Making Math Learning Come Alive: SMART Boards in the Immersion Classroom

By Marcie Dunham, Second Grade Spanish Immersion Teacher, Minnewashta Elementary, and Dave Eisenmann, Director of Instructional Technology & Media Services, Minnetonka Public Schools, Minnetonka, Minnesota

Five years prior to the start of the six early total foreign language immersion programs in 2007, voters in the Minnetonka School District, a suburb of Minneapolis, approved a levy referendum for technology and instructional equipment. The funding resulted in the integration of many technologies into the curriculum for teachers and students, a key component being a standardization of technology hardware in every early childhood to grade 12 classroom. Each one of the 500+ classrooms in the district contains a computer connected to a digital projector hung from the ceiling and a wall mounted SMART Board. This technology is a natural match in the immersion classrooms that makes language learning come alive.

WHAT ARE SMART BOARDS?

SMART Boards are interactive whiteboards. They are about the same size as a standard dry-erase whiteboard but are connected through a USB cable to a computer. The surface of the board is touch sensitive, much like the laptop touch pad used to move your cursor around a computer screen. The image of the connected computer is projected onto the surface of the interactive whiteboard, allowing you to see exactly where to touch the screen to accomplish a task.

For example, instead of using the mouse, you can tap your finger on a link displayed on the SMART Board. When you want to drag an object across the screen, you simply touch the object and slide your finger across the board.

Two first grade students use a SMART Board during literacy center time.

There are pens and drawing tools that you can use to write on the screen. Any program you use on a computer can be used on a SMART Board, allowing you to navigate with your finger and annotate on top of it. Teachers use the SMART Board software, called SMART Notebook, for their daily lessons and activities. The software is similar to a mix of PowerPoint and an art program. Students interact with these lessons on the board using their fingers (or some type of pointer) instead of a mouse to draw, write, drag, sort, match, and more.

SMART Boards cost about $1,500 each, which is about the cost of one school computer. In our district, this technology has been funded by a referendum. Other districts in the area have used fundraisers to pay for

Math is one of the core subjects in elementary classrooms and is a required area of study in secondary schools worldwide. However, the intersection of math learning and second language learning, of the kind that takes place in language immersion classrooms, does not have a deep research base nor has it been much discussed in professional publications. Indeed, looking back on the thirteen years of *The ACIE Newsletter* much of what we have written about math in the context of immersion education has had to do with standardized testing; i.e., how well do students achieve on math testing in English when they are learning math in an L2? Only a couple of archived articles have dealt directly with math instruction and language development simultaneously (see sidebar on p. 8).

We take the opportunity in this year's theme issue to broaden the discussion by focusing on instructional practices that focus on both math learning and second language development. Readers will notice that our authors attend not only to academic language in their math classrooms but exploit the opportunities afforded by math games, partner activities, and dramatic arts to introduce and encourage non-academic language that students can use in other contexts. Finally, one of our authors addresses the tensions that exist in L2 classrooms between math instructional objectives and the goals of learning a second language.

ACIE TRANSITIONING TO ONLINE PUBLICATION

After thirteen years, we are transitioning *The ACIE Newsletter* from a print publication to an online journal. The issues for the 2010-11 academic year will remain in print format but will be reduced to two—one in the fall and one in the spring. Then, starting in the fall of 2011, the newsletter will become an online publication exclusively. As always, the ACIE archives will be available at the CARLA website. The May theme issues are in full pdf format; articles from other issues are easily read online or printable.

—*Kimerly Miller, Editor*

SMART Boards, *continued from page 1*

SMART Boards or applied for grants, such as Federal E2T2 dollars (see a list of possible grants in the sidebar on page 11).

SMART BOARD IMPLEMENTATION

The Minnetonka Public School District is a high performing suburban district approximately 15 miles west of Minneapolis, Minnesota. Minnetonka serves 8,265 students in grades K-12. In 2007, a language immersion program began at each of six elementary schools. Two schools offer Mandarin Chinese immersion to students K-3 and four schools offer Spanish immersion to K-3 students as of the 2009-2010 school year. The program will expand each year through 8th grade as these students progress. In September 2008, at the start of the second year of the program, 40% of the incoming kindergartners district-wide were registered for language immersion.

Our implementation of SMART Boards began seven years ago after school administrators were introduced to one at a conference. We piloted the interactive boards in eleven classrooms, starting with one fourth grade team, sixth grade science teachers, and high school physics teachers. The pilot was successful, and it quickly became apparent that a SMART Board was a useful tool in all subject areas and grades. During the following years we added SMART Boards to all grades and subjects in stages.

Along the way, we were careful to provide technology staff development training for our teachers so that they could successfully

"¡Habla español, por favor!": *Using Math to Promote Use of the Non-English Language*

By Cheryl Urow, Education Specialist, Illinois Resource Center, Arlington Heights, IL

Like in many immersion classrooms, the students in my third grade Spanish-English two-way immersion classroom had a hard time maintaining their use of the minority language – in this case, Spanish. The language of preference – the language they used on the bus, as they walked to school, and as they waited in line on the playground before school – was English. As the students entered my classroom in the morning, I had to refocus them in many ways: from play to work, from social to academic, and, most challenging, from English to Spanish. I found that beginning the day with math did all of this most effectively.

Math is a subject that can be made very concrete with the use of a variety of manipulatives, including pattern blocks, base ten blocks, counters, and number cards. In addition, math is a subject that lends itself to interactive activities that require the use of academic language. The simple attraction of the manipulatives helped draw the students into the academic from the social. Then, the use of these hands-on objects during the interactive academic activity provided students with concrete reminders of the Spanish vocabulary and phrases they were supposed to use.
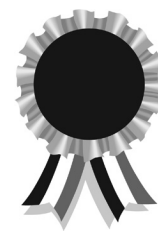
THE FISHBOWL STRATEGY

My math lessons followed a routine that moved students from the concrete to the abstract, while focusing on the development of both content area knowledge and academic language. One of the most successful strategies I used in math class, one I found that allowed me to effectively meet the double challenge of all immersion teachers – to teach language and content simultaneously – was the fishbowl strategy. The fishbowl strategy, as the name implies, takes a small number of students and puts them "in the fishbowl." The other students in the class gather around the "fish" and observe their interactions. The fishbowl I used, described below, was adapted for the needs of the immersion classroom.

As mentioned above, I began math lessons with the concrete. As students entered the classroom in the morning they would find some sort of hands-on manipulative on their desks. In this example, the students encountered a plastic zip-lock bag with cards numbered 0-9 and a place value mat with spaces for *unidades*, *decenas*, *y centenas* (ones, tens, and hundreds). The key words – *las cartas, el tablero, el valor posicional, las unidades, las decenas, las centenas* (cards, game board, place values, ones, tens, and hundreds) – were posted clearly on chart paper. As the students unpacked their backpacks and got settled, some would begin to open the bags and play around with the items in the bag. This was my intention - this was how I drew them into the academic from the social. As I greeted each student at the door I focused their attention on the words on the board and directed them to use the Spanish words, rather than English, as they interacted with the items they found on their desks. When the last of the students had entered the classroom and had settled down, I called for the students' attention and asked them to return the items to the bags. I then asked for volunteers to help me demonstrate how the items in the bag were to be used.
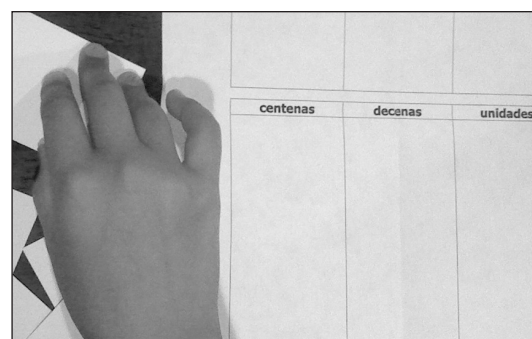
Here is where I was beginning the fishbowl strategy. I was now choosing my "fish", and I

Students play with the place value mat as they enter the classroom in the morning.

