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Adrian E. Tovar

Zheng Zhou

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Understanding Basic Relational Concepts in Directions: A Study of Native Mexican and U.S. Children in Early Elementary Grades

Adrian E. Tovar and Zheng Zhou

Abstract

The present study uses both quantitative and qualitative approaches to examine: (1) U.S. and Mexican children's ability to understand basic relational concepts in directions; and (2) to analyze language arts and math textbooks to determine the levels of complexity in directions (i.e., number of qualifiers or concepts embedded in the directions). A total of 265 first grade (n = 128) and second-grade (n = 137) children in Mexico were assessed using the Boehm Test of Basic Concepts-Revised (BTBC-R) Applications Booklet. Their performance was compared to the U.S. standardized sample of the BTBC-R to make cross-cultural comparisons. Results from the quantitative study suggest that U.S. children at both grade levels outperformed Mexican children on direction following tasks. Furthermore, both cultural groups demonstrated developmental progression from first to second grade. Qualitative analysis of language arts and mathematics textbooks in both U.S. and Mexico revealed that the majority of instructions had "no complexity." Mexico's first grade language arts textbooks had significantly more "no complexity" directives than the U.S. textbooks; whereas first grade math textbooks in Mexico had significantly more "moderately complex" directives than in the U.S. The "very complex" directives were minimal in both cultures. Cross-cultural differences were discussed in terms of linguistic transparency, conceptual complexity, item biases, and the education system.

Keywords: *Basic Relational Concepts, Cross-cultural, Mexican Children*

Boehm (1991) asserts that knowledge of the basic relational concepts allows children to comprehend and describe relationships between objects, distance in relation to the object and the person, and to describe characteristics of objects (e.g., dimensions, positions, movements, quantity, and presence). Children can use their understanding of concepts to make orders, initiate and engage in dialogue with their peers, make comparisons, categorize objects, and problem solve (Boehm, 1991; Zhou & Boehm, 2004). Developing these skills by the time a child enters school is crucial, as linguistic and instructional demands increase significantly. Kaplan (1980) speculated that as children develop, their ability to understand complex directions increases. A child's ability to follow directions in the classroom is often seen as a complex cognitive process which tests their ability to process, comprehend, maintain, manipulate, and recall verbal information that is presented (Zhou & Boehm, 2004). If children do not acquire the foundational knowledge pertaining to relational concepts, they may have difficulty following directives in the classroom.

Cultural implications have also been investigated regarding basic concept acquisition. Specifically, researchers noted that relational concepts develop among children from all cultural backgrounds and are influenced by their language and culture (Siegler, 1998; Zhou & Boehm, 2001, 2004). For example, Spanish-speaking children's performance on *Pureba Boehm de Conceptos Basicos* (PBCB) (Form A, 1971; Form B, 1973) revealed both a similar order of concept difficulty and an increasing mastery with age (Preddy et al., 1984). However, both linguistic complexity and language characteristics interact to influence young children's acquisition of the basic relational concepts (Zhou & Boehm, 2001, 2004).

Defining Basic Relational Concepts

A child's acquisition of basic relational concepts involves their ability to make relational judgments and problem solve, between objects, persons, or sequence of events (Boehm, 1991). Boehm (2004) used the term "basic relational concepts" to describe size (small-medium-large), distance (near, far), position in space (above-below, left-right, between), time (before-after), and quantity (equal, few, whole). For example, when a teacher asks a child to "look *under* the chair for the pencil," or to "place the assignment *on* your desk;" they use relational concepts to describe the task they would like the child to complete.

Acquiring basic concepts early on is essential for children to communicate with their peers; make decisions, solve problems, and accomplish tasks presented by school staff and administrators. These tasks include, but are not limited to: following instructions (e.g., "John, please move to the *back* of the line); comprehending stories (e.g., "When the girl was excited, she jumped *on* the bed"); describing a series of events to others (e.g., "*After* school I went to the park and played *on* the playground"); making commands (e.g., "Can I have *more* food please?"); and describing individual thoughts and feelings (e.g., "I feel sad because I'm *always* last"). By assessing a child's ability to understand basic relational concepts, teachers are able to identify which concepts are difficult for children, who face challenges mastering these skills, and what strategies to use in teaching these concepts (Preddy et al., 1984). Based on these assessments, teachers can modify their instructional materials to promote the development and knowledge of basic concept attainment (Boehm, 2004).

Basic Relational Concepts and Direction Following

According to Kaplan & White (1980), a direction is defined as a statement or command that prompts a behavior or response from another individual(s). A direction has been successfully completed once the behavior matches the directive administered by another person (Kaplan & White, 1980). Basic relational concepts in direction following have been found in textbook materials, as well as in the administration directions of intelligence and achievement test batteries (Flanagan et al., 1995; Zhou & Boehm, 2004). Other researchers,

such as Flanagan and researchers (1995), reported that if directions on intelligence tests were too complex or too long, children may have difficulty understanding the directives, perform poorly, and the assessment will not be an accurate representation of the child's overall ability. In addition, researchers found that directions that contain negative qualifiers or negatively worded questions (e.g., "mark all of the items *except*…") are more challenging for children to understand and hinder their ability to execute a command with accuracy (Chiavaroli, 2017; Jones, 1966). Chiavorili (2017) also emphasized that non-native, English language learners have greater difficulties with these types of questions. Furthermore, directions may be presented in a variety of ways and may differ in complexity. They can be presented both orally and in written form. Some directions may be long or short, while others may include multi-step instructions, and consist of one or more relational concepts in a given instruction (e.g., pick up the book to your *right*, and place it *under* your chair) (Zhou & Boehm, 2004).

In general, limited research has been conducted in understanding basic relational concepts in direction following. With Spanish-speaking children, the studies are extremely scarce. According to the National Center for Education Statistics, in the U.S., Spanish was the primary language spoken at home for 3.7 million "English Language Learner's" (ELL's) in 2014-2015, which represents 77.1% of all ELL children nationwide, and 7.6 percent of all public K-12 children (NCES, 2017). Due to the significant increase of Spanish speaking children entering U.S. public and private schools across the country, it is critical for educators to have an understanding on children's language development and their ability to follow instructions in the classroom. Furthermore, cross-cultural studies on how the textbooks influence children's learning of the basic relational concepts and their ability to follow instructions are nonexistent. Research shows that supporting a bilingual child's learning at an early age can have academic, cognitive and social advantages (U.S Department of Health and Human Services, 2017).

The present study uses qualitative and quantitative methods to 1) assess both monolingual English-speaking (U.S.) and Spanish-speaking (Mexico) children's performance on direction following (directions that contain basic relational concepts), and 2) examine the presence of the basic relational concepts in the textbooks (math and language arts) in U.S. and Mexico, as well as the nature of complexity of the instructional directions (defined by number of concepts embedded in the directions).

