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Xiaodi Zhou
University of Texas Rio Grande Valley, fugee613@gmail.com

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Cover Page Footnote

About the Author:

Xiaodi Zhou, PhD, is Assistant Professor of Literacy at the Bilingual and Literacy Studies Department at the University of Texas Rio Grande Valley. He was born in China, but came to the US after first grade, and has been educated in the US ever since. He has research interests in the cultural and linguistic identities of cultural minorities in the US, as well as their manifestation in and development through literacy. His current work deals with Mexican American students in South Texas, and how their cultures and languages are in dialogue with each other in their daily lives. He loves traveling and sampling different foods from around the world. He now resides in South Texas with his wife and two young children, his greatest joys.

On the Road to Translanguaging in a Dual Language Classroom: Teaching Math and Science in Mandarin and English

Xiaodi Zhou
University of Texas Rio Grande Valley

This article examines the evolving instructional practice of one Chinese dual language instructor in the US as she employs a translanguaging-inspired approach in her math and science Mandarin medium classes. Contrary to the school language allocation policy requiring 90% Mandarin in her Chinese classes, she encourages the utilization of English as well as Mandarin in her instruction. This offers comprehensible input to learners, also making possible greater student participation. Findings from observations and interviews reveal how a focus on meaning-making in instruction resulted in the gradual evolution of bilingual language use and effective communication of content by students and the teacher.

Keywords: Chinese, dual language immersion, pedagogy, scaffolding, translanguaging

"*Hěn hǎo* (很好, Very good), Jason," Ms. Tang (all names are pseudonyms) said, while patting the student on his back, proud of the growth she had witnessed just in the past semester. "*Xiè xie*, *Lǎo shī*" (谢谢, 老师 thank you, teacher), the small African American boy uttered confidently as he snatched his homework back from his teacher. This student was in a Mandarin Chinese/English one-way developmental bilingual program characterized by Hancock County Elementary (HCE, pseudonym) as a "dual language immersion program," in the suburbs of Atlanta. This program was initiated in 2013, five years before the study discussed here. (Unless otherwise noted, all mentions of "Chinese" in this article refer to Mandarin.)

Many models for delivering two languages in a bilingual program are possible, and controversy remains regarding the most effective approaches in particular settings (Baker & Wright, 2017; Ebsworth, 2009). Furthermore, it must be acknowledged that there are cognitive, linguistic, and social issues involved in Chinese bilingual programs as they grow in prominence around the country. Even as interest in such programs has taken off in recent years, there are still unresolved issues that may jeopardize their success. In a traditionally monolingual context such as the United States, there is push-back by some against the usage of languages other than English in the instruction of

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young children (Fu et al., 2019), and the program at HCE is reflective of these tensions. Nevertheless, a flexible bilingual approach allows students and teachers to draw on all their linguistic resources to convey meaning to each other (García & Li, 2014).

The current study considers the development of home language support at HCE by a teacher in two second-grade content-based Mandarin immersion classes in the program, one in math and another in science. The focus here is on the evolution of language use in the direction of first language support through translanguaging by a Chinese/English bilingual teacher and her students in a program where the language allocation policy was 90% Mandarin and 10% English in Chinese classes and 100% English in English-medium classes.

A consideration of the literature in the forthcoming section supports the positive benefits of bilingual education and the effectiveness of allowing students to make use of the languages they know as well as the target language to learn content while developing their additional language skills. Next, I present the methodology of the study. Findings and discussion sections follow and are combined. The last part of the article presents implications for teaching and further research.

Literature Review

Interest in China has taken root in the United States in recent decades reflecting its growth in economic prestige and global influence. Accordingly, the status of Mandarin, the Chinese language of wider communication, has similarly expanded (Ding & Saunders, 2006; Rapoza, 2019). Not only is Mandarin becoming a major second language option for secondary and college students, but this language is also represented as early as elementary levels (Sung & Tsai, 2019). Thus, recent educational efforts such as the program at HCE have focused on beginning early by immersing elementary-aged children in the Chinese language as part of their primary education. Specifically, elementary schools that teach Mandarin have become a growing trend around the nation, seeing a five-fold increase from 2006 to 2013 (Carstens, 2015). For example, Chicago has developed an innovative means of teaching Mandarin at 20 of its public schools (Chmelynski, 2006). To offset the lack of qualified instructors, these schools are hiring teachers from China to team-teach with U.S. teachers, where they plan and implement an integrated cross-curricular curriculum. However, although these teachers from China are native Mandarin speakers, they often have little or no training or experience in bilingual pedagogy, and instruction in the U.S. educational context is challenging for them (Wu, 2017).

In developing the bilingual model at HCE, alternative possibilities were considered. For example, administrators looked at the second language immersion approach. This modern bilingual language education model for instruction was pioneered in Canada where the nation has two official national languages, English and French (Wardle, 2009). Using a second language immersion approach, all the schooling in the initial years was delivered in the target language (French), sometimes progressing to a 50-50 French/English model by higher grades. The Canadian students were mostly English speakers in a French immersion school context. What resulted for these emergent bilingual learners was higher performance in both math and English than what had been achieved by their mainstream peers in all-English programs

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(Lindholm-Leary, 2012). Also, as English-speaking students acquired French in the school setting, their English was maintained in the environment outside school since English was used at home and in the community where they resided. Another benefit of such schooling was greater cooperation between home French speakers and French learners, as the French and English-speaking communities were more socially engaged due to their shared bilingualism.

However, in adapting this model to a Mandarin-English bilingual program in the US, we need to consider that the social milieu is different than in Canada since the community and homes of the students attending the HCE school are largely monolingual. Thus, English is the dominant language in the school as well as outside school. In addition, it is important to note that in linguistic terms there are fewer opportunities for positive transfer between Mandarin and English oracy and literacy compared with French and English in the Canadian context. This reflects the different relationships between the languages, including the fact that Mandarin is a tone language and there are very few cognates between English and Mandarin as compared with French. Furthermore, written Mandarin uses either a traditional or simplified character-based writing system as opposed to an alphabetic one although alphabetic alternatives such as pinyin have been developed. The context for learning is also different as students in the HCE program considered here do not have easy access to native Mandarin speakers as compared with the target language speakers available to French learners in Canada.

Nevertheless, in electing to offer their bilingual program, HCE leadership is responding to the benefits of bilingualism and the advantages of starting early. Teaching a new language is particularly beneficial in the younger grades because of children's higher synaptic plasticity and brain capacity to acquire another language earlier in life (Li et al., 2014). Indeed, the academic benefits of bilingual education are apparent particularly when begun in the elementary grades, as learning an additional language correlates with increased performance in a range of disciplines (Stewart, 2005). This speaks to the concern of U.S. schoolboards and departments of education regarding the mathematical achievement of elementary students; bilingual program participants have shown markedly improved mathematics scores (Lindholm-Leary, 2012) and higher achievement in science as well (Garza-Reyna, 2019). These researchers point to other benefits, include more developed cognitive skills, higher achievement in all academic areas as noted above, and higher standardized test scores over time. This last benefit may be especially appealing for schools and administrations, which are often evaluated based on their students' performance on such exams. An important caveat has been suggested, however, as in a study of bilinguals' reading and mathematics skills (Berch et al., 2018), participants stressed the importance of understanding the language in which mathematics is presented to learn effectively.

Additional advantages of bilingual education programs are consistently reported (Thomas & Collier, 2003), and suggest that both English speakers and speakers of other home languages have been found to gain in creative thinking and insight (Kharkhurin, 2018). Developmental bilingual curricula in the United States are designed to add a language to students' knowledge and/or maintain and continue optimum development of the students' home language while engaging in and learning from a curriculum in

English (García & Baker, 2007). These programs are ideally designed in a rigorous fashion, with a minimum of six years of bilingual instruction, a focus on the core curriculum, and high-quality language arts programs in both languages. In the upper grades, continued instruction of the target language supports an additive bilingual environment with well-prepared bilingual personnel and an active parent-school partnership (Baker & Wright, 2017). This dual language pedagogical approach has the potential to meet the needs of all students, English native speakers, and those learning English as an additional language, in both their academic and linguistic development.