Habla español, *continued from page 3*

was always deliberate in my choice. While I made an effort not to pick the same students all the time for the fishbowl, I did try to choose my most difficult or problematic students first. The students I am referring to here are those students whose inappropriate or disruptive behavior usually garnered them negative attention. By choosing them for the fishbowl, I was taking advantage of their need for attention, but preempting it and giving them positive attention for appropriate and collaborative behaviors instead. And, because I am describing an immersion classroom, problematic students include those who hesitated or resisted using Spanish.

Once my two fish were chosen, they were seated at a table around which all my other students could congregate. I then prepared to narrate both the behaviors and language I expected from my students. This is why I found the fishbowl strategy so effective - because it allowed me to model both the behaviors I wanted students to emulate (the rules of the game, turn taking, etc.) along with the language I wanted them to use (Spanish math vocabulary, turn-taking phrases, etc.) without having to lecture to the students. While I could have listed the rules of the game and then posted the key words and phrases on the board, I found that doing this, while less time consuming than the fishbowl, resulted in a great deal of talking on my part and very little interaction on the part of the students. The fishbowl strategy allowed me to do less lecturing, and the students to do more interacting.

Language for playing the math game is posted for easy reference.

USING INTERACTIONAL LANGUAGE

I then placed the plastic bag between my two fish. Before either had a chance to reach for the bag, I quickly complimented the fact that neither had grabbed the bag from the other, *"Miren que bien que se portan Hannah y Antonio. Ninguno agarró la bolsa. ¡Que educados!"* (Look how well behaved Hannah and Antonio are. Neither has grabbed the bag. How polite!) I then went on to provide Hannah the formal, polite language I wanted the students to use as they engaged in turn taking. I told Hannah to turn to Antonio and say, *"¿Me permite abrir la bolsa?"* ("May I open the bag?"). After narrating the phrase, I posted it on chart paper along with the key content vocabulary. This interactional language – that of turn-taking, negotiating, or sharing – is often the language that immersion students lack, and where they tend to fall into English use. And once English is used, it is often difficult to bring students back to the use of Spanish. I purposely chose phrases and vocabulary I knew students were not using. While they may know how to ask politely, it is doubtful that the students regularly used this kind of language when making requests of one another. I wanted the opportunity to introduce, and have students practice, new language in a highly concrete, comprehensible context.

Once Hannah used the key phrase, I then turned to Antonio and provided him with his

response, *"Antonio, ahora le dices a Hannah, '¡Adelante!'"* (Antonio, now you say to Hannah, 'By all means!'") Once again, I specifically chose a phrase that students were not currently using, and that increased both their receptive and productive language. This phrase was posted on chart paper with the other key language. As each new phrase or word was introduced, it was placed on the chart paper to serve as both a linguistic reference and a reminder for students to use during the activity.

Once Antonio gave Hannah permission to open the bag, I directed Hannah to open the bag and to place all the numbered cards face down, and then to unfold the game board and place it face up between the two of them. I then stated that since Hannah got to open the bag, Antonio could go first. I indicated that he should politely say to Hannah, *"Ahora me toca a mi."* (Now it is my turn.) I then narrated the rules of the game by directing both his and Hannah's actions. First, I told Antonio to pick one card and place it on the ones, tens, or hundreds place, keeping in mind that he was trying to make the biggest number he could, and that once he placed a card on the board, he could not move it to another place. Antonio picked a card that turned out to be a five. As he showed us all what he had picked, I directed him to say, *"Tengo un cinco."* (I have a five.) On the board I wrote, *"Tengo un _____."* Antonio then placed the five in the tens place, and I asked him to complete the new sentence I had just written on the board: *"Ahora vale _____."* (Now it is worth_____.) Antonio correctly read and completed the sentence with "*cincuenta*" (fifty) and it was Hannah's turn.

TEACHING GRAMMAR IN CONTEXT

Hannah then emulated what Antonio had done using the sentence prompts on the chart paper as a guide. Hannah and Antonio continued playing while the other students observed. Once they had each created their three digit numbers, I directed each to read

the full number, and then asked them which of them could use the phrase, *"Yo gané"* or *"Gané yo."* (I won.) With 937 to Antonio's 854, it was clear Hannah had won. I then put up the final sentence prompt, *" _____ gané/ganó por aproximadamente ____."* (_____ won by approximately _____.) Each student then completed the sentence. It is important to note that this last sentence required the students to think about both language and content. Because she won, Hannah had to use "*gané*", the correct first person past conjugation of the verb "to win", while Antonio had to use the word "*ganó*", indicating Hannah, and conjugating the verb in the third person past. In this way, I was able to teach about past tense within a highly concrete, comprehensible context.

"Yo gané," the winner says.

I then asked the rest of the students, those who had been observing, to return to their desks to play the same math game in pairs, following the behavior and language modeled by the two fish. Hannah and Antonio, who were usually my problematic students, became classroom helpers. They circulated throughout the room during the activity, helping students who had forgotten the rules and redirecting students to use the key phrases and vocabulary in Spanish posted on the chart paper.

By beginning with math, and by starting math with a highly concrete, comprehensible activity that focused on both language and content development, I created a classroom environment that raised the status of the non-English language and clearly established high academic and language expectations for all students. ○
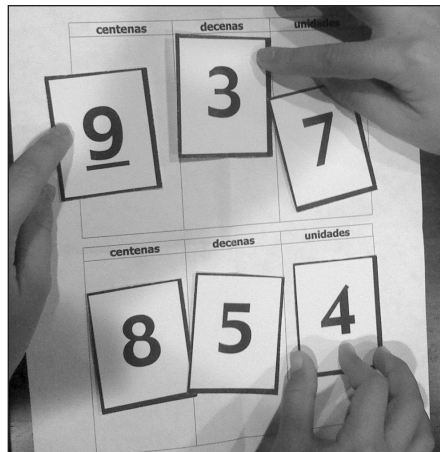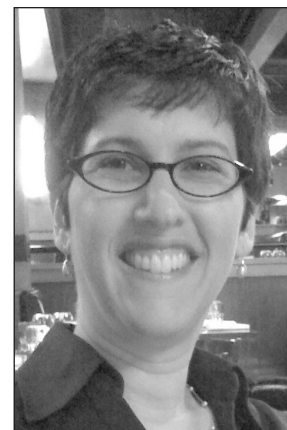
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The author would like to know whether the tensions discussed in this article resonate with the experiences of teachers of mathematics working in immersion programs. Please contact him with your examples at rbarwell@uottawa.ca.

Tensions in Teaching Mathematics Through a Second Language

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Farida is in the final year of elementary school. At home she speaks Punjabi, Urdu and English. In the course of a research project I conducted in her school, she told me a bit about the mathematics she had recently been working on ('she' refers to her teacher, Miss T):

> *oh yeah, circle, and shapes and she talks about three Ds and two Ds like, but one face and hexadas she like says six sides yeah and, and, Miss T like, choose hepsadas, you have six sides, yeah? and pentagon has eight sides, um, and ummm, ummm…*

As a mathematics teacher, how do you respond? As a language teacher? As both? Farida's words can be interpreted in several ways. She seems to understand the features of common polygons and be familiar with their names, but the names themselves are a little mixed up. When she says that pentagons have eight sides, it is not clear whether she is thinking about octagons or has not learned the correct definition of pentagon. Is the issue here one of language or of mathematics? Or both? This brief situation highlights some of the challenges of learning and teaching mathematics through a second language (L2).

It should not be assumed that learning mathematics through an L2 is necessarily detrimental to students' success. Evidence from immersion programs suggests that students can achieve similar scores in mathematics as students enrolled in regular English programs (Lapkin, Hart & Turnbull, 2003; Swain & Lapkin, 2005; Turnbull, Lapkin & Hart, 2001). In some cases, students in immersion programs outperform students in regular English programs in mathematics (e.g., Bournot-Trites & Reeder, 2001). However, other cases have been documented in which partial immersion students underperform (de Courcey & Burston; 2000). There has, however, been little research on the process of learning mathematics within immersion contexts. More generally, research on content classrooms in immersion programs tends to focus more on language learning in the context of content (e.g., Lyster, 2007). Such work rarely engages with research in content area learning and teaching, such as from the domain of mathematics education. Nevertheless, teaching mathematics in a language that students are learning is challenging. In particular, it is difficult to maintain a dual focus on both language learning and mathematics learning. As a mathematics educator with expertise in L2 education, I am interested in how mathematics learning links with language learning.

