conclusions

In sum, the present study supported the effectiveness of the Foundational Instruction intervention in developing young CSL students' Chinese reading comprehension via explicit and systematic progressive instruction on core metalinguistic awareness, decoding and linguistic comprehension skills. Aligning with a substantial body of SVR studies across languages (Melby-Lervåg & Lervåg, 2014; Peng et al., 2021; Sparks, 2021), our findings render unequivocal support to its usefulness as both a descriptive theoretical model and prescriptive intervention model for CSL literacy development. Based on the findings, we argue the importance of providing CSL learners with a balanced curriculum of oral language and literacy focusing on Chinese orthography. Moreover, the findings indicate the importance of instructional designs and approaches with an additional focus on specific metalinguistic skills, such as orthographic knowledge (Chang et al., 2014; Ho et al., 2012), in improving Chinese literacy skills among CSL learners.

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Conflict of Interest

The authors report that there are no competing interests to declare.

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Data Availability Statement

The materials and data supporting the findings of this study are available from the corresponding author upon reasonable request.

Endnotes

[1] Currently, there are two kinds of Chinese scripts: the traditional script (e.g., 環) and the simplified one (e.g., 环) adopted by the People's Republic of China in the 1950s (Su, 2001). The traditional script remains in use in Hong Kong, Macau, Taiwan and some overseas Chinese communities (Li, 2015). In this manuscript, if there is a difference in the characters' orthographic form of the two scripts, like 環/环, both are shown with the traditional form to the left of the slash and the simplified form to the right.

[2] Some simple characters' original form, like 艸 here, are not currently in use but replaced by a compound-character form, like 艸 replaced by 草. The original form 艸 was a pictogram that depicted the image of grass but gradually evolved for ease of writing. In cases like these, explanations will be provided for the students so they can better understand Chinese orthography and its evolution over time.

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Appendix A

The whole set of 28 simple characters/radicals and selected compound characters, words, phrases and orthographic and morphological knowledge of the instructional package

	Simple character/ core radical[1]	Compound character[2]	Word compound/phrase[2]	Orthographic knowledge[3]	Morphological knowledge[3]
1	石 (stone, /sek6/)	研 (study, /jin4/) 碟 (plate, /dip6/)	研究 (investigate, /jin4gau3/) 光碟 (disc, /gwong1dip6/)	• Forms and meanings of the 28 core radicals. • Formal structure of a compound character, including left–right (e.g., 研), top-down (e.g., 照), and surrounding (e.g., 遠). • Positional regularity of radical: e.g., semantic radical on the left while phonetic on the right as in 研.	• Form-to-meaning connections to highlight orthographic distinctions among homophones. • Morphological analysis of compound words and phrases.
2	頁 (page, /jip6/)	預 (prepare, /jyu6/) 顏 (face, /ngaan4/)	預測 (predict, /jyu6cak1/) 顏色 (colour, /ngaan4sik1/)		
3	水 (氵) (water, /seoi2/)	流 (flow, /lau4/) 海 (sea, /hoi2/)	流水 (stream, /lau4seoi2/) 海洋 (sea, /hoi2joeng4/)		
4	糸 (糹) (silk, /mik6/)	紀 (record, /gei3) 繽 (thriving, /ban1/)	紀錄 (record, /gei3luk6/) 繽紛 (colourful, /ban1fan1/)		
5	辶 (辶) (walk, /coek3/)	遠 (far, /jyun5/) 通 (through, /tung1/)	遠處 (far away, /jyun5cyu3/) 通過 (pass, /tung1gwo3/)		
6	人 (亻) (people, /jan4/)	他 (he/she, /taa1/) 價 (price, /gaa3/)	他們 (they, /taa1mun4/) 石值 (value, /gaa3zik6/)		
7	言 (訁) (speak, /jin4/)	說 (speak, syut3/) 設 (build, /cit3/)	說話 (talk, /syut3waa6/) 設計 (plan, /cit3gai3/)		
8	手 (扌) (hand, /sau2/)	打 (hit, daa2/) 撞 (collide, /zong6/)	打架 (fight, /daa2gaa3/) 撞傷 (bruise, /zong6soeng1/)		
9	足 (⻊)(foot, /zuk1/)	跑 (run, /paau2/) 踢 (kick, /tek3/)	跑步 (running, /paau2bou6/) 踢球 (kick the ball, /tek3kau4/)		

