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Literacy Learning of Deaf and Hearing Preschoolers in a Sign Bilingual, Coenrollment Setting in Hong Kong

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The study investigated the literacy-learning conditions of a group of deaf and hard of hearing (d/Dhh) and hearing preschoolers in a mainstream kindergarten sign bilingualism and coenrollment (SLCO) program. The data came from the children's scores on tests of Chinese vocabulary and written Chinese grammar, and questionnaire responses on literacy-learning conditions at home (from parents) and in school (from teachers). The d/Dhh children's performance on the two tests, when compared with that of their hearing peers, suggested that adding sign language and Deaf teachers to the SLCO classroom did not adversely affect the d/Dhh children's literacy learning. Responses to the two questionnaires indicated that parents' and teachers' efforts to organize literacy resources and activities interacted with the children's vocabulary development. These preliminary results encourage more research to elucidate further the relationship between environmental factors and d/Dhh children's literacy development.

Keywords: sign bilingualism and coenrollment education, home and school factors, literacy learning, Deaf teacher, sign language

Literacy has long been recognized as the basis for lifelong learning and educational opportunities (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2006). The UNESCO Institute for Statistics (2021) defines literacy as "the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts." Numerous studies have indicated that preschool literacy level can predict later reading and writing performance in the primary and secondary grades (Bryant & Bradley, 1985; Elkind, 2001; McBride-Chang & Ho, 2000; Rohde, 2015; Whitehurst, 2001). Investigations into literacy development generally adopt either of two perspectives: cognitive process or sociocultural. The cognitive process perspective examines the relationship between the structure of the brain and the related cognitive skills and early literacy development (Ehri, 1992; Frith, 1985). The sociocultural perspective adopts the Vygotskian approach, advocating the importance of environment and interaction (Berns, 2004; Bronfenbrenner, 1979, 1994; Morrow, 2009; Ochs, 1988; Vygotsky, 1978). Within this framework, language acquisition is seen as a socially mediated process in which children internalize language by interacting with caregivers who scaffold their language and literacy development. In the literature, parents at home

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and teachers at school, plus the contextual characteristics of the environments, are crucial components affecting children's literacy development (Altun et al., 2018; Umek et al., 2005).

Little research has been conducted on the relationship between the ways parents and teachers organize literacy learning and the literacy development of d/Deaf and hard of hearing (d/Dhh) preschoolers. In the present study, we aimed to fill this gap. We focused on a group of d/Dhh children who attended a mainstream kindergarten that had adopted the sign bilingualism and coenrollment (SLCO) approach. We identified conditions in their home and school environments that were conducive to bolstering their literacy development.

The present article is organized as follows: We first summarize some previous literature on literacy learning in the home and school environments for hearing and d/Dhh children. Next, we introduce the situation behind children's literacy learning in Hong Kong, especially the challenges faced by d/Dhh children. We also summarize some previous studies that examined the literacy development of d/Dhh children who studied under the SLCO approach. Then, we outline the research framework, which involved four groups of d/Dhh children and their parents and teachers. The child participants had to complete two tasks that gauged their Chinese character/word recognition and production abilities and knowledge of written Chinese grammar. Groups of parents and teachers of these children were invited to complete a questionnaire that asked how and to what extent they organized literacy learning at home (parents) and in school (teachers). The research methodology section is followed by a summary of findings based on the assessment scores of the children and information provided by parents and teachers. Where appropriate, we attempt to associate the children's assessment scores with information about strategies adopted by parents and teachers to support the children's literacy development. We discuss these findings from the perspective of SLCO education in the Hong Kong context. Last, we highlight some limitations of the study and suggest modifications for future research.

Environmental Conditions and Literacy Learning

Home Literacy Environment (HLE)

Many studies have shown that elements of the demographic background of the family, such as parents' socioeconomic status, education level, and reading habits, are associated with children's literacy development (e.g., Bus et al., 1995; Evans et al., 2010; Phillips & Lonigan, 2009; Wasik et al., 2001). Home literacy resources are also examined. A questionnaire survey by Umek et al. (2005) based on parents' self-reports identified five components of the home literacy environment (HLE): (a) stimulating the child to use language, (b) reading books to the child and visiting the library and puppet theater, (c) engaging the child in joint activities and conversations, (d) engaging the child in interactive reading, and (e) stimulating the zone of proximal development (e.g., stimulating the child to use more complicated sentences and to read individual letters and simple words). Among these components, (b), (d), and (e) were positively correlated with child language development and early literacy outcomes. Some other dimensions of HLE in the Korean context were captured in the *Home Literacy Environment Questionnaire*, developed by Lee (1993): (a) incidence and duration of reading activities provided by parents to children since birth, (b) incidence and duration of oral language interactions between parents and children, and (c) the extent to

which parents are model readers (i.e., enjoy and engage in reading at home).

In the Hong Kong and Mainland China contexts, H. Li et al. (2008) designed two questionnaires, the *Home Literacy Environment Index* and the *Classroom Literacy Environment Index*, to investigate Beijing and Hong Kong children's formal and informal literacy environments at home and in school. H. Li et al. found that only formal literacy experiences contributed to these children's later literacy attainment in primary school. Among the dimensions they included in the questionnaire, the researchers found that children's early literacy development was predicted by the application of reading strategies in informal learning environments and direct literacy teaching in formal environments. Other studies indicated that the number of books at home (Evans & Kelley, 2007; Park, 2008) or parental guidance, especially opportunities for parent-child interactions and joint attention in paired or shared reading at home, interacted with literacy outcomes (Mol & Bus, 2011).

Classroom Literacy Environment (CLE)

Research findings have shown that classroom literacy environment (CLE) is associated with children's literacy outcomes. According to Justice (2004), the classroom environment reflects the sociocultural aspects of societies and the philosophy of educational programs. Wolfersberger et al. (2004) claimed that the materials developed for literacy learning and the classroom climate potentially expand children's literacy experiences.

On the basis of the findings of several studies, Connor et al. (2014) identified a set of global characteristics, including teachers' backgrounds, classroom organization, classroom atmosphere, and general discipline, that may contribute to young children's literacy learning. Connor et al. also highlighted some individualized child dimensions that interact with literacy development, such as attention management, the type of instruction and literacy-building activities, and time spent on these activities. According to these researchers, these factors potentially influence children's reading comprehension and language development. Connor et al. designed a rating scale from 1 (low) to 6 (high) on the global and individualized dimensions and examined the extent to which these influenced the vocabulary learning and reading comprehension of 27 third graders. The results showed a combined effect of the global and individualized dimensions on the children's literacy outcomes. Most vocabulary and reading comprehension gains were observed when teachers provided a high-quality CLE and children spent a longer time in teacher-child managed, small-group activities.

The survey by H. Li et al. (2008) on Hong Kong's kindergarten and primary school children included variables such as teachers' beliefs and practices related to Chinese literacy learning, classroom literacy resources, reading strategies, and teacher-child interactions. The overall findings highlighted the importance of early formal literacy activities for later higher literacy outcomes. H. Li et al. also argued that the complex nature of Chinese orthography makes early literacy instruction particularly valuable in early literacy acquisition. Another important variable in their study was the close alignment of expectations of parents and teachers in regard to children's literacy attainment.

Organizing Literacy Learning for d/Dhh Children at Home and in School

Literacy development of d/Dhh children has always been a concern in deaf

education, with reports revealing their persistent difficulty with learning to read and write in a spoken language (Mayberry et al., 2011; Mayer & Trezek, 2015). Previous research has identified three main factors related to d/Dhh children's literacy development in the home environment: parents literacy beliefs and practices, literacy-related activities, and interactions during reading. Limitations found in the research include little professional advice to parents on how to engage d/Dhh children in literacy-related interactions (Heinemann-Gosschalk & Webster, 2003), parents' reliance on professionals for their children's language and literacy development (Watson & Swanwick, 2008), fewer interactions during joint book reading between parents and d/Dhh children than between parents and hearing children (DesJardin et al., 2009), a focus on reading the text of the storybook aloud only (Swanwick & Watson, 2007), and the use of close-ended questions and parent-initiated interactions (DesJardin et al., 2009). Nevertheless, DesJardin and Ambrose (2010) found a positive effect of the frequency of parent-child literacy-teaching activities on d/Dhh children's development of literacy skills. One study investigated the relationship between classroom environment and d/Dhh children's literacy development. Most et al. (2006) compared literacy outcomes of d/Dhh children in individual inclusion and group inclusion settings. Their result indicated that d/Dhh children in individual inclusion showed better literacy performance in the areas of phonological awareness and letter identification. However, there was no difference in reading, writing, and orthographic awareness in comparison to group inclusion.