Immersion classrooms are just one setting in which students learn mathematics through a second language. Other settings include:

- ◆ mainstream mathematics classrooms where L2 learners are present, such as the learners of English as a second language or French as a second language in many Canadian mathematics classrooms;
- ◆ mathematics classrooms in various forms of dual language education programs such as those found in parts of the United States; and
- ◆ mathematics classrooms in many parts of the world where English has been adopted as the language of schooling, even though most of the students do not speak English much at home, such as might be found in South Asia or southern Africa.

Despite the diverse second language settings in which mathematics is taught and learned, it is striking how certain issues consistently arise. I describe these issues as tensions, since they are often present for teachers or learners, but cannot necessarily be resolved in a simple way. Of course it is important not to assume that research conducted in any of the above settings applies directly to immersion contexts. These tensions, however, are present

in a variety of L2 settings and seem to have a degree of generality that may be productive for immersion teachers to consider.

Five tensions are described below, but let us first look at an illustration from Halai (2009). She recorded the following discussion in Pakistan where she lives and works. Although Urdu is the national language of Pakistan and most people speak at least one other regional language, mathematics is taught in English. A group of three 10- and 11-year old students are working on the following word problem: Sara will be 28 years old after 9 years. Find her present age.

> **Shabnum**: *Sara will be 28 years old after 9 years. Will be next (emphasises using body movements).*
>
> **Maheen**: *"Will", nine years ke baad (Will after nine years)*
>
> **Samina**: *Iska matlab yeh hai ke Sara 28 years ki hai (It means that Sara is 28 years old)*
>
> **Shabnum**: *Nahi 28 years ki hogi because after nine years (No, will be 28 year because after nine years)*
>
> **Maheen**: *Because yehan 'will' (hai) 'will' means future (Because there is 'will' here. Will means future)*
>
> **Shabnum**: *Hogi nahi nahi vo hogi nine years ke bad (Will be, no, no she will be after nine years)*
>
> **Maheen**: *Hogi aise batao ke yehan will hai will means future tense (Will be, tell her that here there is 'will' (and) will means future tense)*
>
> *(Halai, 2009, p. 57)*

This exchange in a L2 mathematics classroom illustrates the following tensions inherent in teaching mathematics through a second language.

A TENSION BETWEEN LANGUAGE AND MATHEMATICS

Perhaps it is not surprising that there should be a tension between teaching and

learning language and teaching and learning mathematics, particularly for teachers. In Halai's example, students are discussing the language of the question. For me, this is not a case of 'first understand the question, then do the mathematics'; rather, sorting out the language of the question also entails sorting out the mathematics. In this case, then, attention to language is relevant and contributes to mathematical thinking and understanding. Such attention may not always be productive, however. On some occasions, attention to language may impede mathematical thinking, particularly if the linguistic feature in question is not mathematically significant (Adler, 2001; Halai, 2009).

A TENSION BETWEEN FORMAL AND INFORMAL LANGUAGE TO TALK ABOUT MATHEMATICS

Mathematics teaching and language teaching intersect in the implicit or explicit teaching of formal mathematical language. Requiring students to use rigorously formal mathematical language may inhibit their ability to express their mathematical ideas, and so have a negative effect on their learning. On the other hand, an acceptance of overly informal language does not promote the development of suitably mathematical language. In the example shown above, for instance, it strikes me that the students do not use words like 'add' or 'subtract'.

A TENSION BETWEEN HOME AND SCHOOL LANGUAGES

In the classroom in Halai's research, students were expected to speak English in public, although they could seek the teacher's permission to speak Urdu. The mixture of Urdu and English evident in their group discussion shows how they drew on both languages in their work. Research in bilingual education highlights how language minority learners use their first languages productively to learn a second language (e.g., Cummins, 2000). In the above example, the discussion about 'will' seems to be linguistically rich and

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SMART Boards, *continued from page 2*

learn how to integrate this tool into their instruction. All staff received a four-hour, hands-on beginner class where they learned the basics and practiced using the board. During their first year of using a board, staff receives follow-up trainings for approximately eight additional hours, where they work with other beginners in similar grades and subject areas. They attend these classes either during the day with a reserve teacher or after school for a stipend. In the years that follow the implementation of a SMART Board, a variety of classes and training options are provided to teachers in their second through seventh year of implementation. SMART Boards tend to accelerate the level of technology used by each teacher, so there is an overall increase in interest to learn how to use other software programs and technologies that further enhance the curriculum, such as digital photography, audio file recording, and using SMART Board student responders, called SMART Response, which allow the teacher to poll and assess every student in the class instantly.

IMMERSION + SMART BOARDS

SMART Boards have been an essential part of the success of Minnetonka's language immersion programs. The visual interactivity of a SMART Board complements the students' immersion learning experience. Our immersion classrooms have used their SMART Boards for video conferencing with other schools in another country. Teachers can easily embed images, sounds, and videos within their daily lessons for their students. There are many multicultural websites that teachers and students can interact with on a SMART Board versus passively viewing on a normal computer screen.

Information is not only displayed on the interactive whiteboard, but students manipulate this information. They can match written or recorded vocabulary with pictures, sort spelling words according to phonics patterns, move shapes and numbers to form patterns, or turn the hands on a giant clock. Teachers can zoom in on a portion of a picture or shine a spotlight on a focal point, while the rest of the screen fades to black. Interactive

Tensions, *continued from page 7*

is likely to contribute to the students' learning of English, within the context of mathematical thinking. The tension cannot be eliminated, however. Too much use of students' first languages would negate the idea of learning the target language. Although there is little research about the use of L1 in one-way and two-way immersion contexts, the idea does have its advocates (e.g. Cummins, 1998). Such an approach would, however, need to consider carefully how L1 use impacts L2 production and acquisition in the distinctive contexts of immersion programs. More research is needed.

A TENSION BETWEEN MATHEMATICAL UNDERSTANDING AND THE SOCIAL VALUE OF A SECOND LANGUAGE

Language education must be understood within its wider social context. In many situations, the language of schooling is dictated by social or political factors, rather than educational concerns. In Pakistan, there is parental pressure, particularly from upper socioeconomic groups, for instruction in English. The perceived value of English as necessary to get into good universities or join the civil service is in tension with the value of learning mathematics in a familiar language.

A TENSION BETWEEN POLICY GOALS AND CLASSROOM PRACTICE

Education must also be understood within its policy context. The language of schooling is often set by national or regional policy, rather than by parents or teachers. In Pakistan, the government has recently introduced English as the medium of instruction for mathematics, despite a lack of English-speaking teachers. As the extract shown above illustrates, what is required by policy and what happens in classrooms may not be easily reconciled and can often be in tension. Teachers and students will, at some level, use whatever means they can to ensure learning and understanding.

As mentioned, these tensions are not necessarily resolvable; they are ever-present.

Sometimes, however, it is helpful to identify such tensions, so that we can work more explicitly to find ways to deal with them. In *Mathematics in Multilingual Classrooms: Global Perspectives* (Barwell, 2009), the contributors describe mathematics classrooms in L2 learning settings in the U.S., England, Wales, Australia, Pakistan, and Malta, illustrate how these tensions arise, and highlight the different ways they can be addressed. It seems reasonable to assume that similar issues arise in immersion mathematics classrooms. Indeed in a rare study, Burston (1999) examines how French immersion students in Australia use both French and English while solving a series of mathematical word problems. Her study reveals a variety of strategies deployed by students for using the two languages as they worked on the mathematics.