10	日 (sun, /jat6/)	晚 (night, /maan5/) 映 (project, /jing2/)	晚上 (night, /maan5soeng6/) 映照 (cast light, /jing2ziu3)
11	心 (忄) (heart, /sam1/)	態 (status, /taai3/) 快 (fast, /faai3/)	態度 (attitude, /taai3dou6/) 快樂 (happy, faai3lok3/)
12	艸 (艹) (grass, /cou2)	草 (grass, /cou2//) 苗 (sprouts, /miu4/)	青草 (green grass, cing1cou2/) 樹苗 (sapling, /syu6miu4/)
13	口 (mouth, /hau2/)	呼 (exhale, /fu1/) 問 (ask, /man6/)	歡呼 (acclaim, /fun1fu1/) 問題 (question, /man6tai4/)
14	衣 (衤) (cloth, /ji1/)	袋 (pocket, /doi6/) 被 (quilt, /pei5/)	袋子 (pocket, /doi6zi2/) 被單 (bed sheet, /pei5daan1/)
15	土 (soil, /tou2/)	地 (earth, /dei6/) 垃 (refuse, /laap6/)	土地 (earth, tou2dei6/) 垃圾 (refuse, laap6saap3/)
16	竹 (bamboo, /zuk1/)	簾 (screen, /lim4/) 筷 (chopsticks, /faai3/)	窗簾 (curtain, /coeng1lim4/) 筷子 (chopsticks, /faai3zi2/)
17	蟲 (虫) (insects, /cung4/)	蟻 (ants, /ngai5/) 蝸 (snail, /waa1/)	螞蟻 (ants, /maa5ngai5/) 蝸牛 (snail, /waa1ngau4/)
18	木 (wood, /muk6/)	櫃 (cupboard, /gwai6/) 樹 (tree, /syu6/)	衣櫃 (wardrobe, /ji1gwai6/) 大樹 (big tree, /daai6syu6/)
19	囗 (proud, /wai4/)	圓 (circle, /jyun4/) 圖 (chart, /tou4/)	圓圈 (circle, /jyun4hyun1/) 圖案 (pattern, /tou4on3/)
20	彳 (walk, /cik1/)	行 (walk, /hang4/) 後 (behind, /hau6/)	流行 (popular, /lau4hang4/) 然後 (then, /jin4hau6/)
21	邑 (阝) (area, /jap1/)	那 (that, /naa5/) 郊 (suburb, /gaau1/)	那裏 (there, /naa5leoi5/) 郊外 (suburb, /gaau1ngoi6/)
22	阜 (阝) (mound, /fau6/)	防 (defend, /fong4/) 隔 (partition, /gaak3/)	預防 (prevention, /jyu6fong4/) 隔壁 (neighbour, /gaak3bik1/)

23	女 (woman, /neoi5)	好 (good, /hou2/) 娃 (baby, /waa1/)	美好 (good, /mei5hou2/) 洋娃娃 (doll, /jeong4waa1waa1/)
24	目 (eye, /muk6/)	眼 (eye, /ngaan5/) 看see, /hon3/)	眼睛 (eye, /ngaan5zing1/) 觀看 (watch, /gun1hon3/)
25	火 (灬) (fire, /fo2/)	火 (fire, /fo2/) 燃 (burn, /jin4/)	火焰 (flame, /fo2jim6/) 燃燒 (burn, /ji4siu1/)
26	肉 (月) (flesh, /juk6/)	臂 (arm, /bei3/) 臉 (face, /lim5/)	臂膀 (arm, /bei3bong2/) 臉孔 (face, /lim5hung2/)
27	門 (door, /mun4/)	開 (open, /hoi1/) 閘 (gate, /zaap6/)	開關 (switch, /hoi1gwaan1/) 閘口 (entrance, /zaap6hau2/)
28	宀 (house, /min4/)	家 (home, /gaa1/) 寄 (send, /gei3/)	家庭 (family, /gaa1ting4/) 寄信 (mail, /gei3seon3/)

[1]All 28 simple characters/core radicals covered in the instructional package.

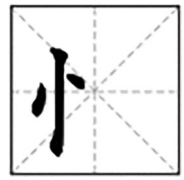
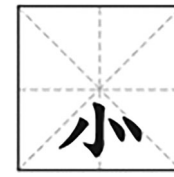
[2]Selected examples covered in the instructional package.