Language and Literacy Learning of d/Dhh Children in Hong Kong

According to Chow and McBride-Chang (2003), literacy learning begins at a very young age for Hong Kong children because parents choose to send their children to a kindergarten or child care center starting at the age of 3 years. The "biliterate and trilingual" language policy in education implies that many children are exposed to written Chinese and English to various degrees during preschool education. The challenges faced by school-age children in developing Chinese literacy are well recognized by educators and policymakers in Hong Kong (H. Li & Rao, 2000, 2005), and more so in the case of d/Dhh children.

Children who are d/Deaf or hard of hearing are generally mainstreamed, but a small proportion goes to a special child care center from ages 2 to 6 years. They undergo literacy learning in written Chinese and English in preschool education like hearing children while they receive speech and language therapy for oral Cantonese development. However, the literacy-learning situation in Hong Kong consistently poses a challenge to d/Dhh children. The orthographic system requires that children who are learning Chinese characters recognize the spatial organization of components from strokes up to the level of radicals. While strokes do not carry meaning, phonetic and semantic radicals offer clues to a character's pronunciation and meaning, respectively. Sometimes this simple rule of thumb in reading out or comprehending Chinese words and characters does not apply. For instance, the character 糊[wu2] means "paste," as in "sesame paste." However, the character comprises three components that can also be independent but simple characters with meanings and pronunciations of their own: 米[mai3] "rice," 古[gu2] "ancient," and月[jyut3] "moon." A further complication is a division between the semantic radical 米[mai3] and the phonetic radical 胡[wu4], as well as the switch from tone 4 to tone 2 in the pronunciation of 糊[wu2]. For d/Dhh children, such complexity can often

result in difficulty detecting the meaning and Cantonese pronunciation of Chinese characters and words. An additional difficulty they must face when endeavoring to comprehend written sentences in Chinese is that the sentences do not adopt Cantonese grammar but the grammar of Mandarin Chinese, an additional language they have to acquire while learning to read in Chinese.

Literacy Development of d/Dhh Children in Hong Kong

Few studies have examined literacy learning of d/Dhh children in Hong Kong. Fung et al. (2005) examined the effect on the vocabulary development of preschool d/Dhh children of an intervention program using dialogic reading by parents. A pretest/posttest design was adopted. The results showed significant gains, mostly in receptive vocabulary with the dialogic reading group ($n = 9$) relative to the typical reading group ($n = 9$) and the control group ($n = 10$). There have also been few studies focusing on sign bilingual d/Dhh children in Hong Kong, but the introduction of SLCO education in a mainstream environment has led to a surge of research interest in their literacy development (see descriptions of SLCO education below). Using the *Pre-school and Primary Chinese Literacy Scale (PPCLS)*, developed by H. Li et al. (2008), Q. Li and Tang (2020) examined character/word recognition and production by a group of SLCO-primary d/Dhh children. These children performed on par with their SLCO-Hearing peers on tasks involving word/character recognition but lagged behind them in tasks involving production. Tang et al. (2014) studied the Chinese grammatical knowledge of a group of SLCO-primary d/Dhh children and found significant positive correlations between their development of oral Cantonese, written Chinese, and Hong Kong Sign Language (HKSL and Cantonese, $r = .663$, $p < .001$; HKSL and written Chinese, $r = .591$, $p = .003$; and Cantonese and written Chinese, $r = .790$, $p < .000$). In sum, the results of these three studies provided preliminary evidence of the growth of Chinese vocabulary and grammatical knowledge of sign bilingual d/Dhh children who studied in the SLCO environment.

The Present Study

Research Questions

The purpose of the present study was (a) to examine the literacy outcomes of d/Dhh preschoolers who underwent SLCO education and (b) to explore the relationship between literacy-learning conditions in the home and school environments and d/Dhh preschoolers' literacy outcomes. We focused on text literacy, defining it as those conventional literacy skills acquired by preschool and kindergarten children to prepare themselves for reading and writing, such as character/word recognition, phonology/word mapping, and receptive grammar in print, to name a few. Findings of these relationships would benefit teachers, parents, and stakeholders in devising strategies to support the literacy development of d/Dhh preschoolers. We addressed two research questions:

1. Were there differences in the literacy outcomes of the d/Dhh preschoolers who underwent SLCO education when compared with hearing children?
2. Which CLE or HLE dimensions were associated with the d/Dhh and other preschoolers' literacy outcomes?

The SLCO Educational Environment

This study involved a mainstream preschool with a SLCO program in one class for d/Dhh and hearing students. We

included hearing students in another mainstream preschool in the design as controls. The SLCO program, established in 2006 in Hong Kong, possesses some unique elements that are not present in traditional mainstreaming for d/Dhh students (Kirchner, 2004). First, coenrollment requires a critical mass of d/Dhh students to study with hearing students, generally a 4:1 ratio between hearing and/Dhh students. Second, it adopts coteaching between a Deaf teacher who is native, if not near native, in HKSL and a hearing teacher who uses Cantonese. Third, d/Dhh students enjoy an academic curriculum equivalent to that of their hearing peers. Fourth, SLCO emphasizes early exposure to sign language, the natural language of the Deaf community, to support bimodal bilingual development and preempt language deprivation (Humphries et al., 2019). It endorses direct communication between d/Dhh children and parents or teachers in the home and school environments. The perception that both languages are of equal linguistic status in the SLCO classroom generates a more balanced language use among the participants over time (Wong, 2018). In the SLCO classroom, teachers and students are both free to choose between HKSL and a spoken language for direct communication or for accessing curriculum content during the pedagogical process. In sum, the SLCO program offers an enriched linguistic environment to support deaf and hearing students' bimodal bilingual acquisition (Tang & Sze, 2018) because it offers a two-way immersion in spoken language and sign language for both students and teachers, deaf and hearing alike.

The kindergarten joined the SLCO program in 2006. In this kindergarten, one class in each grade is designated for SLCO education and admits 5–6 d/Dhh children (i.e., SLCO-Class d/Dhh) and 10–16 hearing children (i.e., SLCO-Class Hearing) each year. Other classes in kindergarten (SLCO-School Hearing) are taught by a hearing teacher. All classes follow the same curriculum. Although the SLCO-School hearing students do not have a Deaf adult coteaching with a hearing teacher in class, and therefore no consistent HKSL input, they are exposed to HKSL during school assemblies.

Methodology

Participants

The participants in the present study were children who had reached the final year of preschool education, with ages ranging between 5 and 7 years. Since the SLCO program admits only 5–6 d/Dhh children each year, we combined the assessment scores of two cohorts of SLCO d/Dhh and hearing children. Cohort 1 was from the academic year 2019–2020 and cohort 2 from 2020–2021 (see Table 1). The hearing children in the SLCO kindergarten were categorized into SLCO-Class Hearing ($n = 24$) and SLCO-School Hearing ($n = 46$). Additionally, 20 hearing preschoolers from a non-SLCO school were recruited as controls. In total, 101 children participated in the study (see Table 1).

Among the SLCO-Class d/Dhh preschoolers, seven were male and four were female; they ranged in age from 71 to 84 months (see Table 2). Ten d/Dhh children had a profound hearing loss in both ears, one had a moderate hearing loss in both ears, and one had a moderate to severe hearing loss in the left ear and a severe hearing loss in the right. Among these 11 children, eight had cochlear implants in both ears, with a 1–2-year implantation gap, two had been prescribed hearing aids in both ears, and one had a hearing aid in the left ear and implantation in the right. All d/Dhh students were the children of hearing parents.

