



## Exploring Students' Chinese Language Learning in Math Class at a Thai Private School: A Case Study of Using Chinese as a Medium of Instruction

Ruirui Li\* and Anchalee Chayanuvat

Faculty of Education, Rangsit University, Pathum Thani, Thailand

\*Corresponding author, E-mail: toleeruirui@163.com

### Abstract

Nowadays, there are relatively few studies conducted on the use of Chinese as a medium of instruction in Thailand. Thus, the aim of this research was 1) to investigate the effects of using Chinese as a medium of instruction (CMI) on Chinese math scores, 2) to determine the level of Chinese knowledge of Thai first graders, and 3) to identify the factors affecting the Chinese language learning of the students in a Chinese math class when using CMI. The study adopted a mixed methods research approach to obtain both quantitative and qualitative data from a class of 21 Thai first graders selected with the convenience sampling method. Pre/post-tests of Chinese math and YCT Level 1 were given to the students to compare the scores of Chinese math and Chinese language knowledge at the beginning and at the end of the course using CMI. The findings of the study revealed that the mean scores of the post-test of the students in Chinese math ( $\bar{x} = 95.95/S.D. = 7.19$ ) and Chinese language knowledge ( $\bar{x} = 196.68/S.D. = 5.83$ ) were higher than those of the pre-tests ( $\bar{x} = 16.14/S.D. = 7.28$ ;  $\bar{x} = 96.28/S.D. = 22.56$ ) sequentially at a significant value of  $P = .001$ . The teacher/researcher's journal revealed that the enhancement of Chinese language learning of the students was notably influenced by eight key factors: 1) students' behavior, 2) classroom management strategies, 3) teacher-student interaction, 4) teaching aids, 5) teacher's support, 6) classroom atmosphere, 7) students' learning outcomes and 8) Chinese ability. Thus, based on the results of this study, it may be recommended that Chinese teachers use CMI in subject-content classes.

**Keywords:** Chinese language learning, Chinese math, CMI, first-grade Thai students

### 1. Introduction

With China's reforms and opening-up, the growth of China's economic influence, and the increasing number of Chinese tourists and residents, Chinese language teaching and learning in Thailand is becoming increasingly popular. Nowadays, Chinese is the second most-spoken foreign language in Thailand after English (Sae-thung et al., 2022). Regarding second/foreign language teaching, in the area of using the target language as a medium of instruction, many theories discuss the methods to make classes more effective and interesting in order to help students not only improve their target language skills but also their academic performance. The following sections describe the theories that are part of the theoretical framework of this study.

#### 1.1 Content-Based Instruction

Brinton, Snow and Wesche (1989) described content-based instruction (CBI) as "the integration of content learning with language teaching aims. More specifically, it refers to the concurrent study of language and subject matter, with the form and sequence of language presentation dictated by content." In this context, content typically refers to academic areas (such as mathematics, physics, or social studies) and the language is employed as the medium to teach the subject knowledge (Mohan, 1986). The language objectives for learning are met through the subject learning; thus, the target language plays an important role in teaching and learning. Moreover, the goal of the research school in this study is to help students become proficient in

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academic Chinese through sustained exposure to Chinese in a mathematics context, and this purpose is consistent with that of one CBI model, the themes-based language instruction model.

According to Brinton, Snow, and Wesche (1989), in the theme-based language instruction model, a language curriculum is developed by selecting specific themes or subjects from the content. Typically, theme-based language education utilizes materials crafted by educators or adapted from external sources. There is often a deliberate effort to integrate the chosen subject across all instructional areas (Brinton et al., 1989). The goal is to assist students in acquiring comprehensive academic language skills by presenting them with captivating and relevant information. Among the three content-based methods, theme-based language education stands out as the most favored, as it can be seamlessly integrated into nearly any existing institutional setting, and the chosen theme or topic can be tailored to align with the students' interests.

Based on this model, language objectives may be classified into two types. The first one is content-obligatory language, which refers to the language that students are required to master for a given academic topic. For example, students should learn and master mathematical vocabulary and terms such as 'feet' and 'inches' in a lesson about measurement. The second is content-compatible language objectives, in which suitable language can be taught in the context of certain materials even though it is not needed for successful mastering of the content.