Students who learn another language also gain in self-esteem and improved self-concept as proficient bilinguals (Lindholm-Leary, 2016). In a study of Mandarin-English and Spanish-English bilingual language programs, 788 students from 5th to 8th grades were assessed, self-rated, and interviewed pertaining to their second language proficiency. These emergent bilingual students were deemed proficient in their second language by test scores, rated their second language as proficient, and enjoyed participating in the program. They also held positive attitudes towards speakers of the target language, as well as its associated culture, appreciating the cognitive and social benefits of dual language programs. The positive associations between language and culture have been widely acknowledged, as the two are intimately connected (DeNisco, 2015). Thus, bilingual language instruction also has the potential to impart cultural awareness to students.

Importantly, the concern that reduced exposure to a target language which results from incorporating two languages in curricula could result in negative learning outcomes is misplaced. Chavez (2016) found that there was no correlation between increased usage of students' home language and decreased usage of the additional target language. In her study of three instructors in a German-as-a-second language classroom in a midwestern U.S. city, the researcher reported varying degrees of English usage in teacher and student utterances. What she found more predictive of target language speaking frequency was the use of peer collaborative tasks, where students interacted authentically with each other in thinking through a question or a problem, and activities such as whole-class peer talk. Thus, the notion that "L1 use reduces L2 use in direct proportion found no support in the data" (p. 155). Indeed, in studies of bilingual and second language classrooms, utilization of students' home language has been found to be an asset to content acquisition and peer communication. Additional evidence comes from a study in which specific classroom activities, such as board games like Mystery Forest, have been utilized to teach Chinese to English speakers in bilingual programs (Poole et al., 2019). While the games in the study were often in English, the researchers report that student engagements and unsolicited comments were often in Chinese. Incorporating such highly interactive games mainly in their home language, with expressions in the target language could be motivational in nurturing proficiency in the target language, as well as developing student interest for learning that language.

Given that ultimate achievement of bilingualism is an asset, some have argued that immersion programs must only use the target language for instruction and communication (Fortune & Jorstad, 1996). However, in a review of recent studies I found a validation for the use of both languages, rather than only the target language,

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even in an immersion classroom. In terms of language immersion classrooms in general, past research has advocated the use of students' home language to help them acquire their additional language, which means that in practice, "immersion" would not necessarily be limited to the additional language input only, as the term might suggest (González-Carriedo et al., 2016). In their study, these researchers investigated a dual language elementary classroom in north Texas, where native Spanish speakers and native English speakers were grouped together; each helped the other with acquisition of their respective additional language. "These bilingual pairs collaborate[ed] and create[ed] meaning together" (p. 109), as they flexibly utilized their home language to assist others and themselves in facilitating both content and language learning. Elsewhere in such programs, students collaboratively created bilingual word walls to abet recognition of the target language for classmates in the dual language classroom (Espinosa & Ascenzi-Moreno, 2021). The idea of validating the use of both languages in immersion programs was promoted over twenty years ago by Cummins (1998) when he alerted us that not all contexts are equally conducive to a full immersion approach. He identified three immersion models that were operational in Canada over a period of years. These were early immersion, middle immersion, and late immersion. However, regardless of the model, the home language played an important educational role over time. In addition, the home language of the students was always used outside school. The criteria of immersion programs that Cummins proposes highlight the importance of meaning enhancement through making input comprehensible. To achieve this, the students' stronger language must play a role in their immersion experience.

A more recent example of the importance of using both languages to learn in immersion programs is found in a study conducted by Swain & Lapkin (2013). In their review of language allocation decisions in one or two-way immersion classrooms, the scholars focus on teachers' perspectives and practices based on those decisions. They identify a broad range of opinions from the extremes of exclusive target language use or great reliance on the home language to more nuanced practices incorporating both languages. Taking a socio-cultural view of language acquisition, they consider not only the need to convey information via language but also how language itself can frame ideas. They reveal the mediating effect of "collaborative dialogue" (p. 106) in developing ideas that are conveyed through language. Using these lenses, they highlight how access to students' stronger languages can help them to understand content and convey the meaning they intend in the target language. The researchers conclude that the integration of both languages in the learning process can be advantageous.

Indeed, in Cummins' (2007) study, he argued against the rigid separation of the languages in instruction, referring to home language as L1 and additional language as L2. He made the case for the use of students' more proficient language in the service of content acquisition. One meaningful learning activity suggested by Cummins involved utilizing the L1 by reading and telling stories in students' L1 and translating them into the L2. Students of the same language background could be grouped together so those who were more proficient in the L2 could assist those who needed help. Students were also encouraged to use bilingual dictionaries and have access to books in their L1. In addition, family members were engaged as a resource for students' L1 development. For example, for one student from the greater Toronto area whose L1 was Urdu,

Cummins found that when linguistic flexibility was employed, "[h]er home language, in which all her prior experience prior to immigration were encoded, became once again a tool for learning" (p. 235). As research and practice continue to develop, strict language separation has become more and more contested (García & Lin, 2017; Wiley, 2019).

Particularly in the context of dual language immersion classrooms, the integration of languages is favored. In these heteroglossic contexts, students' diverse ways of languaging, learning, and showcasing this learning are all valued. Contemporary scholarly literature recognizes the importance of using the rich, complex, and multifaceted linguistic repertoire of students as a strategic tool in instruction to support the learning of both content and language. This view serves as a foundation for the construct of translanguaging. As discussed by Sánchez et al. (2018), this construct acknowledges that students exposed to more than one language "develop a unitary linguistic competence; that is, the two languages of a bilingual are not separate linguistic systems but manifestations of acts of deployment and suppression of linguistic features (words, sounds, rules) that society assigns to one or another language" (p. 38, parenthetical in original).

In this review of the literature, we have seen that various bilingual models have adopted alternative language allocation policies with varying results depending on linguistic, sociocultural, and contextual factors. Furthermore, following earlier work on first language support (Auerbach, 1993; Cummins, 1979; Skutnabb-Kangas & Toukomaa, 1976; Wells, 1999; Williams, 1996), translanguaging was introduced as a key construct that illustrates how the dynamic integration of languages in instruction serves to facilitate learning of content and acquisition of language. As part of an open language policy where all languages are potentially valid communication tools (Shohamy, 2007) it allows learners and teachers to make content comprehensible and meaningful. To deepen the exploration of how the integration of languages in instruction opens different paths to learning, the following section discusses translanguaging as a theoretical and pedagogical construct.

Translanguaging: Theoretical Constructs and Connections to Pedagogy

Translanguaging is conceptualized as a fluid organic integration of languages that maximizes expressivity (García et al., 2016; García & Li, 2014). In the present sense, translanguaging "considers the practices of bilinguals not as two autonomous language systems as has traditionally been the case, but as one linguistic repertoire with features that have been societally constructed as belonging to two separate languages" (García & Li, 2014, p. 2). In this paradigm shift from traditional notions of multilingual education, languages are utilized with each other to transmit meaning. This practice most aptly refers to "the simultaneous process of continuous becoming of ourselves and our language practices, as we interact and make meaning in the world" (p. 8).

Cen Williams (2000) coined the Welsh term, 'trawsieithu' in the 1980's, translated as 'translanguaging' (Lewis et al., 2012). Poza (2017) reviewed the use of this construct over time, and demonstrated its range of usage in the field, adding "a set of teaching practices," which incorporate the fluid use of two languages to make meaning, but also identified its connection to language teaching and learning through the lens of

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critical pedagogy, an aspect that is inconsistently present (Canagarajah, 2011). The advantages to the use of translanguaging, which promote learners' employment of all their language resources in making meaning, continue to be reported and advocated (García & Otheguy, 2020).