Table 1. Distribution of Preschoolers by Group

Group	SLCO-Class d/Dhh	SLCO-Class Hearing	SLCO-School Hearing	Non–SLCO-School Hearing	Total
Cohort 1	6	14	20	n/a	40
Cohort 2	5	10	26	20	61
Total	11	24	46	20	101

Notes. SLCO = sign bilingualism and coenrollment. d/Dhh = d/Deaf and hard of hearing.

Table 2. Demographic Characteristics of SLCO-Class d/Deaf and Hard of Hearing Students (N = 11)

Participant code	Gender	Birth date	Chronological age when taking the test (years; months)	Hearing status	Hearing assistive device	Age when received hearing device (years; months)	Parents' hearing status
Cohort 1: CCH	M	Nov. 11, 2013	6;4	L/R: moderate	HA (L&R)	L/R: 0;7	Hearing
Cohort 1: LCH	M	June 13, 2013	6;0	L/R: profound	CI (L&R)	L: 3;2 R: 3;7	Hearing
Cohort 1: LSN	M	Feb. 26, 2012	7;3	L/R: profound	CI (L&R)	L: 2;2 R: 3;4	Hearing
Cohort 1: CSY	F	Mar. 13, 2013	6;3	L/R: profound	HA (L) CI (R)	L: 0;6 R: 2;8	Hearing
Cohort 1: LPS	F	Mar. 10, 2013	6;3	L: moderate to severe R: severe	HA (L&R)	L/R: 0;5	Hearing
Cohort 1: LYT	F	Apr. 5, 2013	6;2	L/R: profound	CI (L&R)	L: 5;8 R: 4;9	Hearing
Cohort 2: SWD	M	Apr. 29, 2014	6;6	L/R: profound	CI (L&R)	L: 2;8 R: 1;5	Hearing
Cohort 2: HCH	M	Sept. 7, 2014	6;2	L/R: profound	CI (L&R)	L/R: 1;0	Hearing
Cohort 2: WKK	M	May 15, 2014	6;5	L/R: profound	CI (L&R)	L: 5;7 R: 3;5	Hearing
Cohort 2: LTF	M	June 21, 2013	7;4	L/R: profound	CI (L&R)	L/R: 4;8	Hearing
Cohort 2: YH	F	Dec. 12, 2013	6;9	L/R: profound	CI (L&R)	L: 4;8 R: 4;0	Hearing

Notes. SLCO = sign bilingualism and coenrollment. HA = hearing aid. CI = cochlear implant.

Three Deaf and four hearing teachers from the SLCO-Class and six teachers from the SLCO-School, and eight teachers from a non–SCLO-School, completed the CLE questionnaire. They were responsible for teaching the SLCO and non-SLCO classes at the time of the survey. The response rates were 86.67% for all SLCO-School and 100% for non–SLCO-School. These teachers were responsible for K1–K3 students. A

total of 46 parents of K3 children from the different settings returned the HLE questionnaire to the project: seven out of 11 SLCO-Class d/Dhh preschoolers (response rate: 63.63%), 10 out of 24 SLCO-Class Hearing preschoolers (response rate: 41.67%), 9 out of 46 SLCO-School Hearing preschoolers (response rate: 19.57%), and 20 out of 20 non–SLCO-School controls (response rate: 100%). The distribution of participants across the various tasks and surveys is summarized in Table 3.

Instruments

We used two sets of instruments to collect data. The first set aimed at gauging the child participants' literacy development and the second set at collecting information from parents and teachers about the strategies they adopted in their respective environments to support literacy learning.

Tools for Assessing Chinese Vocabulary and Mandarin Grammar

The traditional Chinese character version of the *Pre-school and Primary Chinese Literacy Scale (PPCLS)* (H. Li, 2005) was used in the present study to gauge the preschoolers' recognition and production of Chinese characters and words. It has been standardized and replicated in studies in Singapore and Mainland China (Chow & McBride-Chang, 2003; H. Li & Rao, 2005). It consists of five subscales: picture-character matching (Character Identification, 25 items), listen and point (Visual and Auditory Discrimination, 20 items), point and read (Word Recognition, 75 items), read and say (Expressive Vocabulary, 80 items), and character copying (Handwriting Skills). In the present study, we only adopted the first four subscales. At any point in the experiment, the task would halt if the participant continuously failed to respond to seven stimuli. The total raw scores for each participant were used in our analysis.

A prestandardized assessment tool—the *Chinese Grammatical Assessment (CGA-KG)*—was used to gauge the preschoolers' knowledge of syntactic word order of a set of grammatical structures of written Chinese based on the grammar of Mandarin Chinese (Tang et al., 2014). A word-reordering task with 60 items was adopted. This task is familiar to kindergarten children. It tests the internal word order of adjective phrases, possessive phrases, quantifier phrases, determiner phrases, transitive verb phrases, verb phrases with adverbial "DE," simple intransitive and transitive constructions, sentences with modals, simple yes-no questions, A-not-A questions, "wh–" questions, negative constructions,

Table 3. Distribution of Participants: PPCLS, CGA-KG, HLE, CLE

Group	PPCLS	CGA-KG	HLE	CLE
Non–SLCO-School Hearing	20	20 (8, 40%)[a]	20	8
SLCO-Class d/Dhh	5	11 (7, 63.4%)	7	3 Deaf
SLCO-Class Hearing	10	24 (6, 25%)	10	4 hearing
SLCO-School Hearing	26	46 (28, 60.87%)	9	6 hearing
Total	61	101	46	21

Notes. PPCLS = Pre-school and Primary Chinese Literacy Scale. CGA-KG = Chinese Grammatical Assessment. HLE = Home Literacy Environment Questionnaire. CLE = Classroom Literacy Environment Questionnaire. SLCO = sign bilingualism and coenrollment. d/Dhh = d/Deaf and hard of hearing.

[a]The numbers in parentheses indicate the number and percentage of preschoolers who passed the vocabulary threshold and thus were included in the analysis.

and existential sentences. It is an online, receptive grammar assessment that targets children in their final year of preschool education. The participants were given a vocabulary check initially to assess if they could comprehend the vocabulary used in the stimuli. If they failed to reach a 70% accuracy threshold, the CGA-KG scores would not be included in the analysis. The average passing rates on the vocabulary check of the preschoolers from the SLCO and non-SLCO environments were 52.38% and 40.00%, respectively. The raw percentage scores of those participants who passed the vocabulary threshold were used in our analysis.

Literacy Environment Questionnaire

In developing questions for the HLE questionnaire, we referenced the questionnaire surveys administered previously, especially dimensions (b), (d), and (e) in the assessment by Umek et al. (2005); the three dimensions of Lee (1993); and the two dimensions in the study by H. Li et al. (2008). In all, eight dimensions were included in our HLE questionnaire:

1. incidence and duration of reading activities provided by parents to children since birth
2. incidence and duration of oral-language interaction between parents and children
3. the extent to which parents were model readers
4. reading strategies
5. direct literacy teaching
6. joint activities
7. interactive reading
8. zone of proximal development stimulation

The purpose of the HLE questionnaire for parents was to elicit information about home reading resources and strategies, quality and quantity of parent-child interactions, parental beliefs and involvement in supporting their children's Chinese literacy. The questionnaire consists of 19 questions on parents' demographics and 24 questions on literacy- learning conditions at home (see Appendix). Except for two open-ended questions and four questions whose responses might involve more than one choice, all questions adopted a Likert 4-point rating scale, with 1 low and 4 high. The questionnaire was scored by summing up the values of each selected option. Questions with a positive statement whose responses were obtained with a Likert scale from 1 to 4 correspondingly received 1 to 4 marks. For questions with a negative statement, we first reversed the count by assigning a score of 1 to point 4 on the Likert scale, a score of 2 to point 3, and so forth. As for questions permitting more than one choice as responses, we gave a score of 1 for each choice accumulatively. Open-ended questions were not scored. A total score was calculated for each respondent.

