Twenty-One Days of First Grade Spanish Dual Language Immersion: A Nurturing Mathematics and Linguistics Incubation

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Abstract

Analogous to a 21-day incubation period of a chick, four mathematics and linguistics practices are employed as a framework in a first grade Dual Language Immersion classroom. These practices include: 1) Concrete-Representational-Abstract instructional sequences, 2) Receptive and Productive Language Modalities, 3) Gradual Release of Responsibility, and 4) Number Representations and Subitizing. The article illustrates how the framework can be implemented by offering details about mathematics and management routines and examples of formal mathematics instruction.

Discussion And Reflection Enhancement (DARE) Pre-Reading Questions

1. How would you describe a modeling sequence employed during mathematics instruction?

2. Identify a couple of examples from your own mathematics instruction where students are given the opportunity to use productive modes of communication (i.e., speaking and writing).

3. Describe the role of regular routines in mathematics instruction and discuss the pros and cons of maintaining the routines without deviation.

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Twenty-one days makes a notable difference in the linguistic and conceptual development of first graders in a Dual Language Immersion (DLI) math class, similar to that of a 21-day incubation period for chicks. Science affirms a strong environmental impact on embryonic development with repercussions that impact future growth (De Smit et al., 2006). A similar impact is observed on student development during the initial days of instruction in an urban first-grade classroom. The purpose of this article is to share a 21-day curriculum model designed to promote rapid language acquisition through mathematics routines and activities.

The framework outlined below is recommended for settings such as the one illustrated in this article, where it has been successful, although not formally tested. The first-grade Spanish DLI program where English is the home language (L1) of half of the students and Spanish the L1 of the other half presents a unique need for this approach. All of the students come from kindergarten classes where instruction was delivered only in English, requiring intentional preparation for first grade mathematics content instruction in Spanish. Effective beginning-of-year routines that simultaneously review preliminary mathematics content and present linguistically-rich opportunities to engage with increasingly complex curriculum help facilitate this process.

Framework: A Nurturing Mathematics and Linguistics Incubation Period

"Los pollitos dicen pío, pío, pío . . ." (Orozco, 1999). This song about peeping chicks is introduced on the first day, along with the counting sequence *"uno, dos, tres . . . diez"* (one, two, three…ten). Neither the song nor the numbers are familiar to most students as a result of their prior educational experience. Skillful mathematics instruction serves as the context and catalyst for rapid language acquisition in the days and weeks that follow.

The song about the *pollitos* further explains how the hen provides food, shelter, and warmth, elements that offer nurturing for the chick in the same way that skillful pedagogy affords appropriate student growth. Like the hen with her chicks, caring expert-educators instinctively identify the needs of their students and use best practices to meet these. With the pacing and emphasis of this model, both novice and expert DLI teachers benefit from an explicit awareness of the interdependence of linguistic and mathematical development in the first weeks of DLI Spanish math instruction.

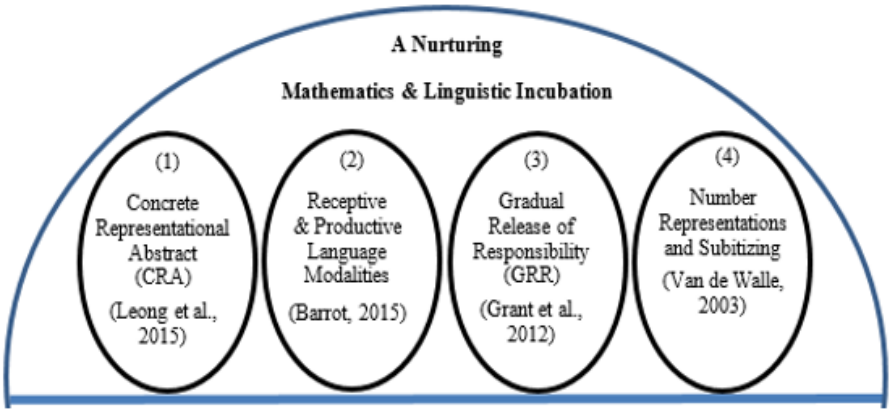


Figure 1. Progression of nurturing mathematics and linguistics incubation.