Snow, Met and Genesee (1989) provided guidance on how teachers who use the target language as a medium of instruction can apply this framework. Effective teachers can design a clear teaching plan to follow and develop students' content-obligatory and content-compatible language competences. In addition, they can integrate the subject lessons and content-obligatory language while creating and seeking opportunities for students to practice their second/foreign language skills whenever possible.

Therefore, the intervention lessons in this study were designed based on the framework of the content-based language theory. The teaching content adopts two themes from the school's regular curriculum from the first-grade Chinese mathematics textbook edited by the People's Education Press (PEP). This means that students practice and learn more Chinese knowledge in class rather than merely math skills.

### 1.2 Content and Language Integrated Learning

Coyle et al. (2010) stated that content and language integrated learning (CLIL) is acknowledged as an instructional approach that promotes the learning of an additional language as well as the content. It permits education to be delivered in a language other than the students' primary language (Nikula et al., 2013). To make sure that students understand the material, it is essential to take into account their language skills. It is difficult to teach pupils in a foreign language if you do not include their mother tongue. According to Lin (2015), the employment of both the primary and second languages during different phases of classroom activities is permitted when implementing CLIL.

Moreover, it is critical to think about building a balance between using the native language and the second language. According to Thomas-Sunesson et al. (2018), teachers can assist students in understanding difficult material by using code-switching or translanguaging. However, to prevent using the first language excessively, caution should be exercised. In a similar vein, Lin (2015) claimed that difficulties with a second or foreign language may lead to an overreliance on the students' native language.

Therefore, it is not difficult to see that CLIL focuses more on the understanding and learning of the subject content rather than the target language (Borsetto & Schug, 2016). This paradigm enables the creation of a bilingual program in which both languages are employed as the medium of teaching, as well as the focus on subject learning.

### 1.3 Related Research Findings

Kasimova (2023) explored the implementation of content and language integrated learning (CLIL) with first-year college students, particularly in mathematics and IT. However, this approach has shown



challenges, with some students struggling to concentrate and facing difficulties in mathematical tasks. Critics suggest that language learning, especially in its initial stages, should solely emphasize language, fearing it could hinder language acquisition. Nonetheless, students willing to engage actively have found value in this method, particularly in collaborative group work. Integrating math skills into language learning promotes critical thinking, reduces sentence repetition, enriches vocabulary, and bolsters comprehension across various language domains. Successful integration requires both language instructors and content teachers to understand the fundamentals of the combined subjects and the theories underpinning CLIL.

Van (2020) aimed to scrutinize the background differences between students in English and Dutch CLIL programs and those in non-CLIL programs in Francophone Belgium. The study was conducted with students in grades 5 to 11. The findings revealed significant distinctions between these groups, indicating that CLIL students generally come from higher socio-economic backgrounds and experience smoother academic paths because they seek a favorable educational environment and language advantage.

Salimovich et al. (2022) discussed the application of content-based instruction (CBI) in English for Specific Purposes (ESP), with a focus on legal English learning. ESP, especially Legal English, requires an understanding of the complexities of the language within a specific academic or scientific field, not just the terminology. Studies have shown mixed results regarding the effects of CBI on language learning, with some suggesting a positive impact on academic performance. Learning Legal English requires a solid foundation in general English, familiarity with the field of law, and an understanding of the complexity of legal vocabulary and the differences between legal systems. Legal English teaching focuses on language skills (grammar, syntax, etc.) rather than jurisprudence, and advocates the integration of legal and language expertise in teaching. Finally, the importance of professional competence and motivation for students who wish to excel in Legal English is emphasized.

Amrani's (2019) qualitative study delved into the impact of content-based instruction (CBI) on enhancing comprehension and vocabulary within an English for Specific Purposes (ESP) course at an engineering school in Morocco. The study involved 40 students split into two groups, undergoing a 15-hour legal English course across six weeks. The course emphasized reading comprehension and vocabulary acquisition through an interactive approach aimed at active learner engagement. Pre-tests and post-tests were administered to gauge progress, comparing results between the two groups initially and then within each group. The findings indicated overall progress in legal English comprehension and vocabulary skills for both groups. Specifically, the experimental group displayed significant improvement in post-test scores compared to their pre-test scores, while the control group maintained higher pre-test scores. The study concludes that content-based instruction positively influences ESP comprehension and vocabulary enhancement. It affirms that focusing on subject matter content indeed contributes to language learning, showcasing how CBI can effectively bolster language skills within a specialized context.