In designing the CLE questionnaire, we referenced Connor et al. (2014) and the Classroom Literacy Environment Index developed by Li et al. (2008). The first part of the questionnaire contained 12 questions on teachers' demographics, including their qualifications, age, mother tongue (i.e., sign language or spoken language), and hearing status (i.e., deaf, hard of hearing, or hearing). The second section consisted of 25 questions, including 19 questions requiring responses on a Likert scale, four questions permitting more than one choice as responses, and two open-ended questions asking about literacy learning in the classroom environment (see Appendix). We adopted the same eight dimensions used in the HLE questionnaire when developing questions for the CLE questionnaire, adapting them into situations that suited the classroom context—for example, daily routines and activities, teacher-student interactions, classroom reading resources, teacher's reading strategies, and direct

literacy teaching in the classroom. The CLE questionnaires were scored similarly to the HLE questionnaire.

Data Collection

At the end of every academic year, the SLCO program uses the CGA-KG to gauge the SLCO-Class and SLCO-School children's level of grammar of written Chinese. In the second year of the project, the PPCLS was included to supplement the results of the CGA-KG. Therefore, in the present analysis, data from the PPCLS only came from the non-SLCO controls and the second cohort of preschoolers in the SLCO kindergarten. The HLE questionnaire was completed by parents of two cohorts of K3 d/Dhh and hearing children who had participated in the assessment. As for the CLE questionnaire, we decided to take the broader SLCO versus non-SLCO context in the analysis since the children entering the system at K1 would be immersed in the respective environment embedded with distinct characteristics. The CLE questionnaire was completed by nine teachers, Deaf and hearing, who taught the SLCO-Class, six teachers who taught preschoolers in other classes within the SLCO-School setting, and eight teachers who taught children in a non-SLCO kindergarten. Participation by students, teachers, and parents was voluntary. The preschool teachers and parents were informed of the purpose of the study and signed a consent form if they agreed to participate. Only those children whose parents agreed to participate were included in the collection of literacy data. The parents and teachers completed the HLE questionnaire and CLE questionnaire, respectively, and returned it in a sealed envelope. The literacy assessment instruments were administered to each child individually by the first author in a quiet room on two occasions due to the children's short attention span. The data were stored electronically with encryption, and pseudonyms were used to protect the participants' privacy.

Data Analysis

Since the sample size for analysis was relatively small and uneven within groups and across the SLCO and non-SLCO environments (see Table 3), we conducted statistical tests cautiously. The statistical software SPSS was used in our data analyses. Initially, a Pearson correlation analysis based on the PPCLS and CGA-KG scores was conducted to verify if an association existed between the two tasks for measuring children's Chinese literacy outcomes. To compare the SLCO and non-SLCO preschoolers' early literacy outcomes across learning environments, we ran a simple *t* test on the PPCLS scores. Then, we compared the means and standard deviations of the scores on the PPCLS and CGA-KG among the four groups of children.

In analyzing the characteristics of literacy learning at home and in school, we first matched the children with their parents and with the teachers who interacted with them in their respective environments. For the HLE analysis, we conducted a correlation analysis between the parents' demographics and ratings of the HLE and the PPCLS scores of the children. For the CLE analysis, since one to three teachers taught many preschoolers in the two kindergartens, their total ratings almost became a constant when their ratings were matched with the PPCLS scores of their students; hence, they were inappropriate for correlation analysis. We therefore decided to examine their responses based on mean ratings within and across groups. To identify possible variables of HLE and CLE, we performed an exploratory factor analysis to generate factor loadings for the questions in the second part of the CLE and HLE questionnaires and extract possible components for literacy

learning based on the factor loadings. Then we conducted a Pearson correlation to verify if any association existed between the HLE components and the preschoolers' literacy outcomes based on these results.

Results

Correlation Analysis of the CGA-KG and PPCLS

Among the 101 preschoolers, 32 (24 SLCO and eight non-SLCO) completed both the PPCLS and CGA-KG (see Table 4 for different data sets for specific analyses). We performed a Pearson correlation analysis based on the CGA-KG and PPCLS scores of these 32 children to verify if an association existed between these two crucial components in measuring Chinese literacy. A correlation coefficient of .632 was computed, showing a strong positive correlation between the two task variables ($r = .632$, $p < .001$), suggesting that these two tasks might reliably measure preschool children's literacy development.

Table 4. Factor Loadings and Communalities Based on a Principal Component Analysis With Oblimin Rotation for 22 Questions in HLE (Open Questions Excluded in the Analysis)

	Component			
Question	1	2	3	4
Q18	.737			
Q2	.706			
Q10	-.654		.357	
Q4	.641	.333		
Q5	.574		.414	
Q11	-.473			.304
Q6		.861		
Q3		.734		
Q16		-.587		.392
Q7		-.552		
Q22	.413	.546		
Q14	-.463	.494	.385	
Q9		.376		
Q1			.843	
Q13			.818	-.358
Q12		-.313	.815	
Q20	.304			.782
Q15				.747
Q21	-.317	.314		.593
Q8				.556
Q19				.538
Q17	.441			.473

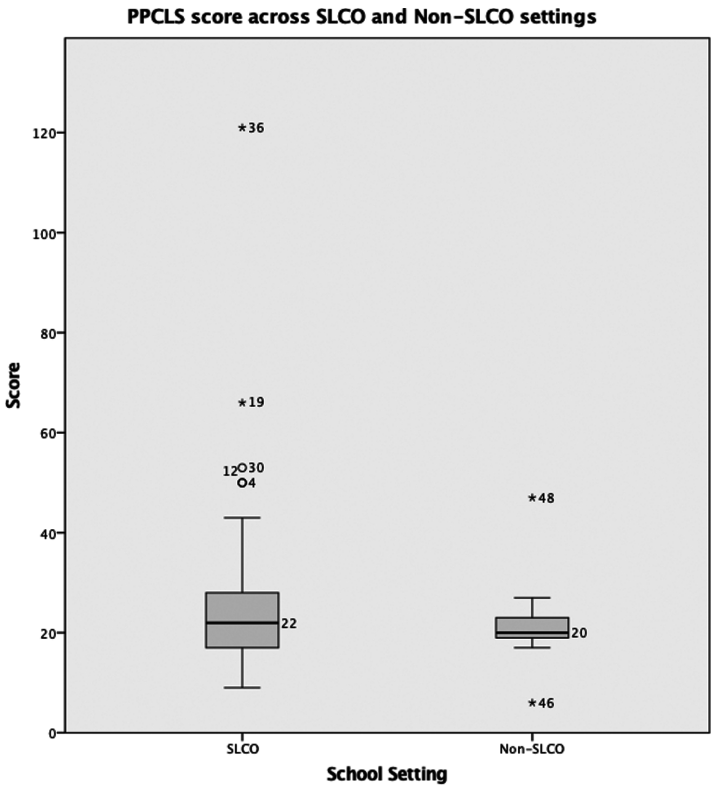
Note. HLE = Home Literacy Environment Questionnaire.