Four elements of research-based pedagogy (Figure 1) interact to ensure comprehensible input and contribute to essential mathematics and linguistics development. Each "egg" in the framework represents a continuum of progression that accelerates student development, particularly in the incubation period of first grade DLI. The four "eggs" demonstrate how mathematics and linguistic developmental components are unique, as well as interdependent, in the context of mathematics instruction. They each play a role in the first 21 days of first-grade Spanish DLI, similar to the food, shelter, and warmth offered to the *pollitos* as a prescribed incubation.

Research Foundations of the Nurturing Incubation Framework

The following descriptions of research foundations for the progression are intentionally brief, focusing on the pedagogical practices outlined in the subsequent sections.

Concrete-Representational-Abstract (CRA) Instructional Sequences

Mathematics acquisition. Bruner's (1966) modes of representation: enactive (action-based), iconic (image-based), and symbolic (language-based) created the foundation for what is now the CRA approach to mathematics instruction. The concrete level includes actions, experiences, and tangible manipulatives. This is followed by a transition to representational use of picture and two-dimensional models. Finally, the abstract level incorporates the use of symbols and formulaic terms (Leong et al., 2015). Attention to this sequence accelerates progress in both linguistics and mathematics learning.

Receptive and Productive Language Modalities

Language acquisition. The four language modalities are classified as receptive (listening and reading) and productive (speaking and writing), with the linguistic complexity increasing in productive mode (Barrot, 2015). Attention to the developmental sequence and linguistic demands affords sheltered instruction and scaffolding for language development during mathematics instruction.

Gradual Release of Responsibility (GRR)

Instructional model. I do – We do – They do – You do. The GRR framework captures the theory that the teacher must model explicitly what she wants students to do before expecting students to perform the task (Grant, Lapp, Fisher, Johnson, & Frey, 2012). Following the teacher model, a pair or group of students demonstrates the task, and then individual students repeat the example. This standard in DLI instruction helps mediate the lack of language that exists at the beginning of the school year.

Number Representations and Subitizing

Acquisition of number sense. There is unique power in ten-frames, dot patterns, tally marks, and other number representations to facilitate subitizing in order to build number sense and foster future learning. Multiple representations offer valuable exposure to and familiarity with number as a foundation for addition and subtraction models – part, part, whole (Van de Walle, Karp, & Bay-Williams, 2015).

Use and Implementation of the Nurturing Incubation Framework

The framework provides the theoretical foundation for the first 21 days of school curriculum for promoting language development through mathematics instruction. The routines and formal instruction are woven together seamlessly in a daily exchange that balances the familiar with the new in order to maintain student engagement and facilitate linguistics and mathematics growth. Figure 2 outlines the framework as a simultaneous interaction of the four elements of the incubation period.

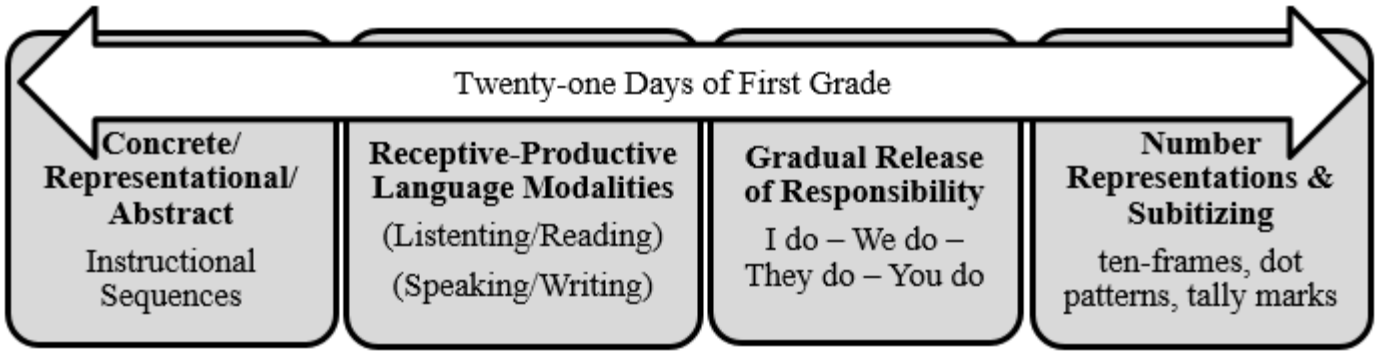


Figure 2. First 21 days of first grade.