What, then, can we do as teachers? Suitable strategies often entail an explicit focus on language in the context of mathematics. The tensions discussed above suggest that attention to language needs to go beyond a focus on vocabulary or grammar to consider broader aspects of students' language use (Cummins, 1998). In the project involving Farida, mentioned at the start of this article, students were asked by their teacher to write mathematical word problems of their own. This task allowed students to make use of familiar contexts from their wider experiences outside of school, of mathematics and of English to construct meaningful problems. Their work naturally integrated language learning and mathematics learning, and bridged students' informal and formal use of English (see Barwell, 2005; 2009). The above tensions are, by definition, complex and emerge differently in different settings. Identifying how these tensions manifest themselves in our own classrooms provides a way to understand the issues more clearly and a starting point to develop teaching strategies. ○

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SMART Boards, *continued from page 8*

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flashcards flip back and forth, and words and pictures "magically" disappear or appear. The SMART Board is a useful tool that allows an immersion teacher the ability to draw attention to something visually that could be difficult to understand or even more time consuming to explain without these features. It's no wonder a SMART Board is an easy way to hold students of any age captive, while increasing participation and engagement.

It is important to note, however, that immersion teachers should not forget the value of verbal communication in the second language (L2). Although high quality graphics are readily accessible at a simple click, it is up to the teacher not to become dependent on visual communication only.

> 66 *Although high quality graphics are readily accessible at a simple click, it is up to the teacher not to become dependent on visual communication only.* 99

EASILY ACCESSIBLE DIGITIZED FILES

An added benefit of the SMART Boards is that because everything the teacher uses it for becomes digitized, it can easily be shared with other teachers and stored for future reference. This has been extremely helpful in the Minnetonka district, where each of our six programs is housed in a separate school, and collaboration across programs is essential for their success. Teachers can build on each other's great ideas rather than reinvent activities and lessons individually. A web-based, password protected portal is used to archive all files for easy access to upload and download lessons submitted by teachers. This web portal can be accessed from any computer with internet access.

Additionally, having a digitized copy of a file helps students easily recall lessons and material from a previous day or week. The file can simply be opened up for instant visual recognition of the previous lesson, triggering the memory of new vocabulary and content learned the day before. These digitized lessons and activities can be quickly posted online for students to review and practice from home, as well as for parents to understand what is being taught in the classroom.

Teachers' SMART Board lessons incorporate a variety of multimedia components that students find very engaging. Lessons come alive as students take turns touching and interacting with the SMART Board. Teachers report increased motivation and interest among students. Overall, Minnetonka schools have seen dramatic increases in student test scores that are partly attributed to the implementation of interactive whiteboards.[1] Technology is seen as such a benefit to education in Minnetonka that it is referred to as an "accelerator of learning."

SMART BOARD USE IN A SECOND GRADE IMMERSION CLASSROOM

As teachers become more accustomed to using a SMART Board, it may even feel difficult to teach without one. In my second grade Spanish immersion classroom, we use our SMART Board throughout the day, not only for lessons but also for classroom management and transitions. For example, when my students first arrive, they make their lunch choice in the morning and read the morning message on the SMART Board. We use the interactive whiteboard to play games, check the weather report, and even to read a story aloud. For transitions, I have slides that display the materials they need to take out or put away before the music that is linked to the file stops playing. This frees me up to continue working with my small group, while my "helper of the week" goes to the SMART Board,

finds the transition page, and clicks the music to begin. Without a word being said, the rest of the class looks up at the board, sees their task, and follows the direction—sometimes while singing along to the music in the target language.

In my classroom, the students use the SMART Board just as much as I do. In addition to using their fingers to navigate, the students use pointers with plastic or rubber-coated ends, fly swatters that I found at a dollar store, and even little stuffed toys. They easily write words, flip objects, lock items in place, and manipulate the sizes. Sometimes they learn cool tricks from their music or art teachers, and come back to my class and teach me how to do things! The possibilities are endless, which is why collaboration of ideas is so beneficial.

FOOTNOTE

1. *Minnetonka Public Schools 2006-2007 Annual Report, Technology page 20, http://www.minnetonka.k12.mn.us/ newsroom/Pages/AnnualReport.aspx*

SAMPLE LESSON

Subject and grade: second grade math lesson
Topic: Subtraction of double digit numbers using "trade-first" algorithm

Content objectives: The immersion learner will...

- Distinguish between double digit subtraction where trading is needed and not needed
- Apply and explain the trade-first algorithm
- Demonstrate understanding of place value while subtracting using base ten block manipulatives or graphic representations

Language objectives: The immersion learner will...

- Content-obligatory:
  - Use key nouns related to the algorithm: *la decena* (ten), *la unidad* (one), *los bloques* (the blocks)
  - Use the phrase *tener que* (have to) in first, second, and third person singular: *tengo que* (I have to), *tienes que* (you have to), *tiene que* (s/he has to)
  - Use the infinitive form of the key verbs related to the algorithm: *restar, cambiar, quitar, tomar* (subtract, trade, take away)
  - Count by ones and tens
- Content-compatible:
  - Use the phrases: *No es necesario cambiar porque* (It is not necessary to trade because)…; *Es necesario cambiar…por…*(It is necessary to trade... for); *Estoy de acuerdo; No estoy de acuerdo porque...* (I agree/I do not agree because); *No te olvides…*(Don't forget to) when working with their partner to explain their thinking.
  - Use the language of sequencing: *primero, segundo, después, luego, finalmente* (first, second, then, next, finally) to perform the steps of the algorithm in sequence.
  - Use a rhyme to help them remember when trading is necessary and when it is not: *Si hay más en el cielo ya está listo, si hay más en el piso cámbialo primero.* (If there's more in the 'sky' it's already set, if there's more on the floor, trade it first.) The Spanish rhyme is based on the English rhyme "If there's more on top, no need to stop. If there's more on the floor, go next door to get ten more."

SMART Boards, *continued from page 11*

Figure 1: *The daily math message on the SMART Board.*

Anticipatory Set

Begin by displaying the daily math message on the SMART Board (Figure 1) while students draw the answer on their personal dry erase board or display the answer using base ten blocks. Base ten blocks are math manipulatives that represent place value of ones, tens, and hundreds. The message asks students to use the blocks to show the number 25 two different ways. A volunteer can come to the board to move the SMART Board base ten blocks to display and explain his/her answer. Students in this second grade class are accustomed to explaining their thinking out loud to the rest of the group. In this case, the student will review sequencing language (first… second…) and lead the class in counting by tens and ones.

Review—Input/Modeling/Check for Understanding

The teacher demonstrates how to subtract double digit numbers when trading is not necessary before introducing subtraction with trading. The teacher uses the SMART Board to model and talk through the steps using base ten blocks and several examples (Figure 2), while students interact both with the base ten blocks at their desk, and the blocks on the SMART Board.

Figure 2: *SMART Board pages showing how to subtract double digit numbers.*
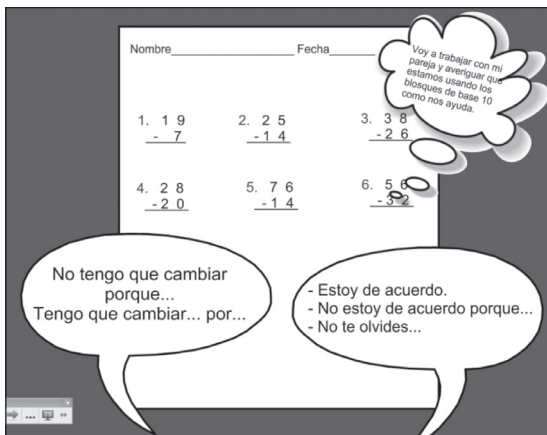
Figure 3: *Dialogue bubbles direct student talk.*

Students work in pairs to complete a few problems in their workbook, a copy of which is scanned in the file for easy explanation. These few minutes serve as a check for understanding as students take turns describing how they solve the problem, checking that each step was followed, and providing assistance to one another. A page on the SMART Board includes dialogue bubbles (Figure 3) with sentence starters to support the students' conversations and use of content-compatible language. For example, "I need to exchange for 10 ones because…" The partner responds with, "I agree" or "I disagree because…" The teacher can rotate around the room, listening to how students are using the immersion language meaningfully and providing support as needed.