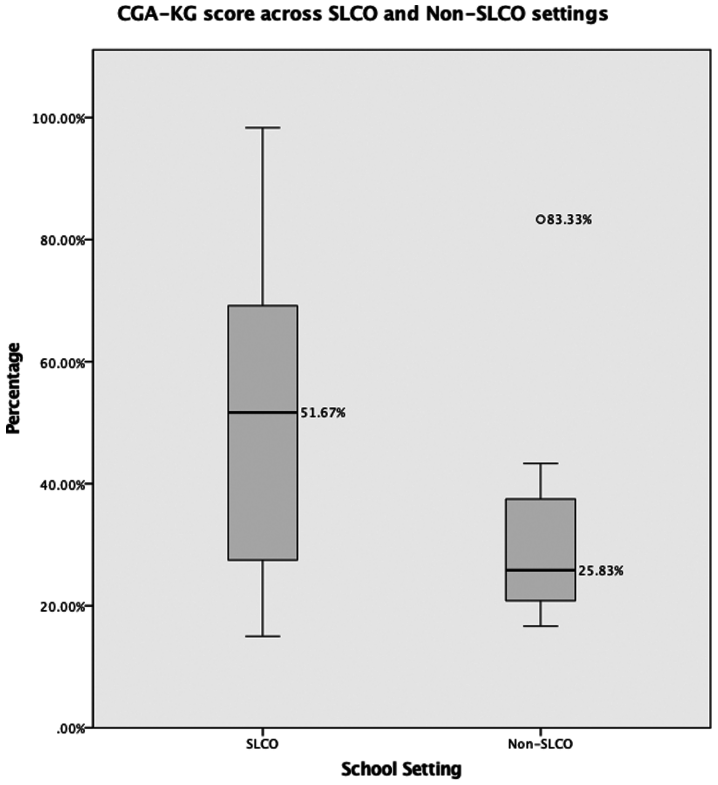
Comparing Literacy Outcomes Between SLCO and Non-SLCO Environments

To verify if differences existed in the literacy outcomes of the SLCO preschoolers versus the non-SLCO preschoolers, we conducted an independent sample *t* test using the scores on the PPCLS. Data from 61 children (i.e., 41 SLCO children from the second cohort and 20 non-SLCO controls) were included in the analysis. The results of an independent sample *t* test of the PPCLS showed no significant differences between the SLCO and non-SLCO preschoolers in Chinese character/word recognition and production, $t(17.241) = 1.282$, $p = .217$. Figure 1a shows that the mean scores on the PPCLS between the two groups of preschoolers were close, but children from the SLCO environment showed a higher degree of individual variation than children from the non-SLCO environment. Since the distribution of preschoolers passing the vocabulary threshold of the CGA-KG was uneven (i.e., 44 SLCO versus only eight non-SLCO), we did not pursue independent *t* tests for comparison; instead, we compared their means for some general indications of tendencies. Figure 1b shows a noticeable difference in the mean CGA-KG scores between groups, suggesting that although the preschoolers of the non–SLCO-School could perform similarly to the SLCO preschoolers on the PPCLS, they had much difficulty passing the vocabulary threshold and, even if they could, in processing the grammatical structures of Mandarin Chinese.

Next, we broke down the group of SLCO preschoolers into SLCO-Class d/Dhh, SLCO-Class Hearing, and

Figure 1. Comparing SLCO and Non-SLCO Preschoolers' Performance





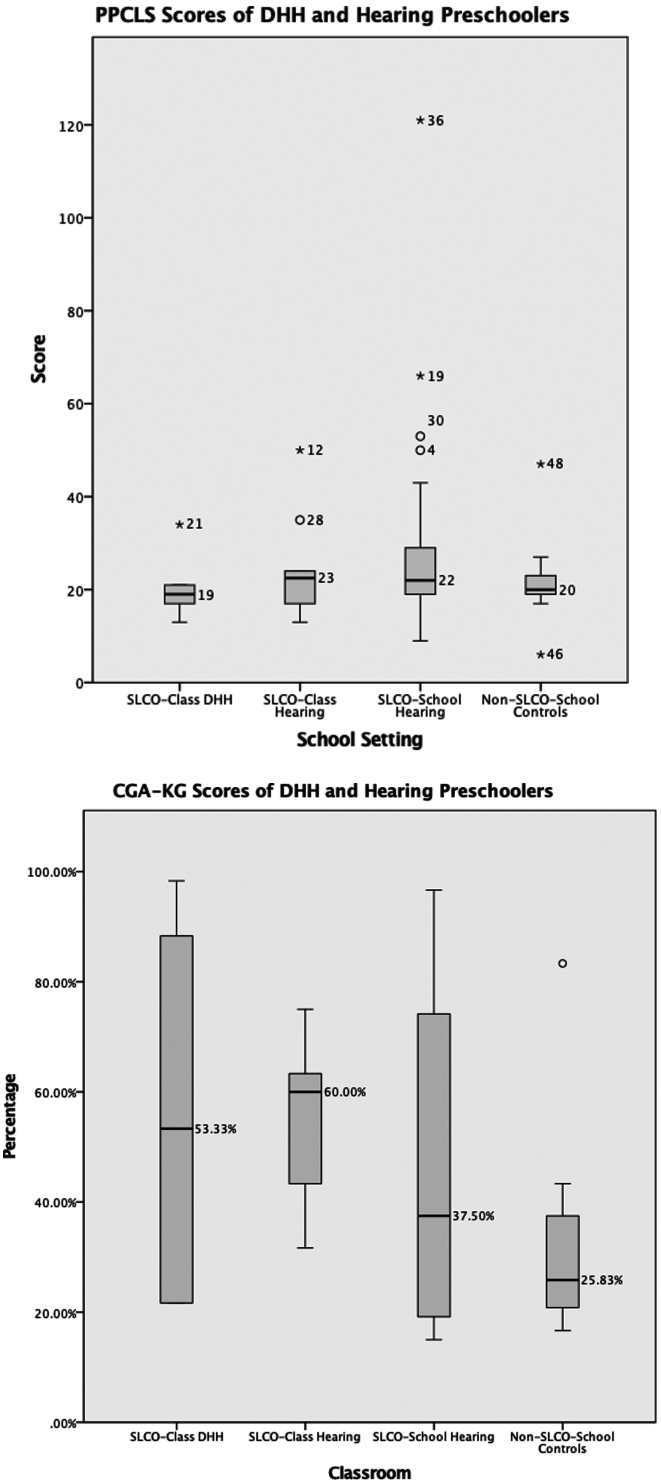
Notes. SLCO = sign bilingualism and coenrollment. CGA-KG = Chinese Grammatical Assessment. PPCLS = Pre-school and Primary Chinese Literacy Scale.

SLCO-School Hearing to examine group performances on the PPCLS and CGA-KG. Figure 2a shows that the mean PPCLS scores of these groups of children were very close, but the biggest individual variation came from the SLCO-School Hearing children. Figure 2b shows the group means of CGA-KG of these children. As discussed previously, the non–SLCO-Hearing children had the weakest performance, but the means of the SLCO-d/Dhh and SLCO-Hearing children were much higher than those of the other groups. Again, the SLCO-School hearing preschoolers showed the biggest variation among the three groups of hearing children. In a nutshell, while no noticeable differences were observed among the mean scores on the PPCLS, apparent differences were observed in the CGA-KG scores: Children from the SLCO class, both d/Dhh and hearing, showed much better performance on the CGA-KG than the SLCO-School and non–SLCO-School groups.

Home Literacy Environment (HLE)

The parents' ratings on the 22 questions in the second part of the HLE questionnaire ranged from 25 to 39. Initially, we compared the mean total ratings of the parents based on descriptive statistics only due to the limitations caused by the small and unequal sizes of the four groups: SLCO-Class d/Dhh, $M = 42.29$, $SD = 2.69$; SLCO-Class Hearing, $M = 36.6$, $SD = 5.337$; SLCO-School Hearing, $M = 35.56$, $SD = 3.844$; non-SLCO Hearing, $M = 25.90$, $SD = 6.504$. These results indicated

Figure 2. Performance on PPCLS and CGA-KG by Four Groups of Preschoolers



Notes. PPCLS = Pre-school and Primary Chinese Literacy Scale. CGA-KG = Chinese Grammatical Assessment. DHH = d/Deaf and hard of hearing. SLCO = sign bilingualism and coenrollment.

that parents of d/Dhh children made more effort to organize literacy learning at home than parents of hearing children. Also, there seemed to be no difference in the extent to which and how parents of hearing children from the SLCO environment organized literacy learning at home, as the means were similar: SLCO-Class Hearing, $M = 36.6$, $SD = 5.337$; SLCO-School Hearing, $M = 35.56$, $SD = 3.844$. Last, parents of hearing children from the non-SLCO setting were least conscientious about enhancing literacy resources at home.