We can see that as the overlapping fields of language learning and bilingual education have developed, the access to one's native tongue to help make meaning while acquiring an additional language or developing both languages have been a consistent refrain (Lin, 2013). Whether in a foreign language setting (where the use of the L2 is essentially classroom-based) or in a second language setting (where the L2 is the language of the community or country in which the class resides), evidence has accumulated that promoting the use of students' total sociolinguistic resources to make meaning is advantageous. And further, this practice is a normal part of social communication in bilingual communities all over the world (Poza, 2017). In a dual language context, enacting a "translanguaging language allocation policy that would enable teachers to legitimately provide students with translanguaging affordances would empower all students to meaningfully participate in classroom instruction, regardless of their types of language performances and learning abilities" (Sánchez et al., 2018, p. 43).

This notion "connotes one linguistic system that has features most often practiced according to societally constructed and controlled 'languages,' but other times producing new practices" (p.14). For instance, a translanguaging reframe can bridge the divide between conceptual growth and language learning by privileging communication and understanding as bilingualism and biliteracy develop in learners (Fu et al., 2019). In this way, learning can be a heteroglossic endeavor (Bakhtin, 1981), so "that the various different points of view, conceptual horizons, systems for providing expressive accents, various 'social languages' come into contact with one another" (p. 282). Other instructional practices that promote a dialogue between languages include translation (Baynham & Lee, 2019), code-switching (oral language), and code-meshing (written language) (Canagarajah, 2010; Grosjean & Miller, 1994).

Relevant to the investigation discussed in this article is the practice of translation. While translanguaging itself is both philosophically and practically more complex and multidimensional, the strategic and targeted use of translation has been identified as of potential use in settings where a translanguaging approach is welcome. When used in a dynamic way, where the focus is to draw on two languages creatively to ensure that meaning is conveyed successfully in a bilingual classroom setting, a teacher or interlocutor may use translation into the learner's dominant language to explain or paraphrase what is said in the less familiar language when it is not understood. The construct of translanguaging can overlap with the practice of translation, as Baynham and Lee (2019) elaborate, "translanguaging can be a way of understanding the moment-to-moment deployment of the multilingual repertoire in the activity of translating" (p. 34).

To summarize, in this study, translanguaging is framed as granting children their full repertoire of linguistic features to maximize their communication. So, as a practice, in the field of bilingual education, "*translanguaging* [has] helped students make

meaning and gain understanding and knowledge" (García & Lin, 2017, p. 3, parenthetical added), thereby supporting content acquisition through scaffolding learning upon established understanding. Learning becomes personalized and authentic, encouraging students' utilization of their home language as they make connections to prior knowledge and experiences, most likely also processed and stored in that language, registering new content into meaningful and intimate know-how (Cummins, 2007). With a focus on meaning drawing on all linguistic resources, learners can more successfully process both content-based and second language expression which becomes comprehensible input (Krashen, 1982, 2014). As explained by Krashen and Terrel (1995), "language acquisition only takes place when a message which is being transmitted is understood" (p. 55).

In essence, by implementing translanguaging pedagogy, the child's language learning becomes a more natural communicative endeavor rife with meaning and relevance. However, to incorporate translanguaging may require a reconsideration of a school community's assumptions regarding multilingualism and pedagogy (Menken & García, 2020). This issue is the focus of my investigation, described in the section that follows.

Research Questions

1. What are the strategies and student engagements within a classroom in which the teacher privileges the exchange of meaningful information through a translanguaging-inspired approach for math and science instruction in a second grade Mandarin/English bilingual setting?
2. What are the social dynamics and academic processes of using a translanguaging-inspired approach for both the instructor and the students?

Method

This case study (Dyson & Genishi, 2005), part of a larger research endeavor, focuses on one Chinese-born early grades elementary teacher implementing an approach that focused on meaningful exchanges in teaching mathematics and science in a second grade Mandarin-English bilingual program. Given the problematic school-based 90% immersion policy in Mandarin classes, it was important to offer thick and rich data documenting the efforts of a teacher prepared to take an alternative route in language allocation to facilitate acquisition of both language and content.

Context

As noted above, the present study was conducted in a second grade of a Mandarin Chinese/English one-way developmental bilingual program at HCE. The bilingual program had been initiated by the school's principal, Dr. Jones, who has a Doctor of Philosophy in Education. She felt motivated to do so after attending a seminar regarding Chinese immersion classrooms, after which she traveled to China for a summer to observe Chinese elementary classrooms in schools in Shanghai. She was eager to bring such cultural and linguistic contextual learning and the benefits of bilingual education to her students in the United States.

In what began as a pedagogical experiment, the school hired six Chinese instructors, some Chinese American and some directly from China, to teach the Chinese

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curriculum. The initiative represented the first Chinese/English bilingual program in the area, and parents of students in the program were eager to expose their children to this type of innovative instruction. Going from kindergarten through fifth grade, students are taught some subjects bilingually in Mandarin and English and others solely in English, as noted above. Importantly, the administration expected instructors of Mandarin language classes to teach in the target language of Mandarin Chinese 90% of the time with 10% allocated to first language support in English.

The students in the program came to Ms. Tang's classroom for math and science in Chinese for half the day and then went to her mainstream counterpart for English language arts (ELA) and social studies in English for the other half. The grade was divided into two sections, and her two classes switched before lunch.

Ms. Tang's class consisted of 48 students in total. Her mainstream colleague had altogether 55 students in total, and the other dual language class had 37 students. All students had comparable socioeconomic, racial, and gender distribution. There was no academic requirement for the bilingual classroom, only parental willingness. This could have meant that these families were more invested in their children's education and had been more eager to support their learning. I am aware that this possible selection bias may have been a confounding factor in my study. There were no separate math or science tracks, nor was a gifted program available. Nevertheless, based on a comparison of prior year test scores and familial, linguistic, socioeconomic, and racial/cultural distributions of students in these classes (this data was offered by the principal), students in all classes were deemed to be evenly distributed in terms of academic and cultural backgrounds.

Participants

The participants in this study were the teacher, Ms. Tang, and 13 students, whose parents signed the consent form, from the science and math classes she taught. Ms. Tang was 28 years old at the start of this study. She had spent the majority of her life in China but moved as an adult to the United States with her Chinese American husband. She received her master's degree in the Curriculum and Instruction department of the College of Education in a major university in the southeastern United States and had been teaching full-time at Hancock County Elementary for four years when I conducted the study in 2018. As part of her degree program, she had completed a year-long internship at a local southeastern U.S. public elementary school, where she learned more about the culture and behaviors of young students in the United States as well as the larger U.S. cultural context, exploring effective pedagogy for meeting their learning needs. When she began her career, she started by teaching a mainstream class during her first year and transitioned to the dual-language program a year later; she was deemed an exemplary instructor by her principal. The reason I chose her classroom as my primary focus was because data from the school reported in summative evaluation highlights distinguished Ms. Tang's class from those of her peers at the school.

Ms. Tang taught two classes: the math class had 23 students (12 girls and 11 boys), and the science class had 25 students (15 girls and 10 boys), totaling 48 students. In the math class, the students were mostly native English speakers, with one Hispanic

girl (from a Spanish-speaking family) and one biracial (Caucasian and African American) boy. The science class consisted of mostly native English speakers except for one East Indian girl (who also spoke Hindi) and one boy of Chinese descent. (The Chinese American boy was dominant in English, but Fujianese, a Chinese variety not mutually intelligible with Mandarin, was spoken by his family; he was culturally Chinese to some degree). All the students with alternative home languages were English-dominant at the time of the study. Family occupations ranged from technicians and mechanics to local restaurant owners and employees of major companies in Atlanta. Both classes took place in the same classroom with students changing rooms at the end of each period.