Preliminary First Grade Mathematics in Spanish DLI

First grade mathematics curriculum begins with identifying and representing numbers. In Spanish immersion, students are initially exposed to counting and number through whole-class mathematics and management routines such as calendar, seating arrangements, distribution of supplies, and transitions. Fingers afford a familiar beginning to number sense, followed by a variety of objects and visuals such as ten-frames, drawings, and dot patterns which lead to symbolic representations. Additional experiences are presented through the context of formal mathematics instruction, modeling, and practice. These two approaches represent a practical implementation of the framework (Table 1).

- Informal Mathematics Exposure to Number: Mathematics and Management Routines – calendar, counting, seating configurations, students' alphabetical number assignment, time awareness, and quantity comparison
- Formal Mathematics Instruction of Number Sense:
  - Number Representations (models) – fingers, digits, dice dot patterns, tally marks, ten-frames, pictures, words
  - Mathematics Tasks – matching, sorting, writing, speaking

The following sections provide examples of practices embedded within the framework.

Mathematics and Management Routines

Informal exposure to number takes place through daily routines that establish both a linguistic and mathematical foundation. Some of the routines are intended for explicit exposure to linguistics content while others have an organizational purpose to reinforce management expectations. Both kinds of routines present motivating and meaningful opportunities to reinforce mathematical content.

Table 1
Framework Implementation

Incubation Period	Informal Exposure to Number Mathematics and Management Routines			Formal Mathematics Instruction of Number	
21 Days	Calendar Routines	Seating Arrangements & Expectation Reinforcement	Organization & Pacing	Whole Class Small Groups Independent	Matching Activity Sorting Activity Modeling Sequence Writing Activity

Calendar Routines

Sitting on the carpet, eyes directed toward the calendar, the student voices repeat in a *call and response* exchange, echoing each phrase of the pattern *"primer día, segundo número, tercer mes, cuarto año"* (day first – number second – month third – year fourth). They follow this four-part sequence, reciting in Spanish the days of the week, days of the month, months of the year, and the year's number and combining them for the current date (i.e. martes, 27 de agosto de 2019).

Day of the week. Cheerful little voices reflect the teacher's enthusiasm as they sing to the tune of *Are You Sleeping? "Siete días, siete días, de la semana, de la semana, lunes – martes – miércoles – jueves – y viernes – sábado – y domingo."* (Seven days, seven days, of the week, of the week, Monday – Tuesday – Wednesday, Thursday and Friday, Saturday and Sunday). They raise their fingers until they have five and two, concluding the song *"Cinco días sí hay escuela, dos días no hay escuela"* (Five days there is school, two days there is not.)

Days of the month. The same voices mimic the teacher model singing *"uno – dos – tres, cuatro – cinco – seis, siete – ocho – nueve – diez . . . veintitrés"* (August 23, the first day of school).

Months of the year. Another tune that the teacher models helps guide the student voices as they sing *"enero – febrero – marzo . . . diciembre – doce meses en el año"* (January – February – March . . . December – twelve months in the year).

Year. Finally, with a rousing cheer, the voices call out *"dos mil diecinueve, dos mil diecinueve"* (two thousand nineteen – two thousand nineteen).

Seating Arrangements and Expectation Reinforcement

The following configurations are designed for organizational and management purposes, but also offer essential exposure to number.