To address the research question of whether parents' demographics had any association with their children's literacy outcomes, we conducted a two-tailed Spearman correlation analysis between parents' demographics and the PPCLS scores of 46 children from all four settings who could be paired with their parents. The results showed a positive correlation only between father's education level and child's literacy outcomes: $r_s = .426$, $p = .013$. Next, a Spearman correlation analysis was conducted to verify the relation between the 46 preschoolers' PPCLS scores and their parents' ratings based on 18 questions in the HLE questionnaire. The findings indicated a significant correlation with three questions only:

Q2: How many Chinese books are available at home? ($r_s = .912$, $p = .008$)
Q12: When did you start reading Chinese books/stories to your child? ($r_s = .458$, $p = .049$)
Q19: How often do you discuss the book contents with your child while reading with him/her? ($r_s = .658$, $p = .014$)

In other words, while the literacy outcome as shown by the PPCLS scores did not have much of a direct relationship with parents' demographics, except for father's education level, it was associated with whether parents kept more books at home, started reading with their children early, and engaged them during paired reading through discussions about book contents.

Next, we conducted an exploratory factor analysis and extracted four components based on the factor loadings of the 22 questions (see Table 4):

1. home reading routine and resources (questions 2, 4, 5, 10, 11, 18)
2. parental reading strategies (questions 3, 6, 7, 9, 14, 16, 22)
3. awareness about organizing reading activities and starting to read with the child early (questions 1, 12, 13)
4. joint interactive activities with the child (questions 8, 15, 17, 19, 20, 21)

In Table 5, we summarize the differences in the weighted mean scores between different groups of parents. Compared with parents of SLCO-Class Hearing children, parents of d/Dhh children showed a higher weighted mean score for components 2, 3, and 4, but a lower weighted mean score with component 1. On the other hand, parents of d/Dhh children showed a higher mean score than the non-SLCO hearing parents for all components; a bigger difference was observed for components 4 and especially 3. Among the parents of the children in the SLCO-Class Hearing, their weighted mean scores on components 1, 3, and 4 were just slightly higher than those of the parents of the SLCO-School hearing and non-SLCO hearing children, and slightly lower than the scores of these two groups for component 2, with a negative difference less than 0.1. These results suggested that the parents of the SLCO-Class Hearing children did not increase their efforts to enhance literacy resources and activities at home even though their children were studying in the SLCO classroom.

A Pearson correlation analysis was then conducted between the PPCLS scores of all children and scores on the four components. Among them, only component 3

Table 5. Parents' Weighted Mean Scores

	Component 1	Component 2	Component 3	Component 4
SLCO-Class d/Dhh vs. SLCO-Class Hearing	-0.100	0.149	0.139	0.137
SLCO d/Dhh vs. non–SLCO Hearing	0.157	0.014	0.256	0.190
SLCO-Class Hearing vs. SLCO-School Hearing	0.094	-0.076	0.083	0.037
SLCO Class Hearing vs. Non–SLCO Hearing	0.257	-0.135	0.117	0.053

Notes. SLCO = sign bilingualism and coenrollment. d/Dhh = d/Deaf and hard of hearing.

(i.e., *conscientious about organizing reading activities* and *start to read early with child*) emerged to be significantly correlated with the preschoolers' literacy outcome: component 1, $r = .171$, $p = .341$; component 2, $r = .032$, $p = .860$; component 3, $r = .446$, $p = .044$; component 4, $r = .047$, $p = .795$.

To conclude, components of the home environment, especially the efforts of parents to organize literacy learning, especially reading activities at home, and to start literacy learning at an early stage during childhood, were important predictors of preschoolers' better literacy outcomes. Although the sample was small, we saw some indication that parents of d/Dhh children were prepared to enhance the literacy resources at home to support their child's development.

Classroom Literacy Environment (CLE)

The following analysis was based on the demographics and total ratings of 21 teachers and the PPCLS scores of 51 preschoolers from all four groups who could be paired with their teachers. The total ratings of the 23 questions included in the second part of the CLE questionnaire ranged from 28 to 61. As we mentioned in the "Data Analysis" section, the teacher-student pairing revealed that the rating of each question by the teacher would be paired with how many students they taught, rendering the adoption of correlation analysis inappropriate. Therefore, we adopted simple descriptive statistics when comparing the responses of the different groups of teachers, to identify information that would provide insights for future research. Before we conduct the comparison, a description of the demographic attributes of the Deaf teachers is in order. There were three Deaf teachers in the SLCO class, who cotaught with the SLCO-Class hearing teachers. Two of these Deaf teachers possessed qualifications up to secondary 5 (equivalent to completion of 11th grade or junior high school), and one had graduated with an associate's degree. None had obtained qualifications for early childhood education. One Deaf teacher had joined the SLCO program just 1 year earlier and was still honing his skills. The other two Deaf teachers had been with the program for 13 years and 8 years, respectively.

First, we compared the mean ratings between the different groups of teachers. We found that the seven teachers (three Deaf, four 4 hearing) from the SLCO-Class setting had a mean rating similar to that of the six teachers from the SLCO-School setting. Also, the teachers in the non–SLCO-School environment showed a relatively higher mean rating than the teachers in the other three groups: SLCO-Class $M = 35.71$, $SD = 11.60$; SLCO-School Hearing $M = 34.33$, $SD = 4.50$; non–SLCO-Hearing $M = 39.13$, $SD = 3.44$. Disaggregating the mean ratings of the SLCO-Class between the Deaf and

hearing teachers disclosed that the Deaf teachers' mean ratings were relatively much lower than those of the hearing teachers: SLCO-Class Deaf $M = 30.33$, $SD = 3.21$; SLCO-Class Hearing $M = 39.75$, $SD = 14.55$. However, it needs pointing out the total ratings of the four hearing teachers were 29, 32, 37, and 61, implying that one teacher gave relatively much higher ratings to the questions than others, with the result being a large standard deviation. If we removed the total rating of this teacher, the mean dropped to 32.67, which would be slightly higher than the mean rating of the three Deaf teachers, with individual scores being 35, 30, and 29. In sum, the descriptive statistics suggest that within the SLCO-Class the hearing teachers were more conscientious than the Deaf teachers in organizing literacy training for students. Also, the hearing teachers from all environments indicated similar degrees of effort in building literacy resources for hearing children in their environment.

Next, we conducted exploratory factor analysis on the 22 questions, and extracted five components based on their factor loadings (see Table 6):

1. direct literacy teaching in the classroom (questions 8, 15, 20, 22, 23)
2. teacher's reading strategies (questions 3, 12, 13, 14, 16)
3. classroom reading resources and exposure (questions 2, 4, 19, 21)
4. teacher-student interactions (questions 1, 7, 17, 18)
5. literacy-rich daily routines and activities (questions 5, 9, 10, 11)

Table 7 summarizes the differences in the weighted mean scores of the components between different groups of teachers. As for the teachers of the SLCO-Class, the weighted mean scores of Deaf teachers were generally lower than those of the hearing teachers, but no difference between them was observed for component 4. The Deaf teachers' weighted mean scores were also lower than those of the hearing teachers in the non-SLCO kindergarten for all except component 3, which showed a positive difference of 0.263, suggesting that the Deaf teachers made more effort to organize literacy resources and language exposure than the teachers in the non-SLCO environment. As for the hearing teachers, those teaching the SLCO-Class had higher weighted mean scores than the SLCO-School hearing teachers except for component 1, but lower weighted mean scores than the non–SLCO-School hearing teachers in all components except component 3. Component 3 is interesting because its weighted mean scores indicated relatively bigger positive differences between the SLCO-Class teachers (Deaf and hearing) and the other hearing teachers in building classroom literacy resources and language exposure for their students. However, the non–SLCO-School hearing teachers made a greater effort to organize activities and procedures to support children's literacy development, such as more direct literacy teaching, devising reading strategies, having more interactions, and setting up routines for reading.