Lai (2018) investigated the attitudes and motivations of EFL students in learning English through content-based instruction (CBI) at a Thai university. Seventy-one college sophomores completed 6-point Likert scale questionnaires about their attitudes and motivation, and researchers conducted classroom observations and collected midterm and final exam scores. According to statistical analysis, the students had a generally positive opinion of the CBI-based course, and their interest in learning English was at a moderate level. There were substantial differences in attitudes between nursing and medical students, although motivations for the two programs did not differ significantly. It is recommended that professors of CBI courses adopt motivational strategies to enhance students' instrumental motivation and comprehensive motivation.

Bellés-Calvera (2018) studied a Spanish-speaking bilingual community in a high school that taught music in English using a CLIL approach. The aim was to assess students' perceptions of these music lessons



and evaluate the suitability of teaching music in English. The study involved tailored materials and a final questionnaire. Results showed that the students found these music lessons in English to be easier compared to regular classes. They not only enjoyed the exposure to English but also expressed interest in participating in CLIL programs in the future. The pedagogical implications suggested the development of learner autonomy, utilization of audio-visual aids, and the need for further research in bilingual and multilingual regions.

Content-Based Instruction (CBI), also known as “Immersion and Content and Language Integrated Learning (CLIL),” evolved as a teaching method that blends curricular subject matter with target language skills (Bellés-Calvera, 2018). These two approaches are not pedagogically different from one another (Cenoz, 2015).

This study was initiated because Chinese language barriers are significantly impacting students’ abilities to engage effectively in the Chinese math class in which CMI is used. Therefore, it would be beneficial for the teacher of the class to learn from the findings on how using CMI can be effectively applied in teaching math, the students would be able to improve and enhance both their math and Chinese capabilities, and the school can make use of the findings to improve how employing CMI can improve students’ learning engagement and performance.

## 2. Research Objectives and Questions

Objectives:

- 1) To investigate the effects of CMI on the Chinese math scores of 21 Thai first graders by comparing the pre- and post- Chinese math tests at a private school in Chachoengsao.
- 2) To explore the effects of CMI on the level of Chinese knowledge of 21 Thai first graders by comparing the pre- and post- Chinese knowledge tests at a private school in Chachoengsao.
- 3) To identify the factors affecting students’ Chinese language learning in math class when using CMI.

Questions:

- 1) What are the effects of CMI on the Chinese math scores of 21 Thai first graders identified by comparing the pre- and post- Chinese math tests at a private school in Chachoengsao?
- 2) What are the effects of CMI on the level of Chinese knowledge of 21 Thai first graders identified by comparing the pre- and post- Chinese knowledge tests at a private school in Chachoengsao?
- 3) What are the factors that can affect students’ Chinese language learning in math class when using CMI?

## 3. Materials and Methods

This study was conducted in a private school in Chachoengsao Province, Thailand. This school provides diversified trilingual education for students from preschool to secondary school, which includes Thai, English and Chinese. However, the teaching time and subjects of the three languages are not completely consistent, except for the language and mathematics courses. At the primary level, students are required to study three Chinese-related courses: Chinese language, Chinese mathematics, and YCT (Youth Chinese Test) in a lower grade or HSK (Hanyu Shuiping Kaoshi) in an upper grade. The teaching materials used in the Chinese language and mathematics courses are the same Chinese and math textbooks edited by the People’s Education Press, and the YCT and HSK courses use the exams’ official textbooks. Moreover, this school follows a language immersion approach, where the target language is used as a medium of instruction to create an environment that fosters language acquisition and application. This method is known for its effectiveness in helping students become proficient in the target language by exposing them to it consistently



in various contexts. Therefore, the school has a very important policy for teachers, who are all mandated to conduct their lessons exclusively in the target language, irrespective of the subject matter.

In order to investigate the students' Chinese language learning in math class when using CMI, the researcher explored the effects of CMI on the Chinese math scores and the level of Chinese knowledge of 21 Thai first graders by comparing the pre- and post- Chinese math tests at a private school in Chachoengsao and identified the factors affecting the students' Chinese language learning in math class when using CMI. Therefore, this study adopted a mixed methods research approach to obtain both quantitative and qualitative data from a class of 21 Thai first graders selected with the convenience sampling method. Since this is a classroom-based study of the researcher's class and is also considered a case study, access was readily available. The obvious sampling technique adopted is convenience sampling. The researcher is employed at this private school and provides instruction in Chinese math in the research class.