The thirteen students in this study were in second grade but had been in the program for two years prior to Ms. Tang's class. In essence, they had a basic understanding of Chinese, were able to understand simple directions, like *zuòhǎo* (坐好, take your seat) and *búyào jiǎnghuà* (不要讲话, no talking). In kindergarten and first grade, children had worked on comprehension of simple Chinese directives, learning how to read and write numbers up to one hundred, and to speak commonly used words and phrases, such as *shū* (书) for "book" and *wǒ xǐhuān zhège* (我喜欢这个) for "I like this," as well as how to ask questions in Chinese with *wèishénme* (为什么) for "why," *shénme* (什么) for "what," and *zěnmehuì* (怎么会) for "how come," which they learned in prior grades. They could also copy Chinese script from the board, and could write basic math terms in Chinese, such as "*jiā* (加, add)," "*jiǎn* (减, subtract)," "*děngyú* (等于, equals)" and "*zǒnggòng* (总共, in total)."

Researcher Positionality

I am a thirty-nine-year-old naturalized U.S. citizen from Nanjing, China. I came to the United States when I had just turned seven, and since second grade, had all my schooling in the United States. While in this country, I rebelled against learning Chinese, and consequently, never maintained my Chinese literacy.

Having been educated for most of my life in the United States, I returned to China as an adult to teach English for three years after receiving my master's degree in Counselor Education. There I learned more about my heritage culture and language. While I am now proficient in speaking Mandarin, I have only very rudimentary Chinese reading and writing ability and so have had to member-check all my translations of Chinese data with Ms. Tang. Throughout the course of this research, I have been intentional in not allowing my personal experiences of and feelings towards learning Chinese influence my analyses of the data.

Data Collection

As the researcher, I worked in tandem with both the classroom instructor and school personnel to implement this study. Data for this study was collected through observations of instruction and interviews of participants as well as a review of student work in the fall of 2018. A conversation with the principal further illuminated the findings. I conducted observations of Ms. Tang's instruction in the second-grade classroom of the Dual Language Immersion program a total of 36 times for an entire day each time. In particular, I looked at the discourse of the classroom, the languages

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utilized in instruction, types of interactions between the teacher and students, the students with each other, as well as the students' engagement with the learning materials. I was also able to observe two other dual language classrooms (Ms. Chen and Ms. Zhang) four times each but did not collect any other data, such as student work or interviews, in those settings. My interest was to compare the practices observed in these two classrooms with Ms. Tang's classroom to identify any patterns of similarities and differences in terms of instruction and communication. Observations were documented through notes of student interactions and writing down specific speech verbatim as I heard it. Observations also occurred on the playground at recess a total of five times.

Additionally, to enrich my understanding and appreciation of the context, I took photographs of classroom arrangements and student work. Lastly, to study written production for translanguaging, I collected writing samples from the students, most of which were assigned and written in simplified Chinese script concerning answers to math or science questions. Ms. Tang shared her students' homework, classwork, and projects digitally with me. In her instruction, she never used *pīnyīn* directly in her teaching although expressions with *pīnyīn* did appear on the walls of the class. Rather, Ms. Tang only pronounced the words and wrote the simplified characters for students. These artifacts documented the students' and teacher's productive use of both languages over time.

I interviewed Ms. Tang a total of six times. Each semi-structured interview lasted approximately an hour. These conversations addressed her instructional practices, the cultural activities, and manifestations of her students, as well as those of herself (Leech, 2002). The principal and parents of students were also interviewed. Audacity software on my laptop was used to audio-record all interviews. I was in the classroom two days each school-week for the entire semester. Another resource for my findings included my observation notes which served to document teacher instruction and student action/interactions. This provided a rich and thick resource which was additive in informing my understanding of how teaching and learning across languages took place.

Data Analysis

Interviews were transcribed via Express Scribe software, and then I coded the transcripts using ATLAS.ti. Emerging themes were identified through a recursive process including U.S. culture, Chinese culture, Chinese language, English language, and digital literacy. The data was initially coded via preset categories of ethnicity, gender, age, Chinese, English, translanguaging (operationalized as the concurrence of both languages in one utterance, writing sample, or reading of text), and types of behavior (e.g., groupwork, one-on-one, independent). There was recursive thematic analysis of writing, speech, and behaviors of students and the instructor (Landauer et al., 1998).

The analysis connected the data to either cultural or linguistic classifications as more Chinese or more US-leaning. For example, when speaking about Chinese language or cultural artifacts, such as orally discussing or writing in simplified script about the Mid-Autumn festival, I coded this as pertaining to Chinese associations. When discussing or writing about U.S.-based issues, like the unit on George Washington Carver for the science unit on the life cycle of peanuts, I coded this as more U.S.

associated. There was a third categorization, which was a hybrid of both cultures, when Chinese artifacts were discussed in English in connection to the students' own experiences and when U.S. artifacts were discussed in Chinese or in the vein of Chinese culture. This hybrid classification was particularly indicated by translanguaging in speech and writing (García & Li, 2014). The codes were mapped on a spreadsheet and the instances for each manifestation were recorded.

Triangulation of data sources included a comparison of the observations, interview data, and student work (Flick, 2004) to identify consistent themes. I analyzed codes from both interviews and observations and then compared them with the student products. For example, "translanguaging" was one major theme that appeared in all three data types. In my analysis of each translanguaging event, I documented the event in rich detail. For instance, I took note of the nature of the communication (e.g., oral, written), content of communication (e.g., math, science) the nature of work (seatwork, collaboration), and the number of students involved. I also noted the demeanors and eagerness of students, their levels of participation indicated by their mannerisms, speech frequency and volume. In the interview, I highlighted words that described translanguaging and noted the corresponding speech around this term. I member-checked interviews and class observations with Ms. Tang after my transcriptions and field-notes. Translanguaging was coded when students were utilizing their entire linguistic repertoire, with English as their dominant language and Mandarin as their additional language, to convey their intended meaning. The next section reveals the multiple dimensions in which translanguaging evolved in the focus classroom.

Findings and Discussion

When I visited Ms. Tang's classroom, I found that the dominant language makeup of Ms. Tang's class consisted of English native or English-dominant speakers, with just a few speakers of home languages other than English. In her classroom I saw vibrant graphic organizers adorning the walls with common Chinese expressions written both in Chinese and *pīnyīn*. Also visible was an agenda for the day on the whiteboard, as well as names of all the students positioned on a behavior chart with corresponding faces (smile=good, no smile=caution, frown=parent contact). There was a treasure box in the front of the room, where the students could trade in their tickets, or what they called *miàn miàn*, for prizes at the end of the week. Tickets were given for commendable behaviors and exemplary schoolwork. There were different graphic organizers of writing conventions and math facts written in both English and simplified Chinese script. There was a map of China and a world map in the front of the room, with desks arranged in six clusters of five with a multicolored oval rug towards the whiteboard at the front. The teacher's desk was in the back end of the front side under a large window to the outside, where she was able to observe all students. As a teacher in the public-school system in Georgia, Ms. Tang was required to follow the Georgia State Standards as mandated by the schoolboard, whose mastery was assessed by end-of-the-year high-stakes examinations.

When observing, I recorded instances of student interactions and conversations with each other almost entirely in English. Students engaged with the instructor mostly in English, while phrases like, "Can I go to the bathroom [我能去洗手间吗 (wǒ néngqù

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xǐshǒujiān ma)],” were spoken in Chinese, having been explicitly taught beforehand. During my entire observation period, 92% of student interactions were in English and 8% were in Chinese or a form of Chinese interlanguage.