Discussion

We addressed two research questions in the present study. First, we asked whether differences in literacy outcomes existed between d/Dhh children who studied in the SLCO environment and those hearing children who came from the SLCO or non-SLCO environment. Since the sample was small and unevenly distributed, one should be cautious about interpreting the findings. We first conducted a correlation analysis based on the scores of the PPCLS and CGA-KG to verify if they shared some

Table 6. Factor Loadings and Communalities Based on a Principal Component Analysis With Oblimin Rotation for 22 Questions From CLE (Open Questions Not Included in Analysis)

	Component				
Question	1	2	3	4	5
Q22	.817				
Q23	.625			.325	
Q8	.602		.328		.368
Q15	.568				
Q20	.461				
Q13		.725			
Q14		.720			
Q12		.643			.518
Q16		.631			
Q3		.598		.560	
Q4			-.782		
Q21		.508	.726		
Q2			.672		
Q19	-.487		.617		
Q1				.831	
Q7				-.663	
Q18	.512			.640	
Q17	.305		.349	.498	
Q11					.803
Q10		.487			.702
Q5	.322				.624
Q9	.506				.566

Note. CLE = Classroom Literacy Environment Questionnaire.

Table 7. Teachers' Weighted Mean Scores

Group	Component 1	Component 2	Component 3	Component 4	Component 5
SLCO-Class Deaf teacher vs. SLCO-Class hearing teacher	-0.152	-0.311	-0.150	0.000	-0.033
SLCO-Class Deaf teacher vs. Non-SLCO hearing teacher	-0.186	-0.390	0.263	-0.042	-0.146
SLCO-Class Hearing teacher vs. SLCO-School hearing teacher	-0.030	0.066	0.333	0.056	0.050
SLCO-Class hearing teacher vs. non–SLCO hearing teacher	-0.034	-0.079	0.413	-0.042	-0.113

Note. SLCO = sign bilingualism and coenrollment.

underlying linguistic properties of written Chinese for children's literacy development. The positive correlation suggested that the two tasks could reliably gauge children's knowledge of written Chinese characters and words as well as grammar. As the children in the study were early literacy learners, a reading comprehension test consisting of passages to read would be beyond their ability. Although no standardized reading comprehension test was used, findings from the CGA-KG provided some preliminary evidence about the preschoolers' competence in processing sentences and phrases in written Chinese during the reading process. The PPCLS helped us gauge their knowledge of Chinese vocabulary in print since the subscales consistently assessed their word/character recognition abilities through an auditory or print mode. Subscale 4 (Read and Say) was quite challenging to all four groups of children, particularly the SLCO-Class d/Dhh preschoolers, because it required them to recognize a character in print and create a new word or a sentence containing the character.

An independent sample *t* test was used to compare the children in the SLCO and non-SLCO environments, with results showing that children from these two environments show no significant difference in performance in regard to Chinese word/character recognition and production abilities. Comparing means from the four groups of preschoolers also showed that the SLCO-Class d/Dhh preschoolers performed similarly to the other three groups of preschoolers (see Figure 1a), suggesting that the SLCO environment could be conducive to their vocabulary development. In the study by Q. Li and Tang (2020), an attempt was made to modify the task of this subscale into writing instead of speaking for a group of primary d/Dhh students; the results revealed that such a modification benefited only those d/Dhh students with low speech perception, while d/Dhh students with better speech perception performed at a similar level to that attained by the hearing controls.

In terms of CGA-KG performance, the mean score of the d/Dhh children was relatively lower than that of the SLCO-Hearing children: 53.33% versus 60.00%. However, both groups of children performed much better than the SLCO-School children (37.50%) and non–SLCO-School hearing children (25.83%). These results are encouraging, as they seem to show that the SLCO-Class d/Dhh and SLCO-Class Hearing children did not seem to suffer adverse effects from the addition of HKSL in classroom interactions, such effects being a common misconception among parents of d/Dhh children and sometimes parents of hearing children in general. It is noted that the preschoolers from the non–SLCO-School environment performed quite poorly on the CGA-KG task. As we have mentioned, the score was generated by just eight children who managed to pass the 70% vocabulary threshold, while 12 children failed to meet it. Nevertheless, it should be noted that only seven out of 11 SLCO-Class d/Dhh children passed the vocabulary threshold and attempted the CGA-KG, a finding that suggests that even within these two groups of children there was a recognizable individual variation in their literacy skills development. To conclude, d/Dhh children and their hearing peers studying in the SLCO environment did not display adverse effects on the development of Chinese vocabulary and written Chinese grammar.

Research question 2 was concerned with identifying HLE and CLE components associated with children's early literacy skills. Three questions in the HLE questionnaire were found to be associated with the children's PPCLS scores. They were (a) number of books at home, (b) preschoolers' age when parents started reading to them, and

(c) frequency of parent-child interactions during reading. The findings suggested that making more books accessible to children facilitates their literacy learning because they receive more exposure to Chinese in printed form. Besides, when parents start reading to children early, frequent parent-child interactions are often indirectly promoted. The present study did not include questions about dialogic reading strategies in the questionnaire; however, the findings to some extent support the findings of Fung et al. (2005), who observed that parent-child interactions facilitated vocabulary learning of d/Dhh children. The HLE results further showed that children's PPCLS outcome was correlated with component 3—that is, parents being conscientious about organizing literacy learning, namely, setting a reading corner (Q1), and starting to read to children early (Q12), and children starting to read words and characters aloud early (Q13). Many of these characteristics echo the findings in the existing literature (see Mol & Bus, 2011) that parental guidance plays a crucial role in young children's literacy development.

Because of the small size of the sample, the present study failed to verify whether parents of SLCO and non-SCLO preschoolers adopt significantly different strategies, nor to what extent the components identified are associated with d/Dhh children's literacy development (see research question 2). However, the mean ratings from parents offered some clues. For instance, parents of d/Dhh children were slightly more conscientious than other parents about starting to read to their child early and devising reading strategies and interactive activities at home. This finding is understandable, given that d/Dhh children's difficulty developing oral language initially or literacy skills for reading and writing at a subsequent stage has consistently concerned many parents. Note that when compared with parents of non–SLCO-School hearing children, parents of d/Dhh children made more of an effort to set up reading routines and literacy resources at home. They were even more conscientious about organizing reading activities or starting to read to their d/Dhh child early (see Table 5). Also, it needs pointing out that the HLE questionnaire did not include any questions about parents' use of sign language when interacting with their d/Dhh children during the reading activities. This issue poses an interesting empirical question for future research, since the quality and quantity of parent-child interactions and the languages adopted are predicted to have an effect on children's literacy development.

In the analysis of the CLE questionnaire, correlational analysis was inappropriate due to the small sample size of different groups of teachers; therefore, we resorted to using mean scores and standard deviations to identify some preliminary findings. The mean total ratings of the teachers therefore were highest for the non–SLCO-School Hearing teachers, while not much difference was observed for the hearing teachers of the SLCO kindergarten. SLCO-Class Deaf teachers had a slightly lower score.

The SLCO-Class Deaf teachers were found to have weighted mean scores that were relatively much lower in component 2 than other components, -0.311 when compared with SLCO-Class teachers and -0.390 when compared with non–SLCO-School teachers. This component involved devising reading strategies to support literacy learning, including frequently changing the books on display (Q3), reading to children early (Q12), children learning to read Chinese characters and words early (Q13), and children learning to write Chinese characters and words early (Q14).

Most of these strategies involved teachers making decisions on matters such as how early children should start to read or write and library policies. Very likely, the Deaf teachers working in this environment did not fully function like independent teachers taking complete control of the classroom procedures. Although they were coteaching with a hearing teacher, their lack of formal training and qualifications for early childhood education might imply that most decisions on curriculum planning and pedagogy were largely made by the hearing teacher. However, reports from the SLCO kindergarten revealed that Deaf teachers were often consulted before decisions were made. In future practice, the SLCO program should reinforce the equal status of Deaf and hearing teachers in the classroom, support more Deaf teachers in receiving tertiary education in related disciplines, and organize more literacy-related workshops to raise awareness of Deaf teachers as a resource for literacy learning, particularly in the use of sign language and techniques for supporting d/Dhh students' reading development.