The data collected were from the students' two pairs of the pre/post-test scores of Chinese math and Chinese language knowledge (YCT level 1) and the teacher/researcher's journal. The pre/post-test of Chinese math was used as a tool to compare students' math scores before and after the study in order to investigate the effects of CMI on the Chinese math scores. The content of the Chinese math pre/post-test was adapted based on two themes from the teaching textbook, Comparing How Many and Position, which are taught in the class, and this test included two parts, listening and speaking plus reading and writing. The pre/post-test of Chinese language knowledge was used as a tool to compare students' Chinese language scores before and after the study in order to determine the effects of CMI on the level of Chinese knowledge. To achieve this, the study utilized the Youth Chinese Test (YCT) level 1. YCT is a globally standardized knowledge exam for the Chinese language, specifically designed to assess the language knowledge of primary and secondary school students whose native language is not Chinese. It aims to evaluate their ability to use the language effectively in both daily activities and academic endeavors. The YCT level 1 test consists of 35 questions and added Pinyin, divided into two parts: listening (100 marks) and reading (100 marks). Before administering the YCT level 1 test to the participants, the test items were thoroughly tested with potential test-takers. Experts were involved in constructing the questions, ensuring that each question aligned with the objectives of the test items, and they were carefully reviewed one by one. Regarding the teacher/researcher's journal, the researcher acted as a classroom teacher and recorded what happened in the classroom based on observations, with every journal entry written after each lesson. Thus, there were ten teacher's journal entries at the end of study. These records were used to analyze the factors affecting learners' Chinese language learning in math class when employing CMI. This provided a deeper understanding of CMI as well.

In addition, the lesson plans that were designed to teach math were adopted as an intervention instrument. Then, during the ten Chinese math lessons studied in CMI, the researcher provided two themes from the Chinese math learning content based on the Chinese mathematical textbook edited by People's Education Press (PEP), Comparing How Many and Position. To better promote Chinese mathematical knowledge and Chinese language development, based on the guidance of Snow, Met, and Genesee (1989) for teachers who are using a second language medium of instruction, the subject matter of these two themes were divided into two parts, one with content-obligatory language and one with content-compatible language. For the content-obligatory language part, it includes 19 words and 15 sentences, and with regard to the content-compatible language, it comprises common items in life, such as fruits and animals, which the students practiced to the maximum extent possible. For instance, in a math class where students are learning the numbers 1-10 in their first lesson, these numbers (1-10) represent content-obligatory language, and any item that is signified as a quantity is considered content-compatible language. Due to the young age of the students and their low level of Chinese, all of the teaching instructions and expressions should be clear and simple, and the learning activities need to be interesting.

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This study spanned five weeks, comprising two Chinese mathematics classes per week, each lasting 60 minutes. Therefore, the students took a total of ten mathematics courses and accumulated ten hours of instructional time learning mathematics through CMI throughout the study. The pre/post-tests of Chinese math and the language knowledge test data are quantitative data. To analyze the data of this type, SPSS software was employed. To begin with, the total scores for each subskill in both the pre-test and post-test, as well as the Chinese language knowledge test, were calculated. Next, the scores were entered into SPSS and the t-test, mean, and standard deviation were obtained. The pre-test scores were then compared to the post-test scores. The data from the teacher's journal as the qualitative data were analyzed by content analysis. The three analysis steps were adopted from the Three Cs (Coding-Category-Concept) process of Lichtman (2013). The assessment of validity in this study pertains to the extent to which the tools accurately measure the intended constructs. To ensure content validity at the item development stage, the researchers applied the Index of Item-Objective Congruence (IOC) developed by Rovinelli and Hambleton (1977).

#### 4. Results and Discussion

The pre/post-tests of Chinese math and Chinese language knowledge were used to compare the students' mathematics scores and the levels of Chinese language knowledge at the beginning and at the end of the course in order to explore the effects of CMI on the Chinese math scores and Chinese language. The third tool was an approved qualitative study, using a teacher journal to record what the lessons in Chinese mathematics were like in order to identify the factors affecting the students' Chinese language learning.