Methods

Study 1 (Quantitative Study)

Participants

Participants from this study were selected from three elementary schools in Celaya, the third largest city in the state of Guanajuato, Mexico. With approximately 494,304 inhabitants, Celaya's growing economy has led to an increase in job opportunities (approximately 77% of the population are employed), and the development of new schools. Most families from Celaya are of average income; working primarily for large industrial/commercialized companies such as Honda and/or own their own family businesses. Children were selected from this major city in particular as it serves as a general representative sample of other urban/suburban cities throughout Mexico. Both parental consent and consent from school administrators were obtained prior to testing. A total of 265 children were assessed (n = 128 for First grade, n = 137 for Second grade).

In order to make comparisons between children from Mexico to those of the U.S., the present study used data from a standardized sample (U.S. First grade, n = 2196; Second grade, n = 2208) collected by Boehm (1986). Although the "middle-class" status is not comparable between the U.S. and Mexico, the overall status of the two samples in comparison to their own country were similar. Although the Applications Booklet of the BTBC-R has not yet been re-normed, Zhou and Boehm (2004) collected a sample of 95 U. S.,

middle class children at the end of Spring 2001 and compared them to the 1986 sample and found no significant statistical difference (interpreted in terms of effect size, d >0.5) between both groups.

Assessment Materials

A translated Spanish version of the Applications Booklet of the Boehm Test of Basic Concepts-Revised (BTBC-R) (*Prueba Boehm de conceptos básicos- Edición revisada*) (Boehm, 1986b) was used. The BTBC-R Applications Booklet consists of 26 items that include the following qualifiers: size, direction, position in space, quantity, time, classification, temporal order, and others (Zhou & Boehm, 2004). The types of tasks included in the Applications booklet consisted of the following direction types: (a) one or more qualifying feature (e.g.,"Mark the *longest* key in the *top* row"); (b) two or more qualifying features (e.g.,"Mark *all* the bugs that are *big* and *black*,"); (c) equal numbers of objects (e.g.,"Mark the pictures that have *equal* number of lollipops."); (d) comparisons involving intermediate position (e.g.,"Find the tree that is *taller* than one but not the *tallest*."); (e) temporal order (e.g.,"Mark the picture needed to keep the story in order."); and (f) a series of commands (e.g.,"Begin at the *left*. Mark an X on the *first* square. *Skip* a square and make an X on the *next* square.") (Boehm, 1986; Zhou & Boehm, 2004).

Procedures

The first author fluent in both English and Spanish traveled to Celaya, Guanajuato, Mexico, toward the end of the 2018 academic school year and administered the Prueba Boehm de Conceptos Básicos–Edición Revisada in three different schools. Each school had two first-grade and two second-grade classes in both the morning and afternoon. Children were assessed in groups of 15 to 20. They were evenly dispersed throughout the classroom in order to prevent them from looking at each other's response booklets. Classroom teachers (one teacher per class) served as proctors to ensure children were not cheating.

Data Analysis

Due to the significant difference between sample sizes (U.S. standardized sample versus the Mexican sample), the current study used Cohen's (1988) recommendation by calculating and reporting effect sizes for differences between proportions in terms of specific values of "h." Cohen used "h" as an indicator of effect size to describe the following: small effect size (h = 0.20), medium effect size (h = 0.50), and large effect size (h = 0.80). For the purposes of this study, only medium and large effect sizes were interpreted. An 80% passing rate, as used by Zhou & Boehm (2004) was also used as the criterion for mastery of the concepts, where percentage passing was calculated using the formula below:

$$\% \text{ PASSING} = \frac{\text{The total number of children who answered an item correctly}}{\text{the total number of children assessed}} \times 100$$

Results (Study 1)

Performance Scores on BTBC-Application

Based on the 80% passing rate, U.S. first graders mastered 10 out of the 26 items (38%), while second graders mastered 17 of the 26 items (65%). In comparison, Mexican children mastered 4 of the 26 items (15%) at the first-grade level and 12 out of 26 items (46%) at the second-grade level. The statistical analyses were significant at both first (h = .53) and second-grade levels (h = .38), suggesting that U.S. children outperformed Mexican children. The analysis also showed that the progression from first to second grade were statistically significant for both U.S. (27% increase, h = .54) and Mexican children (31% increase, h = .70).

Analyses of the Nature of Directions

In order to understand children's direction following, it is important to analyze the directions in terms of conceptual complexity.

Position-in-space. Although both first and second grade U.S. children performed slightly better than Mexican children on items related to position-in-space (e.g., *below, above, outside, inside, etc.*), both cultural groups had difficulty identifying the concepts *above* and *below* at the first grade level (e.g., "Mark the drawing where a ball is *below* a shoe and a ball is *above* a glove") (78% passing for U.S.; 54% passing for Mexico; $h = 0.51$). The data also reveal that there were an increase in developmental progression of 20% for children from Mexico, while U.S. children made an 8% gain for the item related to the concepts *above* and *below*.

At both first and second-grade levels, U.S. children had a better understanding of the qualifiers *outside* and *inside* ("Mark the drawing where a star is *outside* of a circle, and a star is *inside* of a box") (Grade 1, 92% passing for U.S. and 66% passing for Mexico, $h = 0.67$; Grade 2, 96% passing for U.S. and 72% passing; $h = 0.71$). In addition, U.S. first graders had a better understanding of the concepts *across* and *bottom* than Mexican children (e.g., "Mark the arrow that is going *across* in the *bottom* row") (96% passing for U.S. and 74% passing for Mexico, h = 0.67). By the second grade, Mexican children made a 10% gain in their understanding of the concepts across and bottom (84% passing, $h = 0.24$), catching up with their U.S. counterparts.

Intermediate point comparisons. In comparison to their U.S. counterparts, both first and second-grade children from Mexico had difficulty understanding intermediate point comparisons that include the negative qualifier, "not" with three additional qualifying attributes (e.g., "Mark the automobile that is *not* the *farthest* from the stop light, but it is *farther* than *another* automobile") (Grade 1, 36% passing for Mexico, 79% passing for U.S., $h = 0.90$; Grade 2, 60% passing for Mexico, 82% passing for U.S., $h = 0.49$).

U.S. children also performed better than Mexican children, at both grade levels, in their ability to follow directions that contained the concepts *more-less-another* (e.g., "Mark the bowl that has *more* ice-cream than one bowl, but *less* ice-cream than *another*) (Grade 1 76% passing for U.S., 40% passing for Mexico, $h = 0.75$; Grade 2, 86% passing for U.S., 58% passing for Mexico, $h = 0.64$). For first graders, both cultural groups had difficulty understanding the concepts *taller-shorter-another*, (e.g., Mark the tree that is *taller* than one tree, but *shorter* than *another*) (77% passing for U.S., 52% for Mexico, $h = 0.53$). Developmental progression was observed from first to second-grade for both cultural groups; an 8% increase for U.S. children, and a 12% increase for Mexican children.