[3]Types of orthographic and morphological knowledge covered in the instructional package.

Appendix B

Samples of tasks in the intervention

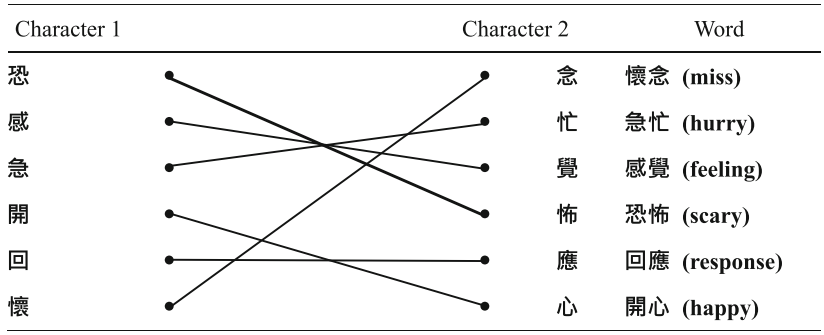
- Tasks for orthographic knowledge
  - Identify the radical variants of simple character 心 in the following compound characters and categorise them into top-bottom or left–right structures.

	Radical forms		
Character form	On the left side	On the bottom	On the bottom
			
Compound characters	Left–right structure	Top-bottom structure	
	懷, 憮, 憤, 懂, 愣	戇, 慈, 恭, 憑, 憩	

- Tasks for morphological knowledge
    - Know about the evolution of the orthographic form of the character 心.

Bronze inscription	Small seal script	Clerical script	Regular script	Running script	Cursive script
					

- Connect the characters to form a word.



Appendix C

A sample of the written version of the orally-presented passages

Original Chinese version	English translation version
《我愛 (love, /oi3/) 大自然》[1] 今天是個風和日麗 (breezy and sunny, /fung1wo4jat6lai6/) 的好日子 (day, /jat6ci4/), 我們一家參加了社區中心 (centre, /zung1sam1/) 舉辦的植樹活動. 來到自然生態 (ecological, /saang1taai3/) 保育區, 青草 (green grass, /ceng1cou2/) 的清新氣息撲面而來. 放眼四周, 大樹林蔭 (tree shades, /lam4jam3/), 盛開的三色牡丹花 (peonies, /maau5daan1faa1/)妝點着一片翠綠, 旁邊的湖泊像鏡, 把這美景 (astounding scenery, /mei5ging2/) 映 (reflect, /jing2/) 在水中, 實在令人心曠神怡 (refreshing, /saam1kwong3san4ji4/).	'I love the countryside' On a breezy and sunny day, our family participated in a tree-planting event held in the community centre. We were embraced by the refreshing scent of the green grass when we arrived at the nature ecological conservation area. Surrounded by numerous towering trees with their large shades and adjacent to a mirror-like lake with astounding reflection, there were some colourful blooming peonies scattering the vast emerald greenery. The wonderful scenery refreshed us.
在領隊的指引下, 我們首先拿着挖土的工具, 在地上挖出一個個坑, 然後小心地 (carefully, /siu2saam1/)從袋子裏取出小樹苗 (sapling, /syu6miu4/). 最後, 把樹苗的梓部埋在坑中便大功告成了! 真希望它們快快 (quickly, /faai3faai3/) 長大, 讓更多人能欣賞到大自然的美.	Under the guidance of the couch, we first dig several holes in the ground. Then, we took out the saplings from our bags and put them into the holes. Covered the holes with mud, and we were all glad that the work was done! We wished the trees would grow up fast and more people would come to appreciate the beauty of mother nature.

Listening comprehension questions

1 那個家庭參加了甚麼活動? (植樹活動) What did the family participate in? (tree-planting)
2 那天天氣怎樣? (風和日麗) How was the weather? (breezy and sunny)
3 那裏的景色如何? (有花、草、大樹, 景色美麗) How was the view? (a beautiful countryside with grass, trees, and flowers)
4 他們把甚麼埋在坑中? (樹苗) What did they plant in the ground? (saplings)
5 他們有甚麼感受? (心曠神怡、開心) How did they feel? (refreshing, glad)

[1]Passage incorporated words/phrases consisting of the targeted simple characters/core radicals 草(艹), 心(忄), and 日. These words/phrases are bolded, underlined, and provided with phonetic romanisation and English translation.

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