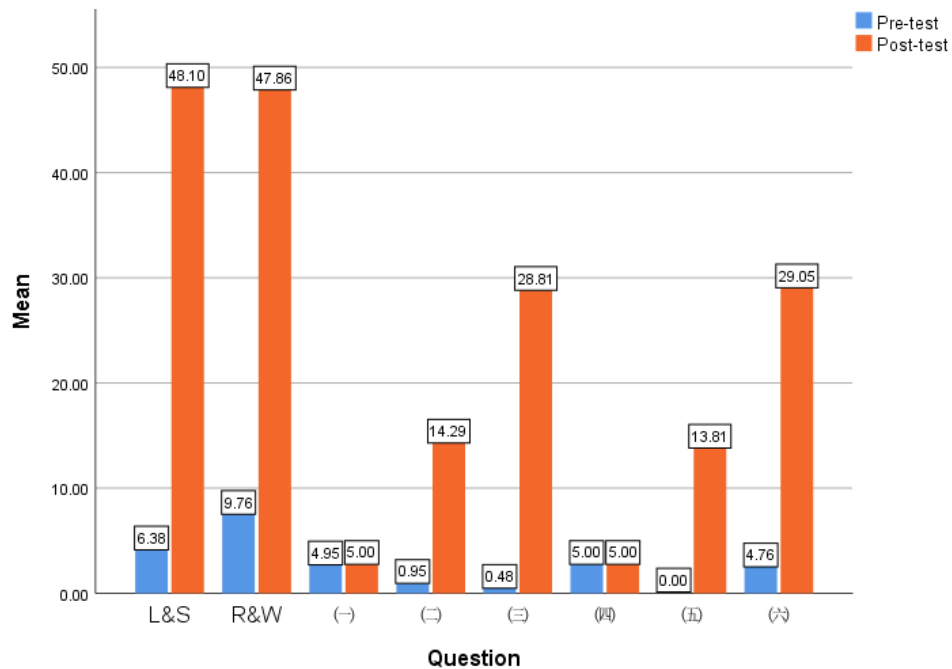
The findings from the three instruments are shown below:

##### 4.1 Pre/Post-Test of Chinese Math

**Table 4.1** Paired Samples Statistics of the Chinese Math Test

Chinese Math Test	Mean	N	S.D.
Pre-test	16.14	21	7.28
Post-test	95.95	21	7.19

Regarding the Chinese math test, Table 4.1 shows that the mean of the pre-test is 16.14, while the mean of the post-test is 95.95 ( $95.95 > 16.14$ ), and the mean in the t-test is -79.81, and thus, the post-test score is 79.81 points higher than that of the pre-test. As can be seen, the S.D in the pre-test is 7.28, while it is 7.19 in the post-test. This indicates that not only were the students' scores higher in the post-test, but the gap among the students decreased after the application of CMI. The t-test reveals a significant difference, with the Sig. value of  $P-0.000 < 0.05$ . This implies a significant distinction between before and after the intervention.



**Figure 4.1** Mean Scores of Each Question in the Chinese Math Test

Figure 4.1 shows the mean scores of each question in the Chinese math test before and after the study. The Chinese mathematics test includes two parts with six questions. The first part is listening and speaking, including question one (一) to question three (三). The second part is reading and writing, including question four (四) to question six (六). The initial set of category data, denoted as L&S in Figure 4.1, represents the average scores of students on questions 1 (一) to 3 (三) of the listening and speaking part in both the pre-test and post-test. The second category, R&W, is the mean score of the students on questions 4 (四) to 6 (六) of the reading and writing section in the pre-test and post-test. According to the comparison of the students' mean scores in the first two categories, it is evident that there was significant progress in learners' listening, speaking, reading, and writing capabilities in Chinese math after studying the course, especially their listening and speaking skills.

The following six categories of means labeled from (一) to (六) correspondingly represent the six questions on the Chinese math test paper. Based on the comparison of the average scores of the pre-test and post-test of the six questions in the Chinese mathematics test, the most substantial improvement occurred in the third question (三), with the score increasing from 0.48 in the pre-test to 28.81 in the post-test. There was a marginal improvement of 0.05 points in the first question (一), rising from 4.95 to 5.00 in both the pre-test and post-test. The second question (二) demonstrated improvement from the score of 0.95 to 14.29 and the fifth question (五) improved 13.81 marks. Improvement in the sixth question (六) was 24.29 marks. It is noteworthy that the mean values for the fourth question (四) remained unchanged between the pre-test and post-test. This is attributed to the fact that the maximum score for this question is only 5 marks, so there was not much room for improvement.