Concept of "equal." Mexico children outperformed their U.S. counterparts at both first and second-grade levels on the concept of *equal* (e.g., "Mark the pictures that have an *equal* number of lollipops") (Grade 1, 62% passing for U. S., 90% passing for Mexico; $h = 0.68$; Grade 2, 76% passing for U.S., 90% passing for Mexico; $h = 0.38$). On item 15 (e.g., "Mark the pictures that have *equal* numbers of stars"), Mexican children also performed better (84% passing) than U.S. children (66% passing) at the first grade ($h = 0.42$), and second grade (88% passing for Mexico and 78% passing for U.S.; $h = 0.27$).

Objects with three qualifying attributes. With regard to directives that contain three qualifying attributes, both first and second-grade children from Mexico had significant difficulties. Specifically, Mexican children had trouble understanding the concepts *large-over-small*, when presented in a single directive (e.g., "Mark the *large* box that is *over* the *small* ball") (Grade 1, 80% passing for U.S., 42% passing for Mexico; $h = 0.80$; Grade 2, 85% passing for U.S., 34% passing for Mexico, $h = 1.10$). There was no developmental progression observed for following *large-over-small* direction, but rather, Mexican children regressed 8% at the end of second grade.

A medium difference ($h = 0.60$) was observed between Mexican (73% passing) and U.S. first graders (94% passing) in their ability to follow directions containing the concept, "*all*," and two other qualifiers (*big-black*) (e.g., "Mark *all* of the insects that are *big* and *black*"). First grade Mexican children also had more difficulty than U.S. children following directions that contained the concepts

*all-wide-up (*e.g.,"Mark *all* the arrows that are *wide* and pointing *up*") (85% passing for U.S., 52% passing for Mexico, $h = 0.74$). Despite the observed difficulties, Mexican children made a 30% increase from first to second grade in their understanding of the concepts *all-wide-up* (from 52% to 81% passing; $h = 0.65$).

On directions that included the qualifiers *shortest-between-tall* (e.g., Mark the *shortest* flower, that is *between* two *tall* flowers), first graders from the U.S. (90% passing) outperformed their Mexican counterparts (42% passing, $h = 1.09$). However, by the end of second grade, Mexican children made a 46% increase in their understanding of the qualifiers *shortest-between-tal*l (from 42% to 88% passing; $h = 1.02$).

Following multistep directions. Using the 80% passing rate as the criterion, both U.S. and Mexican first and second-grade children had difficulty following a series of multistep commands. Specifically, U.S. children had difficulty following the multi-step direction, "Mark an X on the *first* square. *Skip* a square and mark an X on the *next* square" (Grade 1, 60% passing for U.S., 23% passing for Mexico; Grade 2, 73% passing for U.S., and 36% passing for Mexico). On item 25 (e.g., "Mark the *second pair* of shoes"), both U.S. and Mexican first and second graders had difficulty (Grade 1, 33% for U.S., 33% for Mexico; Grade 2, 47% for U.S., 25% for Mexico).

In summary, overall, U.S. children outperformed Mexican children on the BTBC-R direction following assessment. U.S. children at both first and second grades also outperformed their Mexican counterparts in following directions with three qualifying attributes, intermediate point position, and directions relating to space (outside-inside, across-bottom). Mexican children outperformed U.S. children in their ability to follow directions involving the concept of "*equal*" (*igual*). Developmental progression from first to second grade was observed among U.S. children across all items. Developmental progression was also observed on 24 out of the 26-item assessment for Mexican children. Finally, both cultural groups had difficulty following multi-step directions.

Methods

Study 2 (Qualitative)

The purpose of the Study was to: (1) examine the type of basic relational concepts (qualifiers) identified by Boehm (1986) embedded in the instructional materials of math and language arts in both the U.S. and Mexico; and (2) the complexity of directions (the number of qualifiers or concepts found in each directive) present in the instructions in the textbooks. The term "qualifier" and "concept" are sometimes used interchangeably in this section to be consistent with the term used in the extent literature.

Materials

U.S. Math and English Language Arts Textbooks.

For Mathematics, the following textbooks from the United States were analyzed: *Math in Focus 1A and 1B: Singapore Math* (*Grade 1*), and *Math in Focus 2A and 2B: Singapore Math* (*Grade 2*), by Marshall Cavendish Education (Fong et al., 2009). The Singapore Math program was originally developed in Singapore, publishing its first Primary Mathematics (grades 1-6) textbooks in 1982. In 1984, Singapore scored 16th out of 26 nations in the Second International Science Study (SSIS) and in 1995, their children placed first in the Trends in International Mathematics and Science Study (TIMSS). In 2007, Houghton Mifflin Harcourt worked with Marshall Cavendish to produce a Singapore Math program for the United States. *The Math in Focus* textbooks supports the goals of the Common Core State Standards for Mathematics and is widely used across the United States (Clark et al., 2019).

For English Language Arts, the present study analyzed the following textbooks: *Adventures of the Superkids First Grade*, and *The Superkids Hit Second Grade*, by Pleasant Rowland (Rowland Reading Foundation, 2017a, 2017b, 2017c, 2017d). The Superkids Reading program is a core literacy textbook for grades K-2 that teaches all aspects of reading in combination with the language arts and is widely used across the United States.

Mexico's Math and language Arts Textbooks. For the textbooks selected from Mexico, the following textbooks were analyzed: *Español: Primer Grado* (Spanish 1st grade), *Español: Segundo Grado* (Spanish 2nd grade), *Desafíos Matemáticos: Primer Grado* (Mathematics 1st grade), *Desafíos Matemáticos: Segundo Grado* (Mathematics 2nd grade), (SEP, 2016a, 2016b, 2016c, 2016d). These textbooks were created and developed by the Secretary of Public Education (Secretario de Educación Publica–SEP), the General Direction of Textbooks Development (Dirección General de Desarrollo Curricular), and the Assistant Secretary of Basic Education (Subsecretaria de Educación Basica). Similar to the United Stated, according to Article 3 of the Constitution of Mexico, children and families have the right to a free and appropriate public education. This includes access to educational materials, such as textbooks. Furthermore, the textbooks being used for this study are considered to be part of the national textbooks in Mexico that were developed by the government and provided to public schools across the country (WENR, 2016). As stated by the Secretary of Public Education in Mexico, the hope is that by providing a free and appropriate public education, as well as education materials, millions of Mexican children who are traditionally marginalized from proper educational services will have an equal opportunity. The four textbooks selected for the present study, serve to be an accurate representation of the textbooks for first and second grade children across Mexico.

Coding Procedures

Identifying concepts (Qualifiers). A total of 72 Boehm basic relational concepts were used as the criteria for identifying the concepts in the textbooks. Of the 72 concepts, 50 concepts were adopted from Boehm-3 (Boehm, 2001) and an additional 22 concepts were derived from the teacher observation form of Boehm-3. However, only 66 basic relational concepts were used for the Spanish version (50 concepts from the Boehm-3 and 16 of 22 concepts were translated from the teacher observation form (Thorne & Narváez, 1987). The

lower number of Spanish concepts were a result of the differences in language characteristics. For example, while the English language uses the words "each" and "every" for different purposes, the Spanish language uses only one word "cada" for these two English terms.