New Skill—Input/Modeling/Check for Understanding
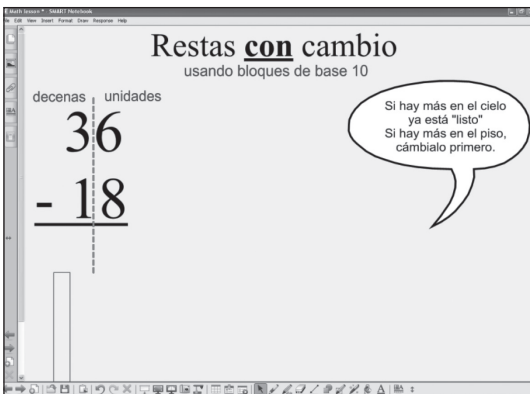
Figure 4: *A rhyme helps students decide when to trade.*

Next the group is gathered together and the teacher introduces the new skill, modeling and talking through the steps for the trade-first algorithm and teaching the rhyme (Figure 4) that helps students decide when trading is necessary. As she walks through different examples, she begins to add pauses to her speech, allowing students to fill in the blank with the key vocabulary words. She uses this strategy to make sure they are ready to use the correct vocabulary when working with their partners. During her final "think aloud," the teacher uses SMART Recorder. This is a feature of the program that records every move that she makes on the SMART Board and records any verbal directions. This enables her to play the recorded sequence back for her students.

Guided Practice

As the students begin work with their partners again, the SMART Board replays the recorded sequence of the trade-first algorithm (Figure 5). The SMART Board continues to act as a teacher modeling the correct sequence while the classroom teacher is free to help other learners. After the teacher observes that partnerships are working successfully, she will combine them into small groups of four students and assign each group a different problem. This encourages students to use the new vocabulary meaningfully and misconceptions surface as they explain their thinking out loud. Students will then orally present their answers as part of the closing activity to the rest of the class.

Closure

The small groups will present the answers to the class using the SMART Board. If time doesn't allow for everyone, the remaining groups will present the following day as a way of review from the day before.

Independent Practice

As the teacher assigns independent practice for home, she explains that this file will be uploaded on the class webpage for easy student access at home. This is especially helpful because the trade-first algorithm is different than the way their parents were most likely taught to do double digit subtraction. The student and adult can watch the video together as the child explains the algorithm to his/her parents. The power of SMART Boards even extends to home learning. ◯
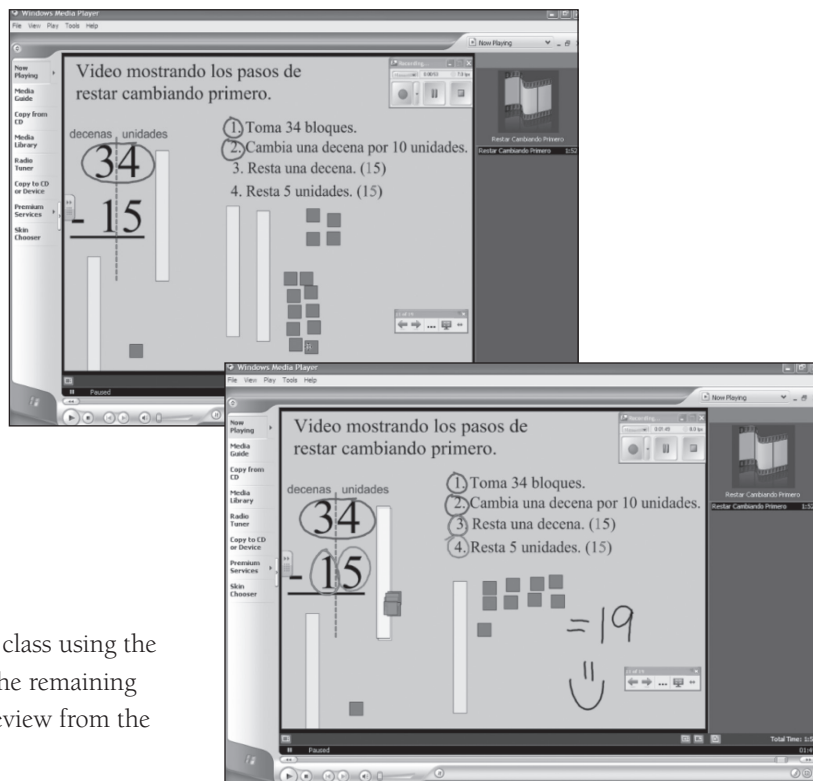
Figure 5: *The SMART Board shows the sequence of steps to subtract double digit numbers.*

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Bringing Content and Language to Life Through Theater: Part II - Math

by Kim Wieber du Saire, First grade teacher, Park Spanish Immersion School, St. Louis Park, MN

Editor's note: This is the second of a two-part article by the author. In the February 2010 issue of this newsletter, she introduced her practice of using drama to teach content and language in language arts and social studies.

A highlight of my math classes is math theater, or *obras de matemáticas*. Students anxiously gather on the audience section of the carpet, hands raised, waiting to be part of the math problem. I lead small groups of students in acting out simple situations, after which the class solves the story problems together, first in words and pictures, and then as a number sentence.

It is quite easy to create and solve simple addition and subtraction stories. For example: Six students are at the park and three more arrive. How many are at the park? (6 + 3 = 9). Seven students are swimming in a pool. One student gets out of the pool. How many are still swimming? (7 − 1 = 6).

DRAMATIZATIONS ENCOURAGE MATH TALK

I have found that many students can more easily solve missing addends problems when they can create a story and see it played out with their friends or in their heads. The following is an example of a missing addends story that my students act out as I narrate: I am going to have a party. I make a pizza for my party and I buy some soft drinks, pantomiming all of the actions. I prepare the plates and glasses. The doorbell rings and I welcome my first guests. *"Hola Katie. Hola Joe."* The students answer accordingly and then respond to my invitation, *"Pasen adelante."* They enter and the doorbell rings again. I welcome the next three students to the party. *"Hola Miguel. Hola Ashlee. Hola Kandra."* The students respond accordingly and join the party. I then pass out the imaginary plates of pizza and the glasses.

"Oh no, I only have four glasses!" It is at this point that we break away from the acting, and with the audience talk about the math in this situation.

First we determine what information we know. There are five children at the party who need a glass, and I have only four glasses. I draw a picture to represent the five students

"Swimmers" act out a math story in front of their classmates.

and the four glasses. Students quickly confirm that I need one more glass. I then lead them in deciding how to write the math equation. We have four glasses. We had to figure out how many were missing so we would have enough for all five guests: 4 + ? = 5. Many students are able to solve this simple equation without the drawing and the story. But for others, the story and the drawing bring meaning to the equation. We agree that I need one more glass and below the first equation I write: 4 + 1 = 5. We then return to acting. I pantomime rifling through my kitchen, and I find another glass. I serve the soft drinks and my guests enjoy the party. The audience applauds for the actors, and hands shoot up, students hoping to be chosen for the next story.
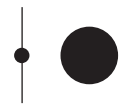
After enough examples, so all children have had a turn and the equations have gotten more difficult, students create their own *obras de matemáticas*. Their work must include a drawing and the number sentence, and they must share their *obras* with other students. I encourage students to work with a partner, which gives them access to more vocabulary. It is also important to set a limit on how large the numbers in the story can be, so the students creating the story and those who hear it are able to solve it. Students enthusiastically invent and share their math plays, practicing both math and language skills.

USING MATH LANGUAGE

Attention must be paid to both content obligatory and content compatible language in math lessons. Because students are acting the math stories, new vocabulary, especially verbs, can be introduced. Stories might require that students swim, plant flowers, or even bake cookies. Muscle memory is strengthened when students are acting out these new verbs. I insert new verbs into every story, thus exposing students to a variety of verbs. Some stories use present tense verbs while others depend on past tense verbs, providing practice in both tenses.

Content obligatory language for math includes *el cuento* (the story), *el problema* (the problem), *resolver* (to resolve), *una suma* (an addition equation), *una resta* (a subtraction equation), *sumar* (to add), *restar* (to subtract), *una ecuación* (an equation), *más que* (more than), *menos que* (less than), *dibujar* (to draw), and *crear* (to create), among others.