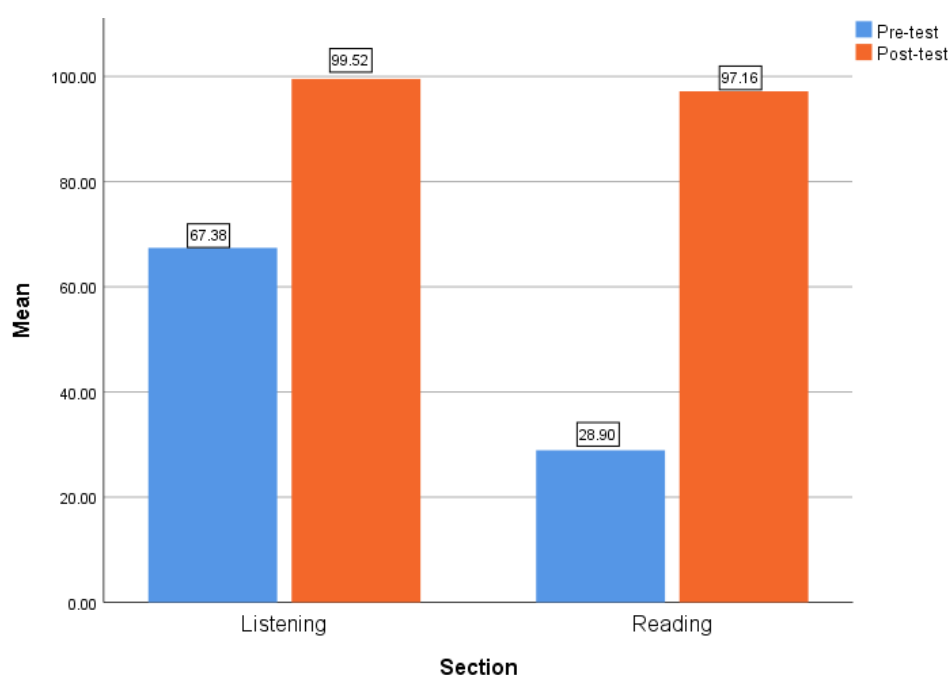
#### 4.2 Pre/Post-Test of Chinese Language Knowledge

**Table 4.2** Paired Samples Statistics of the Chinese Language Knowledge Test

Chinese Language Knowledge Test	Mean	N	S.D.
Pre-test	96.28	21	22.56
Post-test	196.68	21	5.83



Regarding the Chinese language knowledge test, Table 4.2 demonstrates that the mean of the pre-test is 96.28, while the mean of the post-test is 196.68 ( $196.68 > 96.28$ ), and the mean in the t-test is -100.40, and thus, the post-test score is 100.40 marks higher than that of the pre-test. Based on the presented data, the S.D in the pre-test is 22.56, while it is 5.83 in the post-test. This suggests that not only did the students' scores increase in the post-test, but also the disparity among students narrowed after the study. From the t-test, the Sig. value is  $P=0.000 < 0.05$ , which means that there is a significant difference between before and after the study.



**Figure 4.2** Mean Scores of Each Section in the Chinese Language Knowledge Test

Figure 4.2 displays the mean scores of each section in the Chinese language knowledge test before and after the treatment. The Chinese language knowledge test is divided into two parts, listening and reading. In the listening section, students improved by 32.14 marks, progressing from the mean score of 67.38 in the pre-test to 99.52 in the post-test. Improvement in the reading section was 68.26 marks from the mean score of 28.90 in the pre-test to 97.16 in the post-test. In short, Figure 4.2 clearly indicates that the students' listening and reading scores in the Chinese language knowledge level were greatly enhanced after studying.