As part of my larger study of Mandarin classrooms in the school, I was able to observe the other Mandarin math and science classrooms in the same grade led by another instructor, Ms. Chen. Here I describe her classroom to offer a background of what was more commonly observed in bilingual classes other than Ms. Tang’s. Ms. Chen’s class was similar in makeup to that of Ms. Tang in that all students were English natives or English dominant with a similar gender ratio. Ms. Chen’s teaching style consisted of mostly lecturing in front of the classroom the entire time, and the students were not responsive in terms of speech or behavior. Students in that class talked to each other in English about unrelated issues, used their cellphones, and often failed to respond to the teacher’s questions about the course content. There were also instances of evident student and instructor frustration in terms of inability to communicate clearly with each other. There were occasions of student outbursts and the teacher sighing. Ms. Chen, as a newly arrived Chinese teacher, even told me, “In China, students are afraid of the teacher. Here, they’re so wild!” The instructional climate this instructor cultivated did not suggest an interactive instructional style, perhaps reflecting her unfamiliarity with the cultures and school expectations of U.S. students (Wu, 2017).

By comparison, my observation in Ms. Tang’s classroom revealed an instructional style that was interactive with a flexible language use which developed over time. Ms. Tang confirmed that she did not initiate her instruction at the beginning of the semester with any specific plan for translanguaging. In fact, she started following a model in which most teaching was done in Mandarin as official school policy mandated, and as I observed in the other bilingual classrooms. However, when she found that students were becoming frustrated and effective communication could not occur, she shifted her language allocation to incorporate a more fluid model that favored English when needed for comprehension but included Mandarin when it could be used in a meaningful way. Other research has suggested that even seasoned teachers in bilingual programs have struggled, as Ms. Tang’s has, with the 90% target language rules and have had to rely on gestures and pictures to help students learn and retain new concepts (Clydesdale, 2019).

In her interviews, Ms. Tang explained that her decision to allow for more flexible language use in class was also informed by her previous teaching experience. In her first year, she also originally stuck to the 90% target language rule that was the official policy. According to her, this proved to be ineffective, as her English dominant students were often confused and could not learn any of the new math and science concepts introduced, such as odd and even numbers and the water cycle, when these were introduced nearly solely in Mandarin Chinese. Even as Ms. Tang utilized the assistance of graphic aids and gestures, her students did not respond much in class, nor did they work consistently on the assignments or assessments. So, gradually, Ms. Tang arrived at the decision that she would intentionally utilize English as well as Mandarin to support comprehension in her instruction and encourage students’ responses, both oral and written, in English to whet their appetite for the disciplines and build a meaningful foundation of language and content. This, she explained, was her frame of mind at the

beginning of the semester that I observed. Gradually and strategically over time, she increased the input of Mandarin, as students internalized more of the basic math and science content, like odd and even numbers and the states of matter.

Anecdotal information suggested other influences in her decision to continue using Mandarin gradually and strategically in her classroom. For instance, the principal reported that Ms. Tang's students performed better than those in the other class on formal evaluations (personal communication). Also noticeable from observations, during math and science lessons, was increased student attention to the teacher, appropriate responses to her questions, and consistent focus on the tasks she assigned. A positive change in the children's enthusiasm in learning content was noted in parental reports. One parent even told Ms. Tang, "My child used to hate math, but now he can't stop talking about it!".

Science

To describe instruction early in the academic year, Ms. Tang commented, "Science instruction involves a lot of specific new vocabulary, so, I use mostly English with English reading materials so the students could catch the meaning first. Then, I introduce certain Chinese terms relevant to the material." To exemplify, the Science class focused on S2P1 (Georgia State Standards, 2016): Obtain, evaluate, and communicate about properties of matter and changes that occur in objects. To teach this standard using Chinese, Ms. Tang knew she had to first instantiate the concepts deeply using mostly English (her students' home language or dominant language) while teaching select keywords in both English and Chinese. Once they learned the keywords, she utilized only Chinese in referencing those terms but continued to use English in her descriptions and explanations of content. For instance, she taught the words for the states of matter in English and Chinese, like *liquid*, 液体 (*yè tǐ*), *solid*, 固体 (*gù tǐ*), and *gas*, 气体 (*qì tǐ*). She would begin with utilizing both the English with the Chinese, having the children practice the Chinese pronunciations the initial week. As the second week began, she gradually used only the Chinese for these terms. In addition to orally communicating this terminology, she would also write the Chinese characters, having the students copy them in their own work. She did not take points off for handwriting, although some of the students' work was difficult to decipher. The students had never been encouraged to codemesh in their writing (Canagarajah, 2010) by their Mandarin teachers in previous grades.

Early in the semester, to demonstrate the thermodynamics of matter, Ms. Tang had some students standing still holding hands to mimic solids, others holding hands moving around slowly for liquids, and a small group running around individually for gas. During this mini-lesson, students conversed in English about how far apart they should be and how fast they should move. After this activity, students used expressions like, "That was cool!" "Being molecules is fun!" and "I kind of understand now." So, as was evident, student interactions were generally in English during these tasks. During these times, students engaged freely and thus reverted mostly to their home language for communication and processing new learning.

Another example of instruction early in the school year is the creation of book clubs in science. During this activity, students were encouraged to independently

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discover different topics. Pairs of students selected and checked out books in English, which each student independently read and discussed with their partners. Books chosen by the students were mostly nonfiction texts about certain science phenomena, such as the states of matter or the life cycle of frogs, with some fiction, for example, *The Magic School Bus* series. The students shared what they learned using mostly English, with additional instruction from Ms. Tang regarding the various topics. Mandarin was used to identify familiar terms that the class had been practicing in the target language, like the states of matter, but this usage was not required.

In a typical sentence early in the unit, she would say, "With heat, ice will 融化 [*róng huà*] or melt into water," and "With even more heat, water will 蒸发[*zhēng fā*] or evaporate to water vapor." She would go on, "When it is cold, water vapor 凝结 [*níng jié*] or condense into water," and "When it gets even colder, water 冻结 [*dòng jié*] or freezes to ice." So, even though she was able to utilize and instruct the Chinese terminology, most of the sentence was in English to teach the children the concepts. When she did use Chinese, she was sure to utter the English translation right afterwards to reinforce the idea. Her speech demonstrated that communication in her class could intermingle both languages in their conveyance of ideas.

Also noted early in my observations was that students' usage of Chinese consisted mostly of repetitions of phrases previously learned, like 为什么 [*wèishénme*] for why, and 变成 [*biànchéng*] for change, along with their own choice for describing matter (Chinese for several specific types of matter had been taught, e.g. 铁 [*tiě*] (iron) and 水 [*shuǐ*] (water)). As mentioned earlier, Ms. Tang's utterances were most often in English for novel material or deeper explanations, such as the above regarding the thermodynamics of molecules. In this way, common Chinese phrases could be strengthened, and deeper or more nuanced statements could be offered in English, so students were able to comprehend these concepts more fully.

As of the second month, it was evident that students really understood the Chinese terms and even began to use them without teacher support in their comments and questions in class. Gradually, the teacher would insert more Chinese when teaching science. For example, in her lesson on the states of matter, after students had learned the matter transitions of 融化, 蒸发, 凝结, and 冻结, Ms. Tang would change the matter type, to say oxygen or iron, and teach children that with enough heat, any matter can shift between the three states of 气体, 液体 and 固体, thereby reinforcing the Chinese for the states of matter as well.

As the semester continued to progress, instances of rich codeswitching, as a translanguaging practice, were observed. Over time, students inserted more Chinese into their interaction during lessons without being prompted by the teacher. For example, there were several instances of student questioning, such as "为什么水会变成冰啊? [*wèishénme shuǐhuì biànchéng bīng a*?] (Why does water change into ice?)" and "What do the molecules look like in a marker?" Thus, the language of these questions was free to vary between Chinese and English. Sometimes, the questions themselves were also translanguaged, e.g., "Can rocks 蒸发 [*zhēng fā*] (evaporate) too?" Ms. Tang's responses were also a mixture of English and Chinese, such as in responding to the first

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question, she replied "因为 [*yīnwèi*] (because) the water molecules have less energy and are moving slower until they stop moving and stick to each other." She expressed words in the target language that were familiar to students because in her instruction, she prioritized conveyance of meaning by intentionally translanguaging between Mandarin and English to facilitate comprehension.