Another component deserving attention is component 3, that is, classroom reading resources and exposure, derived from ratings given to (a) the number of books in the classroom (Q2), (b) fixing a time for reading with children (Q4), (c) using sign language when reading with children (Q19), and (d) frequency of taking children to libraries, dramas, and bookstores (Q21). Results based on weighted mean scores revealed that the SLCO-Class Deaf and hearing teachers had much higher ratings on these components when compared with the other hearing teachers (SLCO-Class Deaf versus non–SLCO-School Hearing = 0.263; SLCO-Class Hearing versus SLCO-School Hearing = 0.333; SLCO-Class Hearing versus non–SLCO-School Hearing = 0.413).

On the whole, the Deaf and hearing SLCO-Class teachers were more conscious of the need to build classroom resources and language exposure to boost their students' literacy learning. It is probably the presence of d/Dhh students in the SLCO class and their generally perceived weakness in literacy skills development that motivates teachers to be more conscientious about arranging literacy-learning activities in school. The SLCO kindergarten incorporates many reading sessions during the day. There is a preclass reading program in the morning, in which d/Dhh and hearing children are free to choose their reading materials and which is sometimes enriched by storytelling activities led by Deaf or hearing teachers. During the Montessori session in the afternoon, children can go to a reading corner to read independently. Additionally, d/Dhh children are also given individualized education program sessions during which either a Deaf or a hearing teacher conducts paired reading with them. In other words, SLCO education in a mainstream environment supported by direct sign bilingual communication enables d/Dhh children to engage frequently in teacher-student interactions during literacy-building activities at school (Wong, 2018). The addition of HKSL and Deaf teachers and the awareness that d/Dhh children require more teachers' efforts to boost literacy skills development have generally made the kindergarten a literacy-rich environment for all students.

In the SLCO classroom, especially where d/Dhh and hearing students are learning together, sign language has been adopted to help the d/Dhh and hearing students comprehend written content in storybooks. Under these circumstances, Deaf teachers play a pivotal role in facilitating these children's reading comprehension. Very often, interactions between the Deaf teachers and the students are conducted in HKSL and

involve spontaneous questions about story contents via confirmation checks and clarification requests, which are typical patterns in teacher-student interactions. The hearing teacher generally uses oral Cantonese, but also signs for direct communication either with the Deaf teacher or those d/Dhh students who have low speech perception even though they wear hearing devices. The hearing teachers' improved HKSL proficiency over time also implies that they are ready to support the d/Dhh preschoolers' reading using sign language, especially during the paired-reading sessions.

The present research did not address the role played by Deaf teachers or sign language in supporting children's literacy development. In future studies, researchers can systematically analyze the patterns of interactions during the reading sessions between Deaf teachers and d/Dhh or hearing students to identify the types of strategies Deaf teachers adopt to bolster development of reading comprehension skills. Although the SLCO-Class d/Dhh, SLCO-Class Hearing, and non–SLCO-School preschoolers attended a full-day kindergarten while the SLCO-School Hearing preschoolers were half-day students, the opportunity for direct literacy teaching and learning mainly occurred in the morning since kindergartens tend to engage children with extracurricular activities or interest groups in the afternoon. Nevertheless, the effects of a longer duration of exposure to the sign language of Deaf teachers on the literacy outcomes of the SLCO-Class d/Dhh preschoolers requires further investigation.

Limitations

The present study had several limitations. The sample size of each group of preschoolers and that of parents and teachers was small and sometimes unevenly distributed; hence, use of some statistical procedures for some analyses was inappropriate. The diverse performance and individual differences among students might also essentially alter the results. As the SLCO program only admits 5–6 children each year, in future research a longitudinal study substantiated with focus group discussions with preschoolers, parents, and teachers (especially Deaf teachers) would provide insights into the complex situation of adopting sign language and employing Deaf teachers to boost literacy development of children in the SLCO environment. Another limitation was the inability to control the differences in intervention between the SLCO and non-SLCO environments to compare literacy outcomes reliably. For instance, d/Dhh children could receive additional individual instruction because they had an individualized educational plan, which was not the case for hearing children.

Conclusion

The present study provided some preliminary evidence suggesting that, relative to their hearing peers, d/Dhh preschoolers performed similarly in tests on Chinese vocabulary and were slightly better than them in tests on written Chinese grammar. Moreover, the addition of sign language and Deaf teachers did not seem to affect the literacy development of d/Dhh and hearing students adversely. Parents of d/Dhh children were more conscientious about devising strategies to boost their children's literacy development. Although we failed to identify components in the home and school environments that might be associated with the literacy development of d/Dhh children specifically, we were able to find that the SLCO-Class Deaf and hearing teachers were more conscientious about organizing literacy resources and activities than the teachers in the other

environments. However, since the data sets were limited, efforts to replicate the research in the future are necessary.

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Appendix

Questions for the Classroom Literacy Environment (CLE) and Home Literacy Environment (HLE) Questionnaires

1. Does your child/student have a reading corner? (CLE/HLE)
2. How many Chinese books are available? (CLE/HLE)
3. How often do you change the Chinese books? (CLE/HLE)
4. [Options: every 30 days or above / every 15–30 days / every 7–14 days / more often than every week / never change]
5. Do you set a fixed time to read Chinese books/stories to your child/student? (CLE/HLE)
6. How often do you read Chinese books/stories to you child/student? (CLE/HLE)
7. [Options: every day / every week / biweekly / monthly / other]
8. How long does the reading session typically last? (CLE/HLE)
9. Who typically selects the books/stories to read? (CLE/HLE)
10. How often do you read aloud during the reading session? (CLE/HLE)
11. How do you typically get your child/student engaged in Chinese reading? (CLE/HLE)
12. [Options (can choose more than one): Encourage her/him to read by herself/himself / set routine reading time / use play-based method / other]
13. How often do you conduct pre-reading activities with your child/student? (CLE/HLE)
14. How often do you conduct postreading activities with your child/class? (CLE/HLE)
15. When did you start reading Chinese books/stories to your child/class? (CLE/HLE)
16. When did your child/class start to be taught to read Chinese characters? (CLE/HLE)
17. When did your child/students start to be taught to write Chinese characters? (CLE/HLE)
18. How often do you listen to your child/student reading aloud? (CLE/HLE)
19. What kind of materials do you prefer to use for teaching your child Chinese literacy? (CLE/HLE) [Can choose more than one option): children's books / picture books / textbooks / newspapers / magazines]
20. How much time do you spend each day talking to your child/students? (CLE/HLE)
21. How often does your child/class see parents/teachers reading Chinese? (CLE/HLE)
22. How often do you discuss the contents of the books with your child while reading with him/her? (HLE)
23. OR How often do you use sign language when reading with your students? (CLE)
24. How often do you take your child to the library / to the bookshop / to watch children's opera? (HLE)
25. OR How often do you discuss the book contents with your child while reading with him/her? (CLE)
26. What is your main purpose for reading stories/books to your child? (HLE)
27. OR How often do you take your class to the library / to the bookshop / to watch children's opera? (CLE)
28. Do you follow a specific approach in teaching Chinese literacy? (HLE)
29. OR What is your main purpose for reading stories/books to your class? (CLE)

30. [Can choose more than one option): enhance students' literacy / enhance teacher-student interaction / teach story contents / fulfill curriculum requirement / other]
31. What kinds of activities do you typically use when teaching Chinese literacy? (HLE)
32. OR Do you follow a specific approach to teaching Chinese literacy? (CLE)
33. What is/are the main reason(s) for teaching children to read and write Chinese characters in early childhood? (HLE)
34. OR What kinds of activities do you typically use when teaching Chinese literacy? (CLE)
35. What is/are the main reason(s) for teaching children to read and write Chinese characters in early childhood? (CLE)

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