Identifying instructions. The teacher manuals and student textbooks were analyzed to identify the concepts corresponding to the core list. The directions in the textbooks started with the word "***Say***" (English) and "***Diga***" (Spanish) were examined. Each identified concept was organized by grade and subject area (i.e., Math, ELA, Spanish) in an excel spreadsheet.

Identifying the Complexity of Directions. Due to inconsistencies and flexibility in teachers' use of the instructions allocated to them in the textbooks, only children's textbooks were used for this part of the analyses. The complexity of each directive (i.e., the number of concepts or qualifiers found within a single direction) was based on a classification system: *No Complexity* (i.e., containing zero concepts or qualifiers), *Low Complexity* (i.e., containing one qualifier), *Moderately Complex (*i.e., containing two qualifiers), and *Very Complex* (i.e., containing three or more qualifiers). For example:

Directions:

> "You read about an experiment in "3, 2, 1…Liftoff." (0 Qualifiers, No Complexity)
>
> "Read the sentences at the bottom of the page, cut them out, and glue them into the chart in the *order* they happened." (2-Qualifiers (*bottom*, *order*), Moderately Complex-two qualifiers)

Results (Study 2)

Concepts Identified in the U.S. and Mexico Textbooks

Forty-one concepts of the 72 English (57% for U.S) and 66 Spanish concepts (62% for Mexico) identified by Boehm were present in both cultures' textbooks. Results in this section are presented in Table 1.

Table One
Basic Relation Concepts Found in U.S. and Mexican Textbooks

Basic Relational Concepts (Englsih/Spanish)		U.S. Textbooks				Mexican Textbooks			
		English		Math		Spanish		Math	
		1st grade	2nd grade	1st grade	2nd grade	1st grade	2nd grade	1st grade	2nd grade
1	*Most/Mas*	√	√	√	√	√	√	√	√
2	*Next/ Mas Cerca, Siguiente*	√	√	√	√	√	√	√	√
3	*Other/Otro*	√	√	√	√	√	√	√	√
4	*Top/Mas Alto*	√	√	√	√	√	√	√	√
5	*All/Todos*	√	√	√	√	√	√	√	√
6	*Before/Antes*	√	√	√	√	√	√	√	√
7	*Last/Ultimo*	√	√	√	√	√	√	√	√
8	*First/Primero*	√	√	√	√	√	√	√	√
9	*Each/Cada*	√	√	√	√	√	√	√	√
10	*Same/Mismo*	√	√	√	√	√	√	√	√
11	*Tall,Taller/Alto, Mas Alto*	√	√	√	√	√	√	√	√
12	*More/Mas*	√	√	√	√	√	√	√	√
13	*Order/En Orden*	√	√	√	√	√	√	√	√
14	*Shortest/Mas Corto*	√	√	√	√	√	√	√	
15	*End/Final*	√	√	√	√	√		√	√
16	*Beginning/ Empezando*	√	√	√	√	√	√	√	
17	*Different/Diferente*	√	√	√	√	√	√	√	
18	*After/Despues*	√	√	√	√	√	√	√	
19	*Right/ Derecho*	√	√	√	√		√		√
20	*Below/ Debajo*	√	√	√			√	√	√
21	*Second/ Segundo*	√	√	√		√	√	√	√
22	*Pair/ Par*	√	√	√	√		√	√	√
23	*Under/Debajo*	√	√	√	√		√		√
24	*Least/Menos*	√	√	√	√			√	√
25	*Left/ Izquierda*	√	√	√	√	√	√		
26	*Match/Une*	√	√	√	√	√	√		
27	*Part/ Parte*	√	√	√	√	√	√		

Table One
Basic Relation Concepts Found in U.S. and Mexican Textbooks (cont.)

Basic Relational Concepts (Englsih/Spanish)		U.S. Textbooks				Mexican Textbooks			
		English		Math		Spanish		Math	
		1st grade	2nd grade	1st grade	2nd grade	1st grade	2nd grade	1st grade	2nd grade
28	*Front/En Frente*	√	√	√	√		√	√	
29	*Above/Arriba*	√	√	√	√	√	√		
30	*Big/Bigger/ Grande, Mas Grande*	√	√	√	√	√			√
31	*Large/Grande*	√	√	√	√	√			√
32	*Small/Pequeno*	√	√	√	√				√
33	*Between/Entre-Adentro*	√	√	√	√			√	
34	*Across/Atravesada, Atraves De*	√	√	√	√				
35	*Third/Tercero*	√	√	√	√				√
36	*Whole/Completa*	√	√	√	√				
37	*Some/Algunos*	√	√	√	√				
38	*Few/Pocos*	√	√	√	√				
39	*Away/Retirado*	√	√	√	√				
40	*Back/ Detras, De Atras*	√	√	√	√				
41	*Half/Mitad*	√	√	√	√				
42	*Long/Longest/Largo, Mas Largo*		√	√	√	√		√	
43	*Starting/Empezando*		√	√	√	√	√	√	
44	*Alike/Igual*	√	√	√		√	√	√	√
45	*Down/Hacia Abajo*	√	√	√				√	√
46	*Middle/Medio*	√	√	√		√	√	√	√
47	*Up/ Hacia Arriba*	√	√	√				√	√
48	*Every/ Cada*	√		√	√	√	√	√	√
49	*Medium-sized/ Tamano-Mediano*	√	√		√				√
50	*Bottom/Mas Abajo*	√	√		√				
51	*Side/Al Lado*	√		√	√				
52	*Less/Menos*		√	√	√			√	√
53	*Fewest/Menor Cantidad*	√		√	√				

Table One
Basic Relation Concepts Found in U.S. and Mexican Textbooks (cont.)

Basic Relational Concepts (Englsih/Spanish)		U.S. Textbooks				Mexican Textbooks			
		English		Math		Spanish		Math	
		1st grade	2nd grade	1st grade	2nd grade	1st grade	2nd grade	1st grade	2nd grade
54	*Outside/Fuera*	√	√						
55	*Inside/ Dentro, Adentro*	√	√					√	√
56	*Always/Siempre*	√	√						
57	*Behind/Detras*	√		√					
58	*Backward/Hacia Atras*		√		√				
59	*Center/ Centro*	√	√					√	√
60	*Corner/Esquina*			√	√				
61	*Equal/ Igual*			√	√	√	√	√	√
62	*Near/Nearest/Cerca, Mas Cerca*			√	√			√	
63	*Widest/Mas Ancha*	√			√				
64	*Through/A Traves*	√	√						
65	*Over/Sobre*	√	√						
66	*Forward/Hacia Adelante*	√	√					√	
67	*Row/ En Linea*	√	√						
68	*Farthest/ Mas Lejos*			√	√			√	
69	*Skip/Saltando*				√		√		
70	*As Many/ Tantos*				√				
71	*Never/Nunca*								
72	*Separated/ Separado*								

Concepts Found in U.S. Textbooks

English Language Arts. Using the concepts from the Boehm Test of Basic Concepts as the criteria, 60 concepts were found in the first-grade English Language Arts (ELA) textbooks, while 59 concepts were found in second-grade textbooks. Fifty-six (56) concepts were found to overlap in both first and second grade textbooks except for three concepts: *side*, *every*, and *wide*. Additionally, there were three new concepts that were introduced at the second-grade level: *backward*, *long*, and *up*.