Importantly, the latter two utterances demonstrated translanguaging, in the form of interactive code-switching, because they depicted the fluid functional languaging practices of both an emergent bilingual (the student) and a more seasoned bilingual (the teacher). In the case of the student question about the thermodynamics of matter, the boy repeated the more familiar phrase "蒸发" for "evaporate." Though Ms. Tang had explained this concept before in the context of water, the student used translanguaging to cater this inquiry to meet a personal curiosity. He was using Mandarin to show Ms. Tang that he understood the phenomenon of evaporation and translanguaged to English to convey "rocks" since he did not remember the Mandarin word for this object. Later in the semester, translanguaging was deployed intentionally and practically by this emergent bilingual, as he accessed his "full linguistic repertoire without regard for watchful adherence to the socially and politically defined boundaries of named (and usually national and state) languages" (Otheguy et al., 2015, p. 283, parenthetical in original).

In Ms. Tang's response to the question about the freezing of water, to optimize student comprehension, she utilized her entire linguistic repertoire to focus her comment to what her students could comprehend. She told me in an interview, "I used Chinese (Mandarin) when I knew they understood what I was saying. For anything more complicated, or for things I had not taught before, I would add more English while using Chinese." Thus, as the semester progressed, she prioritized communication over linguistic purity continuing to utilize whichever language was easier to understand.

To synthesize observations of science lessons, it was apparent that an evolution in favor of more Chinese language use was observed by both the teacher and students. However, the insertion of Chinese was targeted to interaction with the teacher and to the use of content terminology. Obvious also was the use of translanguaging to negotiate meaning in content-based interactions. For instance, in class, the students worked on different hands-on projects, like making a water cycle chart. During this activity as with others throughout the semester, students continued to use mostly English to converse among themselves. Yet, instruction in science became a bilingual, translanguaging venture as the teacher's statements, as well as those of her students, were an organic mixture of Mandarin and English, with each language used purposefully to best depict the speaker's intended message. Chinese was used occasionally in student questions, and Ms. Tang's responses would be about 20% Chinese, though when she used the Chinese of unfamiliar terminology, she was sure to speak slowly and follow with the English translation. Since there was no end-of-the-year science exam, there was no final quantitative indication of improved science learning beyond class-based work, classroom tests, and course grades. Yet, I observed that student interest in science as a discipline greatly improved as these learners

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continued class discussions outside of class, and they showed mastery of the different science standards as evidenced by unit tests, all completed in English.

Math

Ms. Tang also taught the students math. In math, the students learned how to identify any number up to 1,000 in Chinese. They utilized operational terms like 加 (*jiā*), add, 减 (*jiǎn*), subtract, and 等于 (*děng yú*), equals, in both Chinese and English. Ms. Tang also taught place values in Chinese and English, like 个位 (*gè wèi*), one's place, 十位 (*shí wèi*), ten's place, 百位 (*bǎi wèi*), hundred's place, and 千位 (*qiān wèi*), or thousand's place. Much like in science, she originally taught mostly in English with common math terminology in both Chinese and English, moving gradually to only in Chinese for these terms. Per test scores, students in Ms. Tang's class outperformed their peers in non-translanguaging bilingual settings and regular mainstream math classes on the official end-of-the-year math exam.

The students used many manipulatives, like interlocking base ten blocks in constructing certain numbers. There would be base ten, base hundred, and base thousand blocks that the students would build for those numbers. The students also used a mock economy with play cash to simulate different types of business transactions in student-run restaurants. Groups of these students made menus, and set prices, and Ms. Tang would distribute pretend coins. They pretended to cook and sell these items, and the rest of the students acted as customers purchasing foods from the restaurants. Directions given by Ms. Tang were partially in English, as were the exchanges between students. However, some utterances familiar to the students were spoken entirely in Mandarin, like numerical values and simple requests. Thus, the observable exchanges between students were often translanguaging utterances, as each language was leveraged with intention.

The menus were written in English, but the money had Chinese characters representing one, 一(*yī*), five, 五(*wǔ*), ten, 十(*shí*), and twenty-five, 二十五 (*èr shí wǔ*) (see Appendix A). All menu items had only cent values. In their transactions, the students had to calculate the correct value using a combination of the coins, and correct change needed to be provided by the vendors. The students used Chinese when referring to the cost of the items and the change. They were also taught phrases like "我要一个" (*wǒ yào yí gè*), or "I want one," followed by the English phrase for the item. For example, a student might say, "我要一个 chocolate ice cream," a common expression on my day of observation, and translanguage between Chinese and English. Students were taught the Chinese terms for describing the amount for different types of items.

In addition, the students were also tasked with writing word problems using mostly simplified Mandarin script on the board. In one instance (See Appendix B), two students wrote a word problem that read: "Evan has 25 cars. Hayden has 88 more cars than Evan. 1) How many cars does Hayden have? 2) How many cars in total do Evan and Hayden have?" Ms. Tang kept the template for the problem on the board in Mandarin but allowed students to change the names of the people (in English), the quantity, the item (e.g., cars) (mostly in English), and "more" to "less" (in Mandarin). In this way, students could refer to different classmates on different trials, calculate

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different amounts of different items they were interested in, and reconceptualize the operation of the problem between addition and subtraction. They could also translanguage to leverage their entire linguistic repertoire to construct these personally meaningful problems.

The fact that most of the Chinese in this sentence stayed the same on the board allowed students to learn the paradigm for comparisons in Chinese. For example, the phrase 总共 (*zǒng gòng*) meant "in total," and the character 比 (*bǐ*) designated a comparison would follow. They utilized English to write the content words and items for comparison that shifted with each student's example. Thus, at that moment, the students only needed to learn to read, write, and speak those comparison words, but could translanguage both in writing and speech to English for all other words to fit the sentence to their personal messages. For instance, they did not need to know how to write the Chinese character for "cars" to personalize the aforementioned word problem but could just write the word in English while the remainder of the sentence was in Mandarin. Other items students came up with, like "Hot Cheetos," as well as the names of classmates, did not have direct Chinese translations, so these words were preserved in English to reflect their exact intentions via translanguaging with the rest of the Chinese sentence. In this way, their interactions could be characterized as strategically communicating from "one linguistic repertoire with features that have been socially constructed as belonging to two separate languages" (García & Li, 2014, p. 2).

Similarly, the concept of comparisons of values could be reinforced with initial instruction in English and repetition of the Chinese translation (both in speech and writing) while English was used to personalize the learning. In other words, the conceptual knowledge was initially taught to the students in English with the help of manipulatives to reach both visual and tactile learners and reinforced by Chinese translations which also taught Chinese. Finally, the math content was internalized by the students using their dominant language and Ms. Tang scaffolding their prior knowledge in English. Additionally, students who spoke languages other than English or Mandarin were encouraged to share translations of terms or ideas the class was learning in these other languages (e.g., Hindi, Spanish).

Certainly, the inclusion of more English than was mandated by the school here was essential in the instruction to provide comprehensible input (Krashen, 2014) to learners to facilitate acquisition of math content. However, the use of Mandarin, both orally and in writing, was sustained throughout by translations, codeswitching, and code-meshing. By doing this, translanguaging was an instructional and communicative tool that expanded students' math learning as well as linguistic repertoire in this discipline.

The prioritization of teaching content while ensuring that linguistic input would be understood was practical in nature because all end-of-the-year high-stakes exams were in English. The science terminology, the math concepts, and the student responses on these evaluations were all conveyed in English.