Content compatible language can include verbs such as *encontrar* (to find), *tomar* (to take or drink), *recibir* (to receive), *regalar* (to give), *dar* (to give), *tener* (to have), *comprar* (to buy), *venir* (to come), *llegar* (to arrive), *perder* (to lose), *comer* (to eat), *ir* (to go), *volar*

(to fly), *robar* (to steal), *vender* (to sell), and *compartir* (to share), to name a few.

READER'S THEATER AND MATH

Vocabulary increases when students learn through Reader's Theater. The same can happen when using Reader's Theater in math class. I read the story *"Llaman a la puerta"* (The Doorbell Rang) by Pat Hutchins, while students play the roles of the children dividing up the cookies as more friends arrive at their house. I provide my students with paper cookies that they divide into new groups each time more friends arrive, which requires them to add, subtract, and count. After solving the math problems presented in the story, they are treated to an unexpected twist at the end.

Other picture books that focus on math topics and lend themselves to dramatization include Stuart J. Murphy's MathStart series which have stories with math concepts embedded in them. Two examples are Monster Musical Chairs, which focuses on subtraction and some silly monsters, and A Fair Bear Share, which highlights place value and regrouping as the bear cubs collect berries to make a pie.

Because young children love to use their imaginations, they are easily drawn into the world of math theater. Bringing math to life through theater makes it more meaningful and engaging for all involved. ❍

How do we divide up the cookies amongst more and more children?

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Submission Deadlines

*May 15   Fall issue
November 15   Spring issue*

ACIE NEWSLETTER/MAY 2010

Center for Advanced Research on Language Acquisition

*University of Minnesota
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Minneapolis, MN 55414 USA*

- -

The American Council on Immersion Education (ACIE) is an organizational network for individuals interested in immersion education—teachers, administrators, teacher educators, researchers, and parents.

Conceived by immersion teachers in Minnesota and funded in part by the National Language Resource Center (NLRC) in the Center for Advanced Research on Language Acquisition (CARLA) at the University of Minnesota, ACIE aims to facilitate communication among immersion teachers and others interested in immersion education.

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STARTALK Mandarin Elementary Immersion Summer Teacher Education Program (MEISTEP)

Tara Fortune, Grant Developer, Lead Instructor for Immersion 101 for Chinese and Japanese
Amy Egenberger, Co-Instructor for Elementary Math Teaching, Mentor and Coach for Math Practicum Experience

> "This two-week practicum was a wonderful opportunity for us to see and learn what it feels like to teach in an immersion environment. Combining practice with theory gave us clear concepts about how to prepare a lesson and how to carry it out."
>
> *-Amy Gao, MEISTEP participant*

Introduction

The National Security Language Initiative (NSLI), begun in 2006, is a federally sponsored program coordinated by the Secretaries of State, Education, and Defense and the Director of National Intelligence. Its intent is to expand the number of U.S. Americans capable of achieving advanced- to superior-level proficiency in the country's high-need languages, among them Arabic, Chinese, Farsi, Hindi and Russian. Several programs have been developed to improve and increase foreign language education including the Flagship Programs, Intensive Overseas Summer Language Institutes, and the most recent program, STARTALK. STARTALK's specific mission is to support K-16 language teachers and students through summer program experiences that seek to improve the teaching and learning of politically and economically important languages that are less commonly available in U.S. schools and universities.

National interest in the field of language immersion education has also been growing steadily over the past several decades fueled by evidence that immersion provides students with one of the most powerful contexts for becoming proficient in a second language (see Fortune & Tedick, 2008, for research review). Interest in Chinese immersion education, however, is relatively new; in 2005, only twelve such programs were reportedly in operation in the entire U.S. (Center for Applied Linguistics, 2006). This contrasts with the forty-two preK-12 Chinese immersion programs more recently reported by Dr. Bonnie Liao, founder of the Yu Ying Public Charter School in Washington, D.C. (J. Zhao, personal communication, July 11, 2009).

In Minnesota, a state that currently boasts fifty-two dual language/immersion programs in fourteen districts (and five publicly funded charters), there are 610 immersion teachers and 10,834 students. Five of these programs now offer early total Mandarin immersion to some 756 students. Over the next five years student enrollment is expected to grow 171%. The greatest challenge to this growth and to future program development is the acute lack of licensed and highly qualified teachers who

are prepared to teach elementary academic subjects such as math in Mandarin while concurrently attending to children's language development and culture learning.

Fang Wu and Loretta Eng engage in an interactive learning activity during Immersion 101.

To assist in meeting this need, the University of Minnesota's Confucius Institute proposed, and in the spring of 2009 was awarded, a STARTALK grant to develop the Mandarin Elementary Immersion Summer Teacher Education Program (MEISTEP). Several units at the University of Minnesota collaborated to create the immersion teacher development program: the Confucius Institute, the Immersion Projects at the Center of Advanced Research on Language Acquisition (CARLA), and the Second Languages and Cultures and Math Education Programs in the College of Education and Human Development's Department of Curriculum and Instruction. As part of this program, university project developers and course instructors teamed up with Minnesota's first Mandarin immersion school, Yinghua Academy, to provide teacher participants the opportunity to observe mentor teachers and practice teach in a summer math program for K-4 Mandarin immersion students.

STARTALK MEISTEP harnessed the University of Minnesota's established expertise in language immersion education and teacher development and its emerging leadership in Chinese language education. Project goals were as follows:

- *To develop and implement a cohesive, four-week summer teacher education experience designed to improve participants ability to develop curriculum and teach math and other subject matter in a Mandarin immersion context;*

- *To provide a practicum experience through a university-school collaboration between the University of Minnesota and Yinghua Academy;*

- *To facilitate post-session communication among participants using technology and to exchange lessons developed during the course of the summer program.*

Participants were recruited both nationally and locally and a total number of fifteen provisionally-licensed or prospective Mandarin immersion teachers, all native speakers of the immersion language, participated in the program. As anticipated, their knowledge about and experience with immersion education, U.S. public schooling, family expectations and student behaviors varied, but in many cases was limited. Similarly, participants' prior knowledge and experience with the field of elementary math education in U.S. schools differed. While some were licensed experienced teachers in their home country, others brought professional backgrounds and undergraduate experiences in areas outside of language and education such as engineering.

STARTALK MEISTEP Program Description

Week one of the four-week program took place during one of CARLA's summer institutes, *Immersion 101: An Introduction to Immersion Education for Chinese and Japanese Programs*. This course provided a research-based introduction to the fundamentals of language immersion education and the integration of language, culture and subject matter for the elementary immersion context.

Week two focused on the theory and methods of teaching elementary mathematics in an immersion setting. Participating teachers deepened their understanding of effective strategies for teaching language and math content simultaneously and addressing culturally specific approaches to mathematics. They also learned about and experienced standards-based lessons and a wide range of instructional approaches. Week two activities were designed to help elementary students develop an understanding of mathematical concepts, to increase their agility in solving mathematical problems, and to articulate their thinking throughout the process.

Weeks three and four of the STARTALK MEISTEP allowed participating teachers to apply their knowledge and engage in the practice teaching of mathematics in the context of the Mandarin immersion summer program at Yinghua Academy. Participants observed experienced teachers, interacted with students during center activities, and collaborated to develop immersion lessons that would integrate language, math content, and culture in a meaningful, developmentally appropriate way. Key to the success of the teaching practicum was the opportunity for participants to reflect on their observations and experiences and to share those reflections with one another each day. The feedback and guidance from a seasoned immersion teacher helped the practicum teachers shape and implement their lessons with the unique needs of their Mandarin immersion students in mind.

The "Super Six" teachers who completed all four weeks of the MEISTEP program along with mentor teacher, Amy Egenberger. (From left to right: Amy Gao, Tian Xia, Qin Fang, Amy Egenberger, Fang Wu, Ting Zou and Hsiu-yu Yang)

The lesson excerpt below began its development during weeks three and four of the MEISTEP experience by program participant, Tian Xia. Tian currently teaches first grade at Yinghua Academy in Minneapolis, MN, and graciously gave permission to Tara Fortune, Yu Wang (Confucius Institute, University of Minnesota) and Amy Egenberger to expand on her work and provide a sample math lesson for other teachers working in Mandarin immersion programs across the U.S.