#### 4.3 Teacher/Researcher's Journal

The researcher was the instructor of this course. Therefore, the teacher's journal of this study was written by the researcher. Since this study included ten classes, the researcher wrote a total of ten journal entries based on the observations of each class. Based on the recorded information, it can be coded into eight categories: 1) Students' behavior, 2) Useful classroom management strategy, 3) Teacher-student interaction, 4) Interesting teaching aids, 5) Teacher's support, 6) Classroom atmosphere, 7) Students' learning outcomes, and 8) Weak Chinese ability. The actual words of these eight aspects from the teacher journal revealed that these are the factors affecting learner's Chinese language learning. The following keywords are indicated by the journal's actual content:

- 1) Students' behavior

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Students' behavior in this part refers to the actions, conduct, and demeanor exhibited by the students in the classroom. For example, as mentioned in the journal, the students sat nicely and after seeing the test papers, they would have a discussion in Thai with the classmates next to them. Students' behavior was sometimes good and sometimes bad during the learning process; therefore, the students' behavior always required the teacher's intervention to maintain it well.

2) Useful classroom management strategies

The teacher used classroom instructions, clear slogans, and competition mechanisms to help students sit quietly and focus in class. The reason that these methods are useful is because the students' behavior improved after using them.

3) Teacher-student interaction

In this study, teacher-student interaction occurred when students were engaged in the class, such as answering the teacher's questions and asking the teacher questions.

4) Interesting teaching aids

The teacher opted to use music, pictures, cartoons, stories, and games extensively in both preparing students for the classes and delivering the lessons. In a word, students were very interested in the teaching tools prepared by the teacher.

5) Teacher's support

According to the recorded course details, the teacher was in charge of ensuring that every student learned as much as possible, assisting them in finishing their tasks, and providing one-to-one tutoring.

6) Classroom atmosphere

In this theme, it can be clearly seen that the students' learning attitudes and the learning environment are related. The classroom environment was slightly noisy at the beginning of the course, but after the teacher's intervention, the classroom environment became quiet and positive.

7) Students' learning outcomes

From the records of each lesson, it is not difficult to see that students were able to express themselves in Chinese and write answers using the content learned after studying.

8) Weak Chinese ability

This category appears only twice, both of them before the students were formally introduced to the learning content. At that time, the students were not yet able to ask and answer questions or respond to exams in accurate Chinese.

## 5. Conclusions and Discussion

In this research, as the data show, when the results from the pre-tests and post-tests of Chinese math and Chinese knowledge exams were compared, the students in the study had higher overall scores in both of the post-tests. Furthermore, the rubric scores of the subskills of Chinese math and Chinese language knowledge were also higher in the post-test than in the pre-test. By analyzing what happened in class as recorded in the teachers' journals, the factors that can affect students' Chinese language learning can be classified into eight aspects: students' behavior, classroom management strategy, teacher-student interaction, teaching aids, teacher's support, classroom atmosphere, students' learning outcomes, and Chinese ability.

The teacher used Chinese Mandarin as a medium of teaching to instruct the students in the Chinese math class, and the students followed what the teacher provided to guide them. Hiring a native speaker of the target language for learners is an effective way to create an immersive language environment, provide clear explanations, and serve as a linguistic model for students (Brevil, 2020). This study demonstrates this point. The Chinese math teacher of the participants is a Chinese native speaker. She holds the Mandarin certificate and has studied the major of elementary education. These qualities of teachers align with those of CMI: knowledge in Chinese language skills, a standard accent, a good vocabulary and grammar, and an



understanding of educational theories (Zhao, 2013). Increasing classroom interaction (Jiang et al., 2019) and opportunities for students to communicate, asking questions, and engaging in discussions are the other useful methods to promote language learning when using the target language as a teaching tool in the classroom. Positive classroom interactions are foundational to a successful learning experience. They contribute to a supportive and motivating learning environment, foster effective communication, and create a classroom environment where students feel encouraged to explore and develop their language skills (Lou et al., 2019). For example, students can receive timely and constructive feedback when interacting with teachers actively, along with error correction, which contribute significantly to language proficiency. Visual aids can help students comprehend and enhance their target language learning (Pateşan et al., 2018). The school in this study provided a rich variety of teaching aids and equipment for Chinese teaching; for example, there are computers, speakers, multi-function projectors, electronic pens, and Chinese environmental creation areas in the classroom. These teaching aids all create an enjoyable and understandable immersive learning environment for students.

Therefore, the findings of this study lead us to believe that using Chinese as a medium of instruction in math classes enables students to improve their Chinese language knowledge. Thus, it provides benefits to the bilingual and multilingual situations of teaching and learning.

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