Mathematics. Fifty-five (55) relational concepts were found in the first-grade textbooks, while 57 concepts were found in second grade. Five concepts found in first grade were not found in second grade: *alike, behind, down, middle, up*. Seven (7) concepts were introduced in the second grade only: *another, as many as, backward, bottom, medium-sized, skip,* and *wide*.

Concepts Found in Mexican Textbooks

Spanish Language Arts. Twenty-seven (27) relational concepts were identified in first grade and 29 concepts in second-grade textbooks. There were 24 concepts that overlapped between first and second grade. Three concepts were found in the first grade but not in second-grade textbooks: *final* (ending), *grande* (big), *mas largo* (longest). Five concepts were introduced in the second-grade textbooks only: *saltado* (skip), *segundo* (second), *terminar* (finish), *debajo* (below), and *frente* (in front).

Mathematics. Thirty-one (31) concepts were identified in the first grade and 32 concepts were found in the second-grade textbooks. There is a total of 27 concepts overlapping between first and second grades. Four concepts were found only in the first grade: *corto* (short), *frente* (front), *mas cerca* (near), *mas largo* (longest). Six concepts were only identified in the second-grade textbooks: *hacia arriba* (up), *derecha* (right), *mediano* (medium), *par* (pair), *pequeño* (small), and *tercera* (third).

Cross-Cultural Overlap/Absence in Relational Concepts.

Cross-Cultural Similarities. Some cross-cultural similarities were also observed between textbooks. Specifically, the following concepts were observed in both Mexican and U.S. textbooks: *double/doble, greater/ mayor que, complete/completo, missing/falta, faster/mas rapido, little/chico, total/en total*, and *only/solo.*

Concepts present in U.S. but not in Mexico textbooks. There were 26 concepts observed in the U.S. textbooks not found in Mexico's textbooks. These concepts include: *across, alike, always, as many as, away,*

back, backward, beginning, behind, bottom, center, corner, few, half, least, most, other, outside, over, row, side, some, through, top, whole, wide. On the other hand, all concepts found in Mexico's instructional materials were also found in the U.S. textbooks.

Concepts Rarely Appeared in the U.S. and Mexico Textbooks. Two concepts of *farther/farthest* and *skip* only appeared in 25% of the U.S. textbooks. The concepts that appeared in only 25% of the Mexican textbooks are as follows: *adelante* (forward), *más cerca* (nearest), *más lejos* (further/furthest), *pequeña* (smaller/smallest), *tamaño mediano* (medium sized), *tantas como* (as many as), and *tercero* (third).

Concepts not found in any culture. The concepts of *never/nunca*, and *separated/separados* were not observed in the any of the directions analyzed in the textbooks from both countries.

Concepts other than Boehm's. In addition to Boehm's 72 concepts, other concepts were also found in both U.S. and Mexico's first and second grade Mathematics and English/Spanish textbooks. Specifically, 29 new concepts were found in the U.S. textbooks, while 15 new concepts were observed in the Mexican textbooks. These additional concepts are organized in the following categories:

Space. New concepts found in the U.S. textbooks included: *lower/lowest, opposite, straight*, and *missing*. New concepts from the Spanish Language textbooks include: *horizontal*, *vertical*, and *falta* (missing).

Quantity. In the U.S. textbooks, the following new concepts were identified: *altogether, as much as, both, even, exactly, greater/greatest, how many, similar.* In the Mexican textbooks, the new concepts of *mayor que* (more than), *menor que* (less than), and *muchos* (a lot). The following new concepts were observed in both U.S. and Mexican textbooks: *complete/completo, double/doble, greater/mayor que, total/en total,* and *only/solo.*

Time. In the U.S. textbooks, the new concepts of *repeating* and *again* were observed. No new concepts were observed in this area for the Mexican textbooks.

Speed. The new concepts of *faster/fastest* and *slower/slowest* were identified in the U.S. textbooks. Similarly, the new concept of *mas rapido* (faster) was identified in both U.S. and Mexican textbooks.

Size. The new concept of "little" was found in the U.S. textbooks. Similarly, the concepts of *chico* (small/little), *chiquito* (tiny), and *enorme* (huge) were found in the Mexican textbooks.

Mass. The concepts of *heavier/heaviest* and *lighter/lightest* were identified in the U.S. textbooks.

Complexity of Directions in The Textbooks

The complexity of directions is defined as the number of qualifiers (concepts) found in each directive presented in the instructions. *No complexity* directives (i.e., no qualifiers) have no qualifiers found in a directive; *low complexity* directives (e.g., "Fill in the blanks with the words from the box *above*") have only one qualifier; *moderately complex* directives (e.g., "Complete the *first* column on the *left*") have two qualifiers; and *very complex* directives have three or more qualifiers (e.g., "Use the words *above*, to complete *each* sentence on the lines *below*"). The results for this section are summarized in Table 2.

Level of Complexity	Subject							
	ELA				Math			
	1st Grade		2nd Grade		1st Grade		2nd Grade	
	US (%)	Mexico (%)	US (%)	Mexico (%)	US (%)	Mexico (%)	US (%)	Mexico (%)
No Complexity	**49**	**73***	55	64	**73**	**43***	**67**	**45***
Low Complexity	28	22	31	29	25	39	27	35
Moderately Complex	13	4	12	5	3	**15***	6	16
Very Complex	10	1	2	2	1	3	1	4

*medium effect size

English Language Arts Textbooks (U.S.)

In the U.S., 49% of first grade and 55% of second-grade instructions contained "no complexity," whereas 28% of first and 31% of second-grade directives are "low complexity." Furthermore, 13% of first-grade material and 12% of second-grade material were "moderately complex," while 10% of first-grade material and 2% of second-grade material were "very complex."

Spanish Language Textbooks (Mexico)

In Mexico, 73% of first and 64% of second-grade instructions are "no complexity," whereas 22% of first grade and 29% of second-grade instructions have "low complexity." Furthermore, 4% of first and 5% of second-grade directives were "moderately complex," while 1% of first and 2% of second-grade instructions are "very complex."

Analyses indicated that in language arts textbooks, the Mexico first-grade textbooks (73%) had significantly more "no complexity" directives than the U.S. textbooks (49%) ($h = 0.498$), but not at the second-grade level.

Math textbooks (U.S.)

In the U.S. textbooks, 73% of the first, and 67% of the second-grade instructions were identified as having "no complexity" (i.e., no qualifiers). Twenty-five (25) percent of the first grade and 27% of second-grade instructions are identified as "low complexity." Three percent of first grade and 6% of second-grade directives are identified as "moderately complex." One percent of instructions found across both grade levels were "very complex" directives.