Numbered carpet squares. Once students choose their spot at the carpet they await the chance to be recognized through positive reinforcement. The thirty small, colored paper squares elicit excitement from the students as they eagerly observe the color and then the number, and call out together *"azul . . . dos"* (blue . . . two) identifying the carpet square where a particular student is seated. Five sets of colored papers are numbered 1-6 corresponding with the rows of the carpet and are used to reinforce student expectations as well as to draw attention to linguistic and numeric detail in the environment. In this case, a DLI routine is employed, and reinforced, to elicit language from all individuals. Students place a hand on their head to show they know the answer and when the teacher lifts her hand from her head all students are cued to respond chorally, with the benefit of peer models.

Counting for task completion. A brief transition for a few students provides an opportunity for class-wide counting that keeps everyone engaged and holds all accountable to ensure timely task completion. The students who are asked to distribute or collect supplies do so as their peers count *"Uno, dos, tres . . . once, doce, trece, catorce, quince, dieciséis, diecisiete, dieciocho, diecinueve, veinte."* Students may struggle to coordinate unfamiliar words with finger models as they count 0-20. This offers exposure to the often-challenging numbers 11-20, before individual production is expected.

Organization and Pacing

Assigned student numbers. Initial ownership of assigned student numbers comes both through proper identification of backpack hooks and cubbies and the daily rotation of leadership roles. Most students quickly identify that if student 7 had a turn the previous day it will be leader 8's turn, and they confidently place their hands on their heads ready to call out together *"Marcela, te toca"* (Marcela, it is your turn). The rotation of daily leadership roles presents a model of sequential numbers (one after another, or by twos) demonstrated with sums and differences as well as skip counting. Table groups are numbered as well, giving students the opportunity to respond to that label using variations of evens/odds and sums/differences as they are linguistically and mathematically capable.

Time awareness and quantity comparison. A class-wide number fluency task offers students the opportunity to see, think, wait, and respond in unison to correctly identify numbers. This process presents a motivating opportunity when timed and repeated to determine if the

whole class can correctly identify more or less than ten (or twenty) numbers in one minute. The same procedure is used in small-group fluency practice to increase accountability for Spanish number recognition.

Formal Mathematics Instruction

Explicit mathematics instruction is introduced through gradual release of responsibility (GRR). Whole class matching games allow for introduction to conceptual and procedural components. Teacher and peer models that precede the individual student sorting activity lay the foundation for expectations that emphasize correct Spanish language use and mathematical practice. Finally, students write and produce their own number representations according to the specified and well-practiced models.

Whole Class Matching Activity

A matching game works well to introduce the concept of multiple representations of numbers. Prior to placing the cards face down in a concentration game arrangement, they are placed face up in sequential order side-by-side, each with its match (pairs of pictures and digits), thus familiarizing students with the goal of pairing representations that are identical in quantity. The students are then shown a 5-by-4 grid arrangement of 20 cards, where rows are labeled with numbers 1 to 5 and columns are labeled with letters A-B-C-D. They are instructed how to select a card orally by identifying a number and letter combination, such as *cuatro-C* (4-C) from the rows and columns arrangement.

The whole-class matching activity provides the initial model for the small-group sorting activity students engage in afterward, which in turn prepares them to independently represent the numbers in writing. The students do not create their own representations of the numbers in the matching and sorting activities, but utilize receptive modes that prepare them for later production.

Small Group Sorting Activity

Six sets of sorting cards each representing numbers 0-10 differently are used for practice: 1) fingers, 2) digits, 3) dot patterns (like dice), 4) pictures, 5) tally marks, and 6) ten-frames. Three sets at a time are practiced so that 33 cards are sorted into three piles. The cards are placed face down in a central pile where students turn them over one at a time, and together state both the number and form of representation and then model it with counters, a concrete representation of the pictorial exmple. After students model numbers and group the cards. they arrange each set sequentially from zero to ten.