Mandarin Immersion Lesson Plan: Making the Language-Culture-Content Connection

Context

Program Particulars

Program Model: Early, total, one-way foreign language immersion

Immersion Language: Mandarin Chinese

Grade Level: First grade

Desired Results

Enduring Understandings

When two numbers are added, the sum is the same regardless of the order of the addends. For example, 4 + 2 = 2 + 4 (commutative property).

Materials

Vocabulary cards, picture cards, chart paper, markers, Ping-Pong balls, video clip of Ping-Pong match in China, student worksheet pencils, unifix cubes

Learning Objectives: The Students Will...

Content

Develop initial understanding of the commutative property. (When two numbers are added, the sum is the same regardless of the order of the addends. For example, 4 + 2 = 6; 2 + 4 = 6; 4 + 2 = 2 + 4.)

Culture

Become familiar with Ping-Pong as one of the Chinese people's favorite sports.

Language

Content-Obligatory

- Express addition stories with number sentences (a 加 b 等于 c) using the words 加 (plus), 等于 (equals), and 一共 (altogether) with the numbers 1-10.
- Express the sum of an addition story using the sentence, "一共有…." (There are [number] [noun] altogether.)

- Accurately replace the number 二 (2) with character 两 to express quantity of a noun, e.g., 两只兔子 (two bunnies), 两只小鸟 (two birds), 两只小狗 (two puppies), 两只小猫 (two kittens), 两只熊猫 (two pandas), etc.

- Use appropriate measure particle 只 before nouns in the small, cute animal category, e.g., 3 只小鸟 (3 birds), 5 只小狗 (5 puppies), 7只 老鼠 (7 mice), 9只小老虎 (9 baby tigers), etc.

- Identify the order of addends in an addition sentence using ordinals such as 第一 (first), 第二 (second), and 第三 (third), or other sequencing adverbs (e.g., 下一个 [next], 然后 [then]), etc.

- Compare and contrast the relationship between the order of the addends and the sum in an addition sentence using the modal helping verbs 可以/能 (can), 应该 (should) in a compound sentence and one of two options for the conjunction "but" (但/但是), for example, a和b的顺序可以改变, 但是和应该不变. (The order of "a" and "b" can change, but the sum should not change.)

Content-Compatible

- Provide encouragement, direction and verbal support to a partner or group member with phrases such as 加油! (Come on!), 干得好! (Way to go!), 好球! (Nice hit!), 加油! (Work harder!), 注意! (Pay attention!), 小心! (Be careful!), etc.

- Identify sporting activities that students are familiar with using the pronoun 我 (I) with the verb 玩 (play) and various sporting activities, e.g., 棒球 (baseball), 足球 (soccer), 曲棍球 (hockey), 橄榄 球 (football), etc.

- Review and use known vocabulary for numbers 1-31, months of the year, seasons and small, cute animals, such as 兔子 (rabbits), 鸟 (birds), 猫 (cats), 狗 (dogs), 老鼠 (mice), etc.

- Accept an invitation with the language chunk, "当然可以! 我很愿意!" (Sure, I can! I am glad to!)

Learning Strategies

- *Use graphic organizers:* Create a visual representation of the addition story to assist problem solving.

- *Find/apply patterns:* Identify the use of measure particle 只 that precedes nouns that identify small, cute animals, and the use of the character 两 instead of 二 (2) when counting things.

- *Cooperate:* Work in pairs and small groups to solve addition stories.

Teaching and Learning Experiences

Day One: Preview Phase—"Into" Activities

Introduce the game of Ping-Pong as a much enjoyed cultural practice in China. Play a quick warm-up of game of bouncing Ping-Pong

balls in pairs while counting and recording the number of bounces. The teacher previews phrases of encouragement and suggestions for improvement so that children can verbally support their partners. Debrief the game and invite the students' reflection on their personal use of Chinese. Introduce the concept of the commutative property of addition.

Details and Description of Procedures

Introduce Cultural Practice and Exclamatory Phrases of Support

Show a short video clip of Chinese children playing Ping-Pong and cheering; ask the students if they are familiar with this sport and have played it. Briefly talk about how much Chinese people love playing Ping-Pong. Ask the children what sports they like to play at school, at home, with friends. The teacher records this vocabulary on chart paper to reference later.

Ask the students what kinds of things people in America say and do to encourage each other when they are playing a sport. For example, 好! (Way to go!), 好球! (Nice hit!). Tell the children that you are going to show a short video clip and that you want them to listen carefully for the kinds of words or phrases used with Ping-Pong players as they watch a video. After the video ends, ask the students if they heard those watching the game say anything other than a positive encouragement. Call the students attention to the Chinese cultural tendency to make directive comments to players or call attention to mistakes that were made in addition to offering encouragement to players. You may want to share a personal experience if appropriate.

Then show the video clip a second time. Once the video has ended, ask the students to tell a partner any words or phrases of encouragement or correction they recall. Then invite the students to share these words with the whole class as the teacher records their responses on large vocabulary cards. Add a few additional words or phrases to provide sufficient variety if needed. Display these phrases for the duration of this lesson.

Use vocabulary cards to review exclamatory language typical of sport competitions with the children, e.g., 加油! (Come on!), 干得好! (Way to go!), 好球! (Nice hit!), 加油! (Work harder!), 注意! (Pay attention!), 小心! (Be careful!), etc.

Model Math Game Activity

Ask children if they would like to play a bouncing game with Ping-Pong balls. The goal of the game is to see how many times a group of four students can pass the ball back and forth without dropping it or letting it bounce more than once. Model for the children how to play the game with a student volunteer: in pairs, one player gently tosses the Ping-Pong ball to their partner allowing for one bounce only before

the partner catches the ball; the pair tries to keep the ball volleying back and forth as long as possible without dropping the ball or having it bounce more than once.

This activity takes place in groups of four (two pairs in each group) so the teacher invites two more student volunteers to continue the modeling. The teacher explains, then demonstrates, that the pair who is bouncing the ball will count the number of bounces out loud; at the same time, the other pair will encourage these students to do their best using the phrases just introduced. Once the volley has ended, the players write their score in the appropriate circle on the worksheet (see Figure 1). Then the pairs switch roles and play again.

Once both pairs' scores are recorded in the smaller circles, the group works together to find the sum of both scores and the student with the earliest birthday records the sum in the large circle on the worksheet.
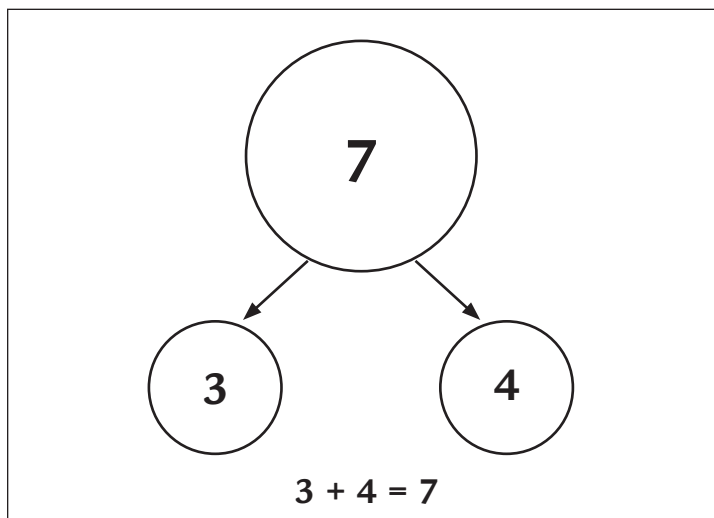

Figure 1: *Example of a worksheet for Ping-Pong scores.*

Next, this student writes a number sentence with this same information ($x + y = z$) just below the graphic (see Figure 1). Lastly, this student's partner will write the group's number sentence on the chart paper hanging in the front of the room. Be sure to post this series of tasks on the board so that students can refer to it during the activity to make sure they are on task.