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Translanguaging Pedagogy in Ms. Tang's Classrooms

This exploration revealed promising aspects of instruction that uses translanguaging as a tool for learning. First, translanguaging practices in Ms. Tang's classroom were multifaceted since they integrated different languages, cultures, and cognitive strategies in teaching content and promoting growth in more than one language. In terms of using multiple languages to learn these practices encouraged the flow from two languages while at the same time they provided a meta-perspective regarding languages that may encourage students to cross over between multiple other languages (See Appendix C). In this example, students learned and wrote down the English and Chinese translations for "hello" and "I need to use the potty." The students learned how the same meaning could be expressed via multiple means, both in script and in speech.

Ms. Tang also subscribed to a cultural asset-based approach (MacSwan, 2020) echoing the earlier Funds of Knowledge strategy recommended by Moll et al. (1992). She drew on students' cultural backgrounds to enrich her class. For example, the Indian girl who spoke Hindi, was made to be proud of her heritage language. Ms. Tang often asked this girl the Hindi translations for certain words the class was learning and then commented on the similarities or distinctions between the three languages of English, Mandarin, and Hindi.

Finally, students were given a metalinguistic perspective of how human languages capture meaning and how those meanings could have nuanced differences. In another example, the currency that the class learned was the U.S. system that consisted of penny, nickel, dime, quarter, and dollar. But there are no nickels or quarters in China, and all Indian currency denominations are centered on the rupee, with one, two, five, and ten-rupee denominations, with the absence of the quarter and the inclusion of the two-value coin. Students had an opportunity to consider these distinctions in enhancing their metacognitive understandings and metalinguistic knowledge.

In this instructional context, intended to be a primarily monoglossic Mandarin space, Ms. Tang's intentional allocation of English heralded a transformative effect, in that students' full linguistic repertoires were accessed in creative ways (Sánchez et al., 2018). In strategically deploying languages, students might utilize Mandarin for current class content and then use English to personalize that learning. As with the word problems, students intentionally utilized languages to construct personally meaningful math learning. Rather than two monolinguals in one, an English-speaker and a Mandarin-speaker, Ms. Tang's students were navigating purposefully within a single unified linguistic repertoire that contained elements of each language in reading and composing, which were able to be used together to convey meaning (Fu et al., 2019). As mentioned earlier, in my conversation with the principal, Dr. Jones, she emphasized that Ms. Tang's students significantly outperformed those in other classes in her grade, according to end-of-the-year math test scores and additional science evaluations.

Second, this investigation underscored the importance of planning for and strategically implementing translanguaging to support content and language learning. Factors that guided Ms. Tang's use of translanguaging were the languaging needs of students and the discipline being taught. While in science, English was relatively more

emphasized, math instruction favored Mandarin. The complexity of science concepts prompted the teacher to support their instruction through English. In math, she encountered terms that could not be directly translated across languages. As explained earlier, because there was no nickel, dime, or quarter coin in Chinese, students were taught to say five cents or 五分钱 (wǔ fēn qián), ten cents or 十分钱 (shí fēn qián), and twenty-five cents or 二十五分钱 (èr shí wǔ fēn qián), respectively. Thus, the concept of cent value for these English coins would be reinforced, while their numerical Chinese translations would also be strengthened.

Indeed, Ms. Tang shared in an interview that one reason for not limiting 90% of her instruction strictly to Chinese was the realization that certain English terms did not have direct Chinese translations. Actually, the nuances across languages prevented literal one-to-one correspondences between equivalent notions, thus highlighting a translanguaging practice that preserved the meaning of certain words in their original vernacular (Fu et al., 2019). Nevertheless, because of the emphasis on numbers in math, Ms. Tang explained that she was generally able to allocate more Mandarin as compared to her science instruction, wherein she utilized relatively more English per her own admission. Thus, her language allocation was the organic result of the languaging needs of her students coupled with the genre-based language of the disciplines.

Third, because students had to access technological support to cross over between languages regularly, they gained technological competence by learning to utilize digital translation resources, such as Google Translate. Students were encouraged to look on Google Translate to research the morphology and phonology of certain Chinese translations of English words. Students were not penalized for not knowing or remembering a certain Chinese word but learned how to search for the correct word themselves. In this way, greater independence was instilled as the students became the actors in their learning.

Fourth, findings suggest that in this classroom, learning was facilitated using a combination of instructional practices aligned with translanguaging. In fact, it is possible to conclude that the choice of a translanguaging policy, or her open language policy that saw all her students' languages as available for communication and learning, was an outcome of an informed and open view of teaching and learning. My observations and discussions indicated that Ms. Tang had an in-depth understanding of her students, their background knowledge, learning styles, and personalities to best engage them in learning. By including hands-on components that related to the real world with tactile and cooperative tasks, the students were kept focused on the learning components throughout the class. She was also sure to reteach certain concepts using mostly English if she felt her students were not comprehending the material.

A key to using translanguaging in this classroom seems to be that students' learning was not limited by their additional language competency, but rather, language acumen developed because of learning the material. Meaning-making and authentic organic communication was prioritized over linguistic restrictions. Students were not penalized for not knowing the Mandarin for an idea, even as they wrote on the board or made class contributions. Over time, they were encouraged to utilize Mandarin as much

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as they could but understood they could employ their English lexicon for an idea which they could not yet express in Mandarin, especially early in a unit.

Fifth, Ms. Tang's students also benefitted socially by being able to communicate in her class in the language that was most comfortable for them. All the students had English as their dominant language. Only the Chinese American boy, the Hispanic girl, and the Indian American girl had different heritage languages, as Fujianese, Spanish, and Hindu were spoken by their families. Because Ms. Tang encouraged communication, her students felt more welcomed to utilize English socially instead of remaining more reticent because of their hesitancy to speak Mandarin. In my observation of the other Mandarin class where English was discouraged, students were noticeably much quieter throughout the class and were often silent even when they were prompted to speak by the instructor. In fact, my observations and interviews suggested that the students and Ms. Tang developed helpful bonds because they could communicate in English as well as Mandarin with each other and with her. Thus, they could converse genuinely and easily with their teacher and each other.

When I spoke with the Mandarin teachers in the third-grade dual language program, they commented on how Ms. Tang's students needed less refreshing on math and science concepts and were noticeably more engaged with the materials compared with students who had previously studied in other parallel classes. In fact, not only was their grasp of content superior per teacher report, their Mandarin usage and understanding was also superior.

Limitations

The possible selection bias for students in the bilingual program whose participation was based on parental choice is an issue to consider in interpreting the findings. Also, one difference among the Mandarin teachers was the fact that Ms. Tang possessed more extensive professional preparation than the others. As discussed in the scholarly literature (Deyrich & Stunnel, 2014), teacher preparation is an important factor in effective instruction and thus may have influenced the findings.

Conclusion

The translanguaging-inspired approach ultimately adopted by Ms. Tang resulted in many benefits to the students. The study presented here indicated greater pupil investment and interest in a learning context marked by the liberal use of their home languages alongside Mandarin Chinese, prioritizing meaningful communication in bilingual math and science in this one-way dual language setting.

In the early grades, the understanding of key mathematical constructs is crucial in providing foundational background knowledge from which to scaffold concepts, such as multiplication, division, and fractions, along with a solid, secure number sense. The focus for the early grades needs to be development of a solid math and science background that can be understood in each of the languages acquired by the students. This study suggested that restricting much of children's input to a language they are only beginning to learn is bound to make them lose interest in both the content and the second language itself. To emulate the success of French immersion in Canada,

Hancock's ambitious experiment prioritized second language immersion to the detriment of comprehension.

In addition, most of the Emergent Bilingual students in Hancock Elementary did not have anyone with whom to practice Mandarin Chinese once they left class. Observations outside the classrooms confirmed a communicative pattern dominated using English. Such language use patterns were typical on the playground, where student interactions outside of class throughout the entire semester were nearly completely in English as well. These exchanges outside of the classroom were devoid of the academic expectation of Mandarin usage when students engaged with each other purely socially. Their world outside of school was devoid of this language, and so they could not continue their language learning in their daily lives. This added to the difficulty encountered by the class in learning science and math content almost exclusively through Mandarin. By prioritizing communication and offering comprehensible input through translanguaging, content was successfully taught bilingually.