For example, at one table, Scott turns a card over and he and his peers quickly touch their heads to show that they know the answer before they complete the prompt together, *"El número es . . . siete"* (The number is . . . seven). The teacher asks a follow-up question *"¿Muestra siete dedos, el dígito siete, o siete marcas de conteo?"* (Does it show seven fingers, the digit seven, or seven tally marks?) and the four students answer accurately, *"siete marcas de conteo"* (seven tally marks), after which Scott places the card on the pile with tally mark representations. Procedural and oral precision work reciprocally to reinforce correct numbers and representations.

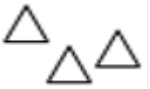
Modeling sequence. Scott's group is selected to model the activity only after the teacher provides the first example, modeling correct linguistic forms (using sentence frames) and mathematical terminology. The whole class gathers around Scott's group in a fishbowl model (a surrounding circle of observers) to reinforce the expected pattern they will follow in their own groups. The teacher supports the students as they implement the procedures and reinforce mastery of the learning objectives.

Written Number Representations Activity

The written activity involves a table with six columns, each labeled with a different form of representation and a number per row to be modeled in the six ways (Table 2). The digit is provided in the first column, and blank boxes invite supplying the word, tally marks, ten-frame, and pictures.

Modeling sequence. After the teacher completes the first row of the task, she invites individual students to finish additional rows with coaching and suggestions from the class. Oral modeling and participation help reinforce the language associated with the content. Each demonstration also involves concrete counters to represent the numbers displayed pictorially and abstractly on the activity page.

Table 2
Excerpt of Written Number Representations Activity

Nombre:_____	REPRESENTACIONES DE NÚMEROS 1-9			
dígitos	**palabras**	**marca de conteo**	**tabla de diez**	**dibujos**
3	tres			
5				
8				

A small group then models further completion of the table by taking turns where each person completes a row and passes it on. The observing students retain their focus in order to correct, commend, and coach one another through the process. The teacher and the students model-draw in the air the correct letters and the tally marks (placing emphasis on the connecting position of the fifth one) while they describe aloud the process "c-i-n-c-o; uno, dos, tres, cuatro y cinco." Finally, student groups cooperate to follow the example and together complete additional rows in the table of numbers.

All students are accountable to complete their own work after the benefit of multiple models and group practice and prior to engaging in more game-configurations that rely on these number representations. The preparation process increases students' eagerness for independent effort, similar to the effort a chick makes to leave its shell when the right time arrives. Like chicks, the strength the students gain through the process (including some productive struggle) prepares them to be successful in the first grade Spanish DLI mathematics classroom.

Conclusion

A newly hatched chick has fledgling, but fully functional, capabilities following a successful incubation period. Students in a DLI program likewise can become capable, long-term learners, contingent on nurturing pedagogical practices that foster development of both mathematical and linguistic skills. Like the incubation period of a chick, the first 21 days of first grade Spanish DLI ensure that students develop fledgling abilities and are on a course toward further advancement. This is achieved through a four-part *Nurturing Mathematics and Linguistics Incubation Framework*, including 1) CRA instruction, 2) skillful implementation of language modalities, 3) GRR sequencing, and 4) a sound foundation in number representations.

Classroom routines designed to reinforce content and management complement formal mathematics instruction and together provide the context for implementation of the framework. Many of the same practices implemented during the 21-day incubation will continue to offer nurturing throughout the school year as students gain familiarity with and confidence in using them. Successes come as individuals begin to engage meaningfully with number in Spanish, often following the lead of their peers. Students with the highest levels of Spanish proficiency quickly assume the role of language models. This contribution expedites learning for the whole class and reinforces the expectation that all students are accountable for production. On the twenty-first day of first grade, all of the students independently count *uno-dos-tres* . . . and sing "*los pollitos dicen pío, pío, pío* . . ." (Orozco, 1999), happily demonstrating their fledgling successes, fully confident in their future progress.

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Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. What are the four research foundations that shape the Incubation Framework?

2. Describe a couple of the mathematics and management routines explained in the article.

3. How does the formal mathematics instruction described in the article illustrate a gradual release of responsibility (GRR)? How do you incorporate GRR in your instruction?

4. How do concrete models help convey meaning for students who are still developing proficiency in the language of mathematics instruction?