Prepare Students for Math Game Activity

The teacher asks the students, "How could you find out which member of a group has the lowest birthday number?" Elicit from the students a sample of questions they could ask to find this out. If necessary, model a question or two and write them on the whiteboard with a picture cue next to the question. Possible questions: 你的生日什么时候? (When is your birthday?), 你的生日在哪一天? (Which day of the month is your birthday?), 你的生日在哪个月? (Which month do you have a birthday?), etc. The teacher asks the students to get

into groups of four and figure out whose birthday comes first. Let the students know that you will be circulating around the room listening for Mandarin only.

Then the teacher tells the group that the student with the earliest birthday (lowest number, closest to January) will choose a partner and they will play the game first. They are also responsible for getting one Ping-Pong ball from the materials basket for their group. The remaining two students will play next and are responsible for getting the math worksheet and a pencil for recording the group member names and scores.

Before beginning the game, the teacher quickly reviews the vocabulary of encouragement and direction , e.g., 加油! (Come on!), 干得好! (Way to go!), 好球! (Nice hit!), 加油! (Work harder!), 注意! (Pay attention!), 小心! (Be careful!), etc. with the vocabulary cards. She then reminds the children to count in Mandarin while bouncing the ball and to verbally encourage their group members using the new phrases. She also reminds the children that she will observe the play and listen for groups who are able to use only Chinese for this activity.

Play the Game

First, the teacher gives the groups a few minutes to practice bouncing the ball. The teacher then gives a signal when it is time to start the game. Each pair of students plays the game, records their scores and together the group finds and records the sum. One student will also write the group's number sentence on the class chart paper. While the students are playing, the teacher circulates and gives the students who are using only Chinese some words of encouragement. After the game is played, the teacher collects the Ping-Pong balls and the math worksheets.

Discuss the Game and Its Findings

The teacher gathers the students around the chart paper for a discussion of the class findings. First, she invites the students to pause a moment and think about the amount of Chinese they spoke during the activity. She asks the children to show her with one hand on their chest a number between 0-5 (fist to five) how much Chinese they used. She then comments on what she observed about the students' language use during the activity.

She then invites one student to use a pointer and lead the whole group as they read the 6-7 number sentences aloud, for example, "3+4一共等于7." (3 + 4 = 7 bounces altogether.) Once they finish, the teacher computes the class's total number of bounces and offers congratulations with "干得好!" (Way to go!) She then invites the students to read the number sentences together again. This time they are encouraged to hold up the corresponding number of fingers for each number as they say it, and make a big circle in the air with one finger each time they say the word "altogether."

Call Attention to the Math Concept in Focus: The Commutative Property

The teacher asks the students to look at all the number sentences on the chart paper and talk with a partner about what they notice. The teacher then invites individual students to share with the whole class what they noticed about the number sentences. During this debriefing the teacher ensures that any incorrect number sentences are discovered and changed. (Possible questions for the students: 这些句式相同的是什么? 不同的是什么? 你还注意到什么? [How are these number sentences the same? Different? What else do you notice?]) The teacher also calls attention to any examples on the chart paper of the commutative property, if they exist. If not, the teacher circles one of the number sentences from the chart paper to exemplify this concept. For example, $4 + 6 = 10$.

The teacher writes each of the three numbers (4, 6, 10) on a separate whiteboard and calls on three student volunteers to come to the front and hold one of the three whiteboards. These students are asked to put themselves in order according to the events of a story that the teacher will tell. The student whose number is reported first stands in the left most position; the student whose number is reported last and holds the sum stands on the right. The teacher also invites two other students up to the front to act as number sentence interpreters for the story. As interpreters, they will take turns listening carefully to the story, constructing a number sentence about it and writing it on the large whiteboard for all to see. The teacher reminds the remaining students that their job is to observe and see if they agree with what their classmates are doing.

The teacher tells a short story about two students playing the Ping-Pong game. For example:

开始, Jane拍了4下，接着，Sarah 拍了6下，他们一共拍了10下. (First, Jane made 4 hits. Next, Sarah made 6 hits. Altogether, Jane and Sarah made 10 hits.)

The teacher pauses and asks the students who are seated and watching, "你注意到刚才的故事和三个学生的位置有什么关系? 白板上的句式和三个学生的位置有什么关系?" (What do you observe about the relationship between the addition story and the students' positions? What do you observe about the relationship between the number sentence on the whiteboard and the three students' positions?)

Then the teacher tells the story a second time. This time Sarah's score is reported first.

开始, Sarah 拍了6下，接着，Jane拍了4下，他们一共拍了10下. (First, Sarah made 6 hits. Next, Jane made 4 hits. Altogether, Sarah and Jane made 10 hits.)

After pausing for student volunteers to complete their tasks, the teacher asks, "在这些句式中，哪些改变了，哪些没变?" (What about the number sentences changed and what did not change for these two

stories?), "两个数相加, 这两个数的顺序会改变和吗?" (When two numbers are added together, does the order of these numbers change the sum?) "如果是，怎么改变的?" (If so, in what ways?)

Possible student observations: "两个都等于10." (Both equal 10.) "在这个句式里，第一个数字是4，在这个句式里，第一个数字是6." (In this number sentence [pointing to the numbers on the whiteboard] the first number is 4; in this number sentence the first number is 6.) "第一个数字和第二个数字的位置改变了，但是最后的数字没有变." (The positions of the first number and the second number are changed, but the last number does not change.) The teacher guides student responses to the awareness that x加y等于y加 x (x + y = y + x).

Day Two: Focused Learning Phase—"Through" Activities

In pairs the students will work together to visually display the story problems told by the teacher in two ways. One student uses unifix cubes to show each of the two addends in the story; the other student constructs a number sentence on a small whiteboard. The teacher invites the students to tell a story for the class to interpret.

MEISTEP participating teacher, Amy Gao, prompts students to reflect about their mathematical thinking at a counting station during the 'math carnival' on the final day.

Day Three: Expansion Phase—"Beyond" Activities

Each student will draw a picture that tells an addition story to contribute to a whole class storybook about addition stories and helping and playing together. On the back of the picture the student will write two possible number sentences for their story: a + b = c and b + a = c. The students will also write two additional number sentences replacing the Roman numbers with Chinese characters. This makes four sentences total (two with Roman numbers and two with characters). The students will need to limit the topics to stories about small, cute animals (a category of nouns preceded by measure particle 只) and the numbers 1-10. They will also be expected to convert 2 to 两 when counting with the nouns. By writing the number sentences on the back of the picture and not underneath the picture, this book will be able to be used independently by the students to review the commutative property, the use of 两 for 2 when counting and use of measure particle 只 before nouns that fit the category of small, cute animals.

Differentiation

Extra support: Students use the pre-printed worksheets to tell a story, write the number sentences and make a page for the class book.

Challenge: Students increase the number of addends (0-9) in their stories to three and write as many number sentences with that same sum as they can.

Evidence

Lesson-Level Formative Assessment Procedures

Informal assessment occurs through observation of the students' oral communication, use of phrases of encouragement, the students' "fist to five" reflection on personal language use, accurate use of the (两) + measure particle (只) construction instead of the number 2 (二) before certain nouns, and participation in the activities. Math worksheets from the group's game activity and the students' individual contributions to the class book of addition stories will be collected and reviewed.

Conclusion

The purpose of this article was to describe STARTALK MEISTEP, a teacher development program for elementary Mandarin immersion teachers that focused specifically on the teaching and learning of math, and to exemplify with a model lesson how teachers can effectively bridge math, language and culture learning. Teachers who took part in the full four-week program gained new insight and experience in creating lessons and teaching math to k-4 Mandarin immersion students as was evident in comments written on program evaluations and summary statements of learning. We offer a few examples below.

- "[This workshop] gave me so much good immersion teaching practice both in research and real field experience—it's very intensive but interesting. Great encouragement by listening, reading and participating."

- We learned to "give students more manipulatives to discover the [concepts] and to help students to find the mistake and correct it by themselves."

- We learned to "make content and language relate to real life using manipulatives and graphic organizers, … and to "integrate listening, speaking, reading and writing."

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