Math textbooks (Mexico)

In Mexico, 43% of first grade and 45% of second-grade instructions found in student textbook contained "no complexity," whereas 39% of first and 35% of second-grade directions were "low complexity." In addition, 15% of first grade and 16% of second-grade instructions were "moderately complex," and 3% of first and 4% of second-grade directives were "very complex."

Analyses indicated that at both first ($h = 0.618$) and second-grade ($h = 0.447$) levels, U.S. math textbooks had significantly more "no complexity" directives than found in Mexico math textbooks. However, at the first-grade level, Mexico math textbooks had significantly more "moderately complex" directives than found in U.S. math textbooks ($h = 0.447$). The "very complex" directives were minimal in both cultures.

Discussion

This study was conducted in order to gain a more comprehensive understanding of direction following among the Spanish-speaking children in Mexico in comparison to their English-speaking counterparts in the United States. In addition, the language arts and math textbooks from each country were analyzed to determine the role that teaching materials play in a child's understanding of basic relational concepts and their ability to follow directions.

Conceptual Complexity, Linguistic Transparency and Direction Following

Cross-cultural differences and similarities were identified. U.S. children at both grade levels outperformed Mexican children on direction following tasks. Furthermore, developmental progression was observed among both cultural groups from first to second grade. This finding is consistent with previous research (Kaplan & White, 1980; Zhou & Boehm, 2004), that children were better able to process increasingly complex directions as they got older.

Although overall, the U.S. children outperformed the Mexican children on the direction following test, it is interesting to note that Mexican children performed better than their U.S. counterparts on some specific directions. For example, Mexican children had a better understanding of the concept of *equal* at both grade levels. It could be that the Mexican children took advantage of the transparency of the Spanish language. For example, the English language uses the concepts of *equal*, *alike*, and *same* to describe quantity, whereas the Spanish uses the single term *igual* to describe quantity. Therefore, there was less ambiguity or confusion about the concept for the Spanish-speaking children. According to Evans (2017), there are many reasons why English is a more complex language in comparison to other languages in terms of difficult spelling system, complex grammatical patterns, phrasal verbs (i.e., run, run up, run over, run something down), and idioms. Furthermore, Mexican children better understanding the concept of *equal* may also be attributed to the

amount of exposure they receive from the school textbooks. Based on our textbook analyses, the concept of *igual* (equal) was consistently found across all subjects (Math and Language Arts), all grades (first and second), and appeared more frequently in Mexico, while it was observed in the U.S. only in Math textbooks across grades.

Mexican children also outperformed their U.S. counterparts on the concept of *longest/mas largo*. We speculate that linguistic transparency in Spanish could have helped Mexican children in their demonstrated mastery of this concept. Specifically, the English language uses the suffix "-est" to form superlatives at the end of one or two syllable adjectives (Bos & Nissim, 2006; Zhou & Boehm, 2004). The Spanish language, similar to Chinese, uses the adverb mas (i.e., more or most) before the adjective to form the comparatives and superlatives. For example, the concept of *mas largo* is directly translated in English as the "the most long" (i.e., longest) and the English concept of *furthest* is translated as *mas lejos* or "the most far." Understanding and using the suffix "-est" is linguistically more complex and demanding (Zhou & Boehm, 1999), while adding a word like *mas* is simple and straight forward. However, despite the transparency of the Spanish language, Mexican children had difficulty at both grade levels with *furthest* and *further* (e.g., "Mark the automobile that is not the furthest from the stoplight, but is further than another automobile"), as well as *taller* and *shorter* (e.g., "Mark the tree that is taller than one tree, but shorter than another"). One of the explanations could be that these directions are conceptually more complex because they involved relativity in the comparison, that is, one could be taller or shorter depending on what it is being compared to.

Difficulty with conceptually complex concepts is also revealed in U.S. and Mexican children's understanding of the concepts *left-right* (e.g., "Mark the cat that is to the *right* of the table, and to the *left* of the basket"), *second pair* (e.g., "Mark the *second pair* of shoes") and a combination of the concepts *left, first, skip, next* (e.g., "Begin at the *left*. Mark an X on the *first* square, *skip* a square, and mark an X on the *next* square"). Zhou and Boehm (2004) purported that children who had difficulty understanding the left-right perspective could be a reflection

of the "egocentric representations" (p.). Siegler (1998) further pointed out that children were better able to identify visual-spatial perspectives if provided with the opportunity to shift their bodies in the direction the presented object is facing. As for the concept of "skip," our analyses of the textbooks in both cultures revealed that children were not exposed to this concept as much as other ones, which could have impacted on their mastery of this concept.

In addition to the conceptual complexity inherited in the concepts, the complexity in the directions (number of qualifiers embedded in the direction) could have also played a role in a child's ability to execute the tasks. In our study, U.S. children outperformed their Mexico counterparts on direction following tasks at both first and second-grade levels. This performance discrepancy parallels our analyses of the nature of directions embedded in both countries' textbooks. We found that Mexico first-grade language arts textbooks had significantly more "no complexity" directives than in the U.S. textbooks. Consistent with previous studies, our findings seemed to support that the more exposure children had to relational concepts, the better they were at following complex directions (Boehm, 1991; Kaplan & White, 1980). Furthermore, the more complex directives in the U.S. language arts textbooks used in the "Superkids" program could also suggest emphasis on familial and teacher support in children's learning. Researchers have identified positive associations between higher school-based parent involvement and improved student success, particularly in the early years of school (Daniel et al., 2016). Equally important is the positive influence of textbook materials on student learning through teacher and child interactions with those specific materials in the classroom (Stein et al., 2007). Although Mexican textbooks also require familial support, factors such as family SES levels and parental education could limit a parent's resources and ability to support their child academically (Schalla, 2015).

U.S. math textbooks had significantly more "no complexity" directives than found in Mexico's math textbooks. However, at the first-grade level, Mexico's math textbooks had significantly more "moderately complex" directives than found in U.S. math textbooks.

Perhaps Mexican educators do not recognize that "complex" directions can inhibit or interfere with a child's learning and make it more difficult for a child to understand what is being asked of them. The complexity of directions may also be contributory factors of low-test scores in the area of math in Mexico. Specifically, research shows that 86.2% of Mexican elementary and secondary school children fall in the "basic" or "insufficient" range in the area of math (Vila Rosado et al., 2018).

More broadly, there are also cross-cultural similarities regarding the levels of complexity in directions in the textbook's materials. Overall, directions in both U.S. and Mexican textbooks contained more concise directions that had no qualifiers ("no complexity") or low complex directions. From an information processing perspective, in order for children to execute any directive presented, instructions should be kept short, simple, and with low complexity (e.g., one to two qualifiers used). Perhaps, overelaborated directions do hinder compliance (Kaplan, 1978; Kounin, 1970). This is because there are connections between memory and a child's ability to follow written direction (Engle et al., 1991). Engle and colleagues (1991) reported developmental differences in the relationship between working memory capacity and directions following. Other researchers found that the more complex the information in textbooks materials is, the more difficult it is to process which can lead to misinterpretations of the information presented (Martiniello, 2009; Mestre, 1988). Thorndike and Lorge (1944) emphasized that how teachers present information to children impacts the way children learn and understand the material being presented to them.

Traditional Concepts, Newly Emerged Concepts, and Cultural Biases

An overlap in many concepts was observed in both cultures' textbooks. This suggests a similar instructional approach that focuses on measurement (e.g., longest vs. shortest), comparisons between objects, and teaching concepts relating to position in space (e.g., near vs. far).

Perhaps at the elementary level, "all" academic coursework presented to children is "mostly common" (Brown, 2014). Meaning, that what is taught at the first-grade level in one country, may parallel instructional materials in another. In most countries, all children pursue and complete a "common curriculum" up through secondary school (Schwarts, 2014).

Also worthy of attention are several qualifiers outside of Boehm's typical concepts that the author identified. These concepts include: *double/doble* (e.g., "Draw a circle around the bag with *double* the amount of candy"), *complete/complete* (e.g., "Write the letters that are missing to *complete* the words"), *missing/falta* (e.g., "Write the *missing* numbers in the shapes below"), *fastest/mas rapido* (e.g., "Circle the object moving *fastest*"), *little/chico* (e.g., "Draw a circle around the tree that is *little*") and *only/solo* (e.g., "Mark *only* the numbers"). These concepts were important to add to the assessment tools because they appear frequently in modern textbooks and entire lessons were based on some of these concepts. As knowledge and technology evolve, additional concepts emerge. It is important for educators and researchers to understand and keep up the new educational demands (Thomas et al., 2016).

Possible cultural bias and cultural loading on the BTBC-R direction following test was identified on two items: items 12 (e.g., "Mark the pumpkin needed to keep the story *in order*") and 14 (e.g., "Mark the toy robot needed to keep the story *in order*"). While the United States celebrates Halloween and uses pumpkins, vampires, ghosts, and goblin costumes, etc., the Mexican culture does not. Similarly, understanding toy robots is crucial for any student to answer item 14 with accuracy. It is possible that not all children from Mexico have been exposed to *toy robots* or know how they are made. Such "culturally loaded" items may put children from different cultural background at a disadvantage (Reynolds & Suzuki, 2012).

Implications of the Study

Several implications can be made from the present study. First, it is important to keep cultural and ecological factors in mind when interpreting children's performance. Mexican children's difference in

performance on BTBC-R Application test could be partly attributed to challenges and/or differences in Mexico's education system. These speculations are consistent with the findings from the Program for International Student Assessment (OECD, 2019), where Mexican children scored well below other countries involved. Guichard (2005) indicated that although education has been a priority for several decades in Mexico, "teaching is still largely based on rote learning rather than comprehension skills and communication." In addition, teachers within the same school seldom interact and cooperate with one another (Guichard, 2005; Ministry of Education, 2004). Further, schools in Mexico run on a schedule that is considered a double-shift system (e.g., morning and afternoon sessions, or *vespertino y matutino*). Studies show that children enrolled in the afternoon program may receive a poorer education due to tiredness (Sagyndykova, 2013) or the diminishing productivity of teachers, which negatively impacts the quality of instruction (García Garduño, 2004). In addition, a child's concentration may be lower in the afternoon, which impacts their ability to learn new material, resulting in lower academic performance (Sagyndykova, 2013). Other researchers have also discovered that children who attend later shifts (e.g., afternoon sessions) have significantly lower grades in Spanish than children who attend morning sessions (Denham, 2011; Travino & Travino, 2004). Teachers who work in the afternoon sessions have a greater number of children from low socioeconomic homes and are often criticized and harassed by the directors of the "morning shifts" (Denham, 2011).

Researchers, psychologists, and test publishers responsible for developing assessment tools for early childhood (e.g., achievement and cognitive batteries) should be mindful of cultural practices, linguistic demands, and level of complexity in test instructions. This would reduce the amount of test bias, cultural loading, and would improve the overall quality and fairness of the assessment.

Children from Mexico, as well as those from other Spanish-speaking countries, are not exposed to the same number of relational concepts as their monolingual counterparts from the United States.

Therefore, it may be difficult for them to follow directions in the classroom. With the growing number of ethnic minorities entering the U.S., it is essential for educators to have an awareness of this and to address the cultural and linguistic differences these children face (Lasagabaster, 2017; Souto-Manning, 2018). Research also stresses the importance of understanding the impact acculturation and socialization can have on an immigrant child's education, language development, and their overall emotional well-being (Souto-Manning, 2018; Yousef, 2019).

References

Boehm, A.E. (1986a). *Boehm* Test of Basic Concepts-Revised. The Psychological Corporation.

Boehm, A.E. (1986b). *Prueba Boehm de conceptos basicos (Edición revisada)*. The Psychological Corporation.

Boehm, A. E. (1991). Assessment of basic relational concepts. In B. A. Bracken (Ed.), *The psychoeducational assessment of preschool children* (pp. 241–258). Erlbaum.

Boehm, A.E. (2001). *Boehm Test of Basic Concepts-3*. The Psychological Corporation. https://www.pearsonassessments.com/store/usassessments/en/Store/Professional-Assessments/Academic-Learning/Brief/Boehm-Test-of-Basic-Concepts-|-Third-Edition/p/0158020995.html

Bos, J., & Nissim, M. (2006, July 22). *An empirical approach to the interpretation of superlatives.* [Conference proceedings]. Conference on Empirical Methods in Natural Language Processing, Sydney, Australia (pp. 9–17). *Association for Computational Linguistics* (ACL).

Brown, C. (2014). *All Children Need Common Foundational Skills* (Vol. 14, No. 3). Education Next. https://www.educationnext.org/children-need-common-foundational-skills/.

Chiavaroli, N. (2017). Negatively-worded multiple-choice questions: An avoidable threat to validity. *Practical Assessment, Research, and Evaluation, 22*(3) 1–14.

Clark, A., Coyne, C., Resnick, S., & Gifford, L. (2019). Math in Focus: Singapore Math: K-8 Curriculum & Assessment: Houghton Mifflin Harcourt. https://www.hmhco.com/ programs/math-in-focus

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Erlbaum.

Daniel, G. R., Wang, C., & Berthelsen, D. (2016). Early school-based parent involvement, children's self-regulated learning and academic achievement: An Australian longitudinal study. *Early Childhood Research Quarterly, 36*, 168–177.

Denham, S. (2011). *Escuelas de doble turno en México: Una estimación de diferencias asociadas con su implementación* (Revista Mexicana de investigación educative), *16*(50), 801–827.

Engle, R. W., Carullo, J. J., & Collins, K. W. (1991). Individual differences in working memory for comprehension and following directions. *The Journal of Educational Research, 84*(5), 253–262.

Flanagan, D. P., Kaminer, T., Alfonso, V. C., & Raderc, D. E. (1995). Incidence of basic concepts in the directions of new and recently revised American intelligence tests for preschool children. *School Psychology International, 16*(4), 345–364.

Fong, H. K., Ramakrishnan, C., Wah, B. L. P., Bisk, R., Clark, A., & Kanter, P. F. (2009). *Math in focus: The Singapore approach.* Marshall Cavendish Education.

García Garduño, J. M. (2004). La administración y gestión educativa: Algunas lecciones que nos deja su evolución en los Estados Unidos y México. *Revista Interamericana de Educación de Adultos, 26*(1), 11–52.

Guichard, S. (2005). *The Education Challenge in Mexico: Delivering Good Quality Education to All*. OECD Economics Department Working Papers, No. 447. OECD Publishing (NJ1).

IES – Institute of Education Sciences, & NCES – National Center for Education Statistics. (n.d.). *IES & NCES Fast Facts website: Elementary and Secondary: English language learners.* U.S. Department of Education. (n.d.). https://nces.ed.gov/fastfacts/display.asp?id=96

Jones, S. (1966). The effect of a negative qualifier in an instruction. *Journal of Verbal Learning and Verbal Behavior, 5*(5), 497–501.

Kaplan, C.H. (1978). *A developmental analysis of children's direction following behavior in grades K-5*. [Unpublished doctoral dissertation]. Columbia University.

Kaplan, C. H., & White, M. A. (1980). Children's direction following behavior in grades K–5. *The Journal of Educational Research, 74*, 43–48.

Kounin, J. S. (1970). *Discipline and group management in classrooms.* Holt, Rinehard & Winston.

Lasagabaster, D. (2017). Language learning motivation and language attitudes in multilingual Spain from an international perspective. *The Modern Language Journal, 101*, 583–596.

Martiniello, M. (2009). Linguistic complexity, schematic representations, and differential item functioning for English language learners in math tests. *Educational Assessment, 14*(3-4), 160–179.

Mestre, J. (1988). The role of language comprehension in mathematics and problem solving. In R. Cocking & J. Mestre (Eds.), *Linguistic and cultural influences on learning mathematics* (pp. 201–220). Erlbaum.

OECD – Organisation for Economic Co-operation and Development. (2019). Mexico: Student performance PISA 2015. http://gpseducation.oecd.org/CountryProfile?primaryCountry= MEX&treshold=10&topic=PI

Preddy, D., Boehm, A. E., & Shepherd, M. J. (1984). PBCB: A norming of the Spanish translation of the Boehm Test of Basic Concepts. *Journal of School Psychology, 22*(4), 407–413.

Reynolds, C. R., & Suzuki, L. A. (2012). Bias in psychological assessment. *Handbook of psychology, Second edition*. doi: 10.1002/9781118133880.hop210004

Rowland Reading Foundation. (2017a). Adventures of the Superkids (1st grade). *First semester teacher materials*. Zaner-Bloser, Inc.

Rowland Reading Foundation. (2017b). More adventures of the Superkids: (1st grade) *Second semester teacher materials.* Zaner-Bloser, Inc.

Rowland Reading Foundation. (2017c). The Superkids hit second grade (2nd grade). *First semester teacher materials.* Zaner-Bloser, Inc.

Rowland Reading Foundation. (2017d). The Superkids take off (2nd grade). *Second semester teacher materials.* Zaner-Bloser, Inc.

Sagyndykova, G. (2013). Academic Performance in Double-shift schooling. Nazarbayev University.

Schalla, L. K. (2015). Family-school collaboration in Mexico: perspectives of teachers and parents. [Unpublished doctoral dissertation]. University of Minnesota Digital Conservancy. http://hdl.handle.net/11299/171715.

Schwarts, R. (2014). Multiple Pathways Can Better Serve Children. (Vol. 14, No. 3). Education Next. https://www.educationnext.org/multiple-pathways-can-better-serve-children/.

Secretario de Educación Publica (SEP) (2016a). Español (1st grado). *Libro para el*

maestro. Impreso en Mexico.

Secretario de Educación Publica (SEP) (2016b). Español (2nd grado). *Libro para el maestro.* Impreso en Mexico.

Secretario de Educación Publica (SEP) (2016c). Desafíos Matemáticos (1st grado). *Libro para el maestro.* Impreso en Mexico.

Secretario de Educación Publica (SEP) (2016d). Desafíos Matemáticos. *Libro para el maestro* (2nd grado). Impreso en Mexico.

Siegler, R. S. (1998). *Emerging minds: The process of change in children's thinking.* Oxford University Press.

Souto-Manning, M. (2018). Disrupting Eurocentric epistemologies: Re-mediating transitions to centre intersectionally-minoritised immigrant children, families and communities. *European Journal of Education, 53*(4), 456–468.

Stein, M. K., Remillard, J., & Smith, M. S. (2007). How curriculum influences student learning. In F. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 319–370). Information Age.

IES – Institute of Education Sciences, & NCES – National Center for Education Statistics. (n.d.). *IES & NCES Fast Facts website: Elementary and Secondary: English language learners.* U.S. Department of Education. (n.d.). https://nces.ed.gov/fastfacts/display.asp?id=96

Thorndike, E. L., & Lorge, I. (1944). *The teacher's word book of 30,000 words.* Bureau of Publications, Teachers Co.

Thorne, C., & Narváez, A. (1987). La Prueba de Conceptos Básicos de Boehm: Adaptación y elaboración de baremos para Lima y Callao. *Revista de Psicología, 5*(2), 135–148.

Thomas, P. A., Kern, D. E., Hughes, M. T., & Chen, B. Y. (2016). *Curriculum development for medical education: A six-step approach*. Johns Hopkins University Press.

Treviño, E., & Treviño, G. (2004). Estudio sobre las desigualdades educativas en México: La incidencia de la escuela en el desempeño académico de los alumnos y el rol de los docentes. *Colección Cuadernos de investigación*. (No. 5).

Vila Rosado, D. N., Duran, M. M. G., & Riera, J. L. R. (2018, August 22-27). *Development of mathematical skills like a support to executive functions in Mexican students and the psycho-pedagogical benefits.* [Conference proceedings]. Conference on Social Sciences and Humanities, Princeton, NJ. (pp. 21-23). Research Association for Interdisciplinary Studies (RAIS).

World Education News Review (2016). Education System Profiles: Education in Mexico. https://wenr.wes.org/2016/08/education-in-mexico

Yousef, N. (2019). Prejudices and Obstacles Immigrant Students Face in the Los Angeles Unified School District. *Aleph, UCLA Undergraduate Research Journal for the Humanities and Social Sciences, 16*. https://escholarship.org/uc/item/3742m8cd

Zhou, Z., & Boehm, A. E. (2004). American and Chinese children's understanding of basic relational concepts in directions. *Psychology in the Schools, 41*, 261–272.

Zhou, Z., & Boehm, A. E. (2001). American and Chinese children's knowledge of basic relational concepts. *School Psychology International, 22*(1), 5–21.

Zhou, Z., & Boehm, A. E. (1999). Chinese and American children's knowledge of basic relational concepts.