Future research must consider the complex intersections of variables involved in developing bilingualism and biliteracy through schooling, both generally and in particular for Mandarin/English bilinguals. Merging language teaching with content in bilingual and biliterate educational settings requires careful development and evaluation of curricula that can be delivered *meaningfully* by thoroughly prepared teachers with a rich background in language and pedagogy, as indicated by the bilingual professional education standards (Nevárez-La Torre, 2015/2019). To reiterate, real communication and comprehensible input should be privileged over rigid policies of language separation; current best practices support such a translanguaging approach (García, 2020). The sociolinguistic experiences of learners outside of classroom settings must also be considered by researchers, curriculum developers, teachers, and teacher educators.

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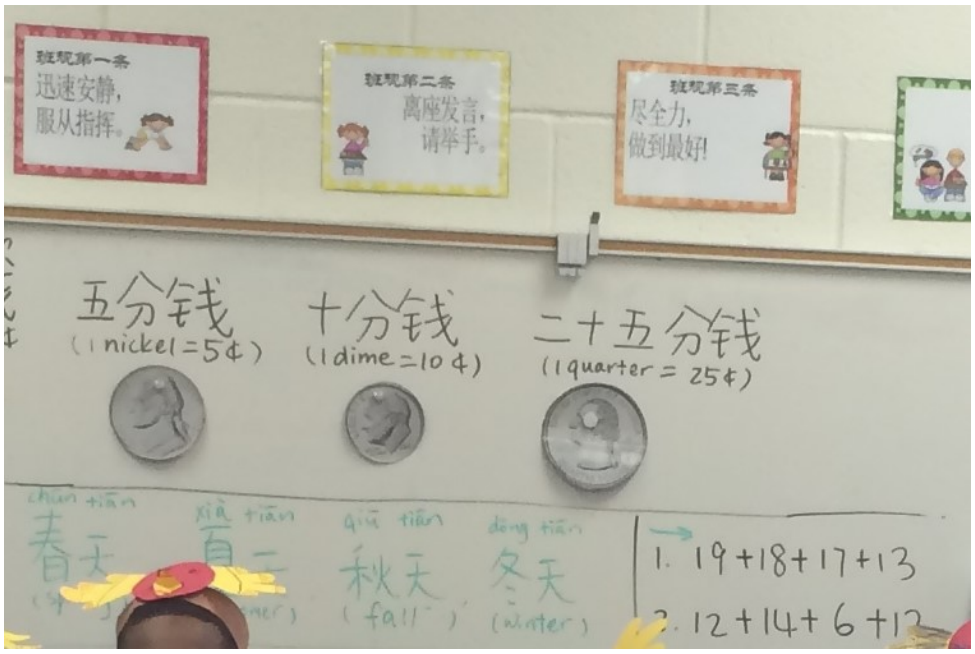
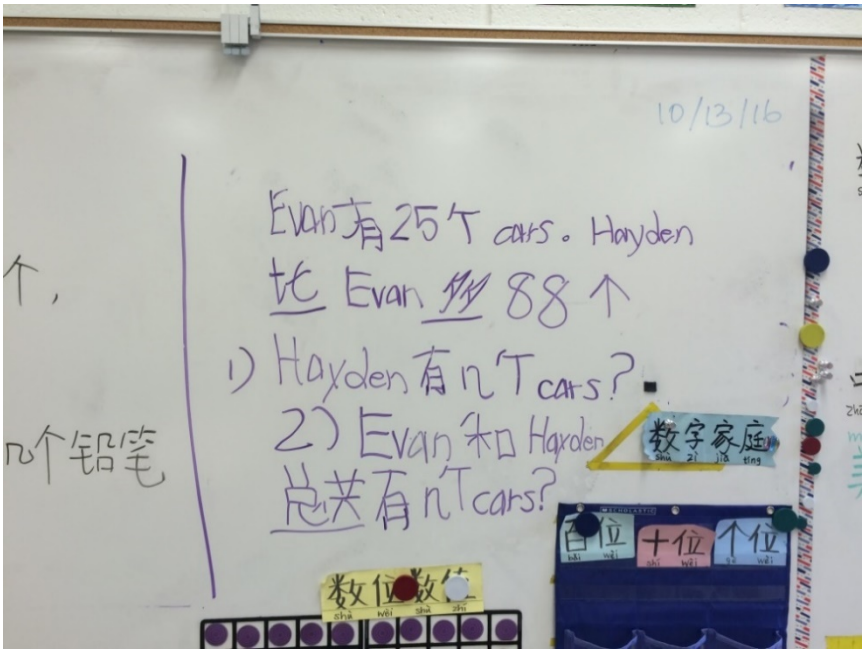
Appendix A

Photograph of Ms. Tang's Whiteboard with Laminated Enlarged U.S. Nickle, Dime, and Quarter Coins, with Simplified Chinese Translations, Their English Names, and Numerical Values



Appendix B

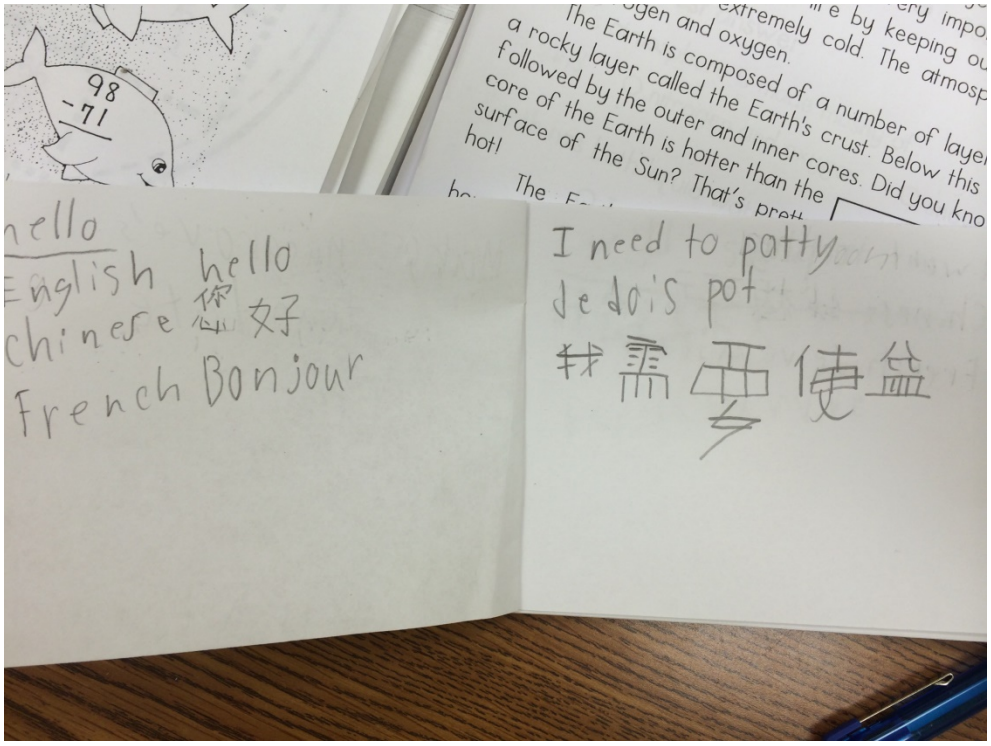
Translanguaging Word Problem Template Describing Word Problems of Numerical Comparisons



This sentence reads: Evan has 25 cars. Hayden has 88 more cars than Evan. 1) How many cars does Hayden have? 2) How many cars in total do Evan and Hayden have?

Appendix C

Translations of English and Chinese Phrases



The meaning of the above Chinese phrases: hello; I need to use the potty.