DIFFERENCES IN MATHEMATICAL INSTRUCTION FOR ESL/ELL AND TWO-WAY IMMERSION PROGRAMS

by

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DIFFERENCES IN MATHEMATICAL INSTRUCTION FOR ESL/ELL AND TWO-WAY IMMERSION PROGRAMS

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ABSTRACT

There are many structures for teaching second language; two-way immersion and ESL/ELL are the two primary focuses of this paper. The objective of a teacher with an ESL/ELL student is to provide the student with sufficient content-specific language for him or her to meet state standards and succeed in that teacher’s specific area of content. The objective of a two-way immersion classroom is to foster the learning of a new language through the teaching of content. This study examines what research claims are best practices of two-way immersion, to what extent do the ESL/ELL modifications align with the researched two-way immersion modifications, and how the best practices and modifications can be incorporated in a first grade mathematics two-way Spanish/English immersion lesson plan. The primary focus of language use is student discussion, the final discussion as a large classroom is designed to share multiple solving strategies and listening to both English and Spanish being used. This hypothetical lesson was written based on the combination of suggestions of best practices for teaching mathematics in a two-way immersion classroom.

INTRODUCTION

Second language education is incorporated in some form in the majority of US schools through: electives, English Language Learners (ELL), English Second Language (ESL), or immersion programs. In response to globalization and the increasing numbers of refugees and immigrants, educators, researchers, and policy makers all have noted the importance of US students gaining fluency in languages beyond English. Likewise, the need for ESL and ELL programs has grown due to the increasing population of students with Limited English Proficiency (LEP) in mainstream classrooms. Within the last thirty
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years, two-way immersion programs, a structure and instruction style for integrating a second language into the classroom, have been adopted by an increasing number of schools and the focus of ongoing research to meet the language needs of all students (Cummins, 1998).

In Texas, students can satisfy foreign language requirements for high school graduation by completing a minimum of two years of an elective foreign language course. Students are not tested in the foreign language at the state level, but may take an Advanced Placement (AP) test if enrolled in an AP foreign language course. Two years of a foreign language will provide students with a basic introduction to a different culture and language, but falls short of the level of multilingualism found in classrooms in other countries (19 TAC chapter 74, Subchapter G, no date).

Students whose first language is not English and lack the fluency in English necessary to be successful in typical mainstream classrooms are supported through ESL and ELL programs. The goals of ESL/ELL programs are to provide the ESL/ELL students with sufficient English knowledge and vocabulary to be successful in schools where the dominant language for instruction is English (cf. Cummins, 1998; Yoon, 2007). In Texas, ESL/ELL students’ fluency in English is assessed yearly through the Texas English Language Proficiency Assessment System (TELPAS) (2013-2014 STAAR Decision-Making Guide for LPACs, 2013). After meeting the designated level of English fluency, the ESL/ELL student is fully included into the mainstream classroom where the student is provided the appropriate accommodations and modifications. ESL/ELL students may also receive accommodations on standardized testing and if they have
minimal English proficiency, for example, they can take the STAAR-L, a modified state exam (2013-2014 STAAR Decision-Making Guide for LPACs, 2013).

Alternatives to typical foreign language education are dual language programs. In contrast to learning a language through elective coursework, Met (1994) described dual language education as the process where instruction is structured so the students learn content through two languages, while developing their proficiency in both languages through the content being taught. Yet, the design and implementation of dual language programs vary as demonstrated by differences in immersion and two-way immersion programs.

Immersion programs develop students’ acquisition and fluency in two or more languages through teaching all or part of the curriculum "in a second language (L2) instructional environment" (Cummins, 1998, p. 34). Therefore, L2 is used as a medium of instruction where students' degree of fluency in L2 could be an advantage or disadvantage to their learning of content.

In two-way immersion programs students are acquiring one, if not two, new languages through the learning of content. The difference between two-way immersion and immersion programs is the classroom population. In an immersion classroom, the students share the same native language and are all learning the same second language. In two-way immersion, students have different native languages and learn a new language. However, that new language is not the same for every student. For example, a two-way Spanish/English immersion program would include Spanish Native Speakers (SNSs) learning English as a second language and English Native Speakers (ENSs) learning Spanish as a second language. In two-way immersion programs, all students are second
language learners (SLL) because the classroom’s population consists of students learning two languages and are not native speakers in at least one of the languages. Therefore, neither group of students has a greater advantage or disadvantage in terms of language barriers and literacy.

The focus of this study is on two-way immersion for the acquisition of Spanish and English in early elementary mathematics classrooms. Therefore, the students in this classroom are learning English, Spanish, or both languages for the first time or as non-native speakers. Specifically, this study examines the modifications provided for an ESL/ELL classroom and compares them to the needs of students learning in two-way immersion classrooms.

**LITERATURE REVIEW**

A unique quality of two-way immersion programs is students’ ongoing language growth in both English and Spanish through the implementation of both languages in the teaching of content. In a study of Canadian elementary students in an immersion school, Cummins (1998) found that, “students gain fluency and literacy in French at no apparent cost to their English academic skills” (1998, p.34). Cummins focused on *The Additive Bilingualism Enrichment Principle*, where students add another language at no cost to their native language. The students learn both their native language and a second language in the classroom. Students do not lose proficiency in their native language while acquiring a second language. This principle supports the concept that immersion education enhances a student’s intellect and linguistic processes. He also used Johnson and Swain’s (1997) *Core Features of Immersion Programs*, see Figure 1, to describe eight core features of an effective immersion program. These aspects develop L2 while
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maintaining and continuously developing L1, therefore expanding their multi-lingual vocabulary and ability.

<table>
<thead>
<tr>
<th>Core Features of Immersion Programs</th>
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<tr>
<td>1. The L2 is a medium of instruction</td>
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<td>2. The immersion curriculum parallels the local L1 curriculum</td>
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<tr>
<td>3. Overt support exists for the L1</td>
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<td>4. The program aims for additive bilingualism</td>
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<td>5. Exposure to the L2 is largely confined to the classroom</td>
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<tr>
<td>6. Students enter with similar (and limited) levels of L2 proficiency</td>
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<tr>
<td>7. The teachers are bilingual</td>
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<td>8. The classroom culture is that of the local L1 community</td>
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Figure 1 Core Features of Immersion programs (Johnson & Swain, 1997)

Second Language Instruction. Foreign language instruction is a process in which multiple instruction styles and techniques are used for students’ acquisition of a second language. Tedick (2003) noted the importance in today’s society for students to learn more than one language during their public education. Modern globalization has resulted in multilingualism becoming increasingly vital for success in the near future. Tedick developed the CAPRII instructional model to structure a classroom and lesson plans in order to incorporate two languages of equal relevance in the classroom consisting of,

Six key concepts that we believe should guide language instruction: (1) *Contextualization* of grammar in language instruction, (2) *Authenticity* of task and text, (3) and emphasis on *Process*, (4) the value of *Reflection* for both language learners and language teachers, (5) an emphasis on *Interaction* within and beyond
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the classroom, and (6) *Integration* of the four modalities and of language and content, as it related to other academic disciplines or cultural themes. (2003, p. 3)

This manner of instruction was developed to assist students in their acquisition of a second language and expand on their literacy in their native language.

There are many challenges that students face when learning a new language. This requires the teachers to be aware of students’ prior-knowledge and work towards providing the content-necessary information to facilitate learning for non-native speakers. For instance, Leimbigler’s (2014) identified the differences between Mandarin and English that are potential causes of confusion for Mandarin native speakers learning English. Some of these examples included the fact that Mandarin uses a different number of words, typically fewer, to articulate the same meaning than the amount of words and symbols used in the English language. The Chinese also have a different way to state disagreement and reveal embarrassing information. These differences can lead to confusion among Mandarin native speakers learning English, making it difficult to communicate with non-native Mandarin speakers or even just communicate among each other in English.

Grammar is one of the main components of a language along with vocabulary; therefore, it is a foundation to acquiring a second language. Ellis (2006) found a guaranteed transfer in grammar structures and use of tenses between the child’s first language (L1) and the language being acquired (L2), which can be beneficial for students to make connections between L1 and L2. However, there are instances where students are going to transfer information, but if not grammatically correct this transfer can result in a great deal of confusion.
Researchers believe that a partial transfer of grammar information between L1 and L2 is both necessary and inevitable. Ellis (2006) explained a situation in which a French (L1) student learning English (L2) might be confused with word order “French learners of English produce errors of the kind *Mary kissed passionately John* because French permits an adverb to be positioned between the verb and the direct object” (2006, p.89). The connections a student potentially makes between L1 and L2 are a mix of helpful and disadvantageous connections for student’s learning (cf. American Speech-Language-Hearing Association). Therefore, it is necessary that the teacher is knowledgeable of the common misconceptions in transferring knowledge from L1 to L2 and is prepared to monitor for the use of misconceptions.

**ESL/ELL instruction.** The objective of a teacher with an ESL/ELL student is to provide the student with sufficient content specific language for him or her to meet state standards and succeed in that teacher’s specific content area. ELL students are often placed in mainstream classrooms with teachers who may or may not speak the student’s native language. Ganesh and Middleton (2006) found that in a mainstream classroom with ELL students there is often a communication barrier between the ELL students and the teacher, because the teacher is not required to be familiar with or speak the student’s native language. Ganesh and Middleton (2006) concluded that technology can “lighten the learning burden for ELLs as well as create opportunities for extended understanding in mathematics and other subject areas” (p. 103). Garrison and Kerper-Mora (1999) noted that teachers often have easy access to manipulatives and images that technology provides. The use of manipulatives and technology were found to help facilitate learning
for all students, but are even more important for ESL/ELL students in the mainstream classroom.

**Bilingual mathematics education.** The research that has been conducted within bilingual classrooms concludes students must discuss mathematics to better understand and to develop a sufficient English vocabulary to succeed in the classroom. Ganesh and Middleton (2006) found that “meaningful questions and explanations with multiple opportunities for students to hear and produce important mathematical vocabulary to be facilitative of students’ mathematical understanding” (2006, p. 138). The context in which students identify when to use the proper language is also important. Discussion in mathematics classroom is not common, but has been proven to help students gain a greater understanding of concepts by allowing students to verbalize their thoughts and understanding of mathematics.

A result of students explaining and discussing their mathematical thinking is that students are indirectly practicing their oral language skills, and listening to the other students’ thoughts and use of language. Draper and Siebert (2004) discussed the concept of content literacy in mathematics, students talking about mathematics using proper mathematical language (cf. Ganesh and Middleton). Similar to English and Spanish, mathematics has its own literacy. Mathematics has symbols aside from the English alphabet, in addition to words and graphs that are foreign before learning mathematics. Mathematics must be taught in a manner that creates this mathematical literacy. Draper and Siebert made the argument that there is a need to “talk about talking about mathematics” (2004). Therefore, a resulting form of instruction for mathematics would be discussion. During the students’ discussion, the students explain their plan for solving
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the problem, a solution justification, etc. Implementing discussions in a two-way immersion mathematics classroom would function on multiple levels: having students speaking (practicing their oral language) and talking through their mathematical thoughts.

Students are constantly learning, acquiring knowledge in and out of the classroom. Donovan and Bransford (2005) explained how students bring knowledge into the classroom from their everyday lives. This knowledge must be addressed in a way that connects mathematics outside of the classroom to mathematics within the classroom. Within a two-way immersion classroom, the students bring their out of school knowledge which may include knowledge of two different languages and two different cultures. The prior knowledge and experiences the students have must be addressed by the teacher bridging the gap between school and the “real world.”

Mathematics is often seen as a difficult subject. Generally, it is assumed that incorporating the teaching of mathematics in a non-native second language would complicate understanding mathematics and make it more difficult for students to grasp the mathematical concepts and meet state standards. Barwell (2010) noted that that “evidence from immersion programs suggests that students can achieve similar scores in mathematics as students enrolled in regular English program” (2010, p.1). This information suggests that in no way does a second language interfere with understanding mathematics. The teacher does need to modify his or her teaching and preparation in order to incorporate more language and vocabulary into his or her instruction. However, there is no evidence that teaching mathematics in a second language takes away from understanding mathematics.
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**Intersection of ESL/ELL and immersion research.** Considerable research exists regarding the structure and instructional implications for ESL/ELL and immersion classrooms. There is little research in regards to the implication and instructional strategies of mathematics in a two-way immersion classroom. Given the research on teaching mathematics, and teaching mathematics to ESL/ELL students in a mainstream classroom, there is an evident gap in the research of best practices for teaching mathematics in a two-way immersion classroom based on students’ prior-knowledge and experiences.

A common theme among the extant research on immersion and ESL/ELL programs is the importance of students learning *content-obligatory* and *content-compatible* vocabulary for the co-development of their knowledge of a specific content area and language acquisition. In describing a researched based two-way immersion teaching model, Met (1994) noted the necessity of identifying and addressing *content-obligatory* (CO) and *content-compatible* (CC) language.

Content-obligatory language is language so closely associated with specific content objectives that students cannot master the objectives without learning the language as well…. content-compatible language can easily be taught through a content lesson, but the material could be taught and learned without knowledge of this vocabulary, grammar or language functions (1994, p. 161)

The goal for language development of ESL/ ELL learners’ is CO language. A two-way immersion classroom goes beyond the development of CO language to include CC language.
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CO language is directly related to the content, and necessary for the students to master the content being taught. For example, CO language for elementary mathematics would include “add” and “subtract”. The CC language includes words that can be added into the lesson but if not included the students would still be able to master the appropriate content. In this sense CC language enhances and can adds real world context to the lesson. An example would be: you have two apples and you buy three more apples, how many apples do you have now? In this context, apple is CC language. Without apple, the question would be you have 2 and buy 3 more, how many do you have now? Even without the CC language, it is still possible to solve the mathematical problem. However, the CC language provides real world context and thus expands the students’ vocabulary.

In ESL/ELL classrooms, the priority is for the student to learn CO language. In two-way immersion, the priority is for the students to learn both CO and CC language.

<table>
<thead>
<tr>
<th>Content-Obligatory and Content Compatible Language in the Classroom</th>
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<tr>
<td><strong>Content-Obligatory (CO)</strong></td>
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<tr>
<td>ENS</td>
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<tr>
<td>SNS</td>
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<tr>
<td><strong>Content-Compatible (CC)</strong></td>
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*Figure 2. Content Obligatory and Content Compatible Language in ESL/ELL and two-way immersion mathematics lessons.*

*Figure 2* shows that the degree to which students engage in CO and CC language varies by their native language (e.g., English or Spanish) and type of bilingual education program. Figure 2 models the type of language (CC and/or CO) that ENS or SNS learn in ESL/ELL or two-way immersion. In an ESL/ELL classroom the ENS student will gain a deeper knowledge of CO and CC language in English, see English column of ESL/ELL in Figure 2. In English, the SNS student will learn CO and consequently acquire
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knowledge of CC language from being in a mainstream English taught classroom see English column of ESL/ELL in Figure 2. The SNS students will still have CO and CC vocabulary knowledge in Spanish but it will not be instructed in Spanish in the classroom (see Spanish column of ESL/ELL in Figure 2).

In a classroom with ESL/ELL students, the only students that have CC and CO language for Spanish are the SNS students. However, every student in that classroom is provided with CO language in English. As a factor of being with students who speak English, the SNS student will acquire some English CC language. There is no instruction in Spanish; therefore, the ENS speakers do not gain any CO or CC language in Spanish. Spanish is not instructed in the classroom. The goal is for the SNS to gain sufficient CO language to be successful in the content of the mainstream English classroom.

In two-way immersion programs the ENS and SNS students will be instructed in CO and CC language in both English and Spanish (see Two-Way Immersion section of Figure 2). Unlike ESL/ELL, each student is instructed in both languages. Beyond the CO instruction, there is instruction for CC in both languages in order to build fluency in the student’s L1 and L2. In two-way immersion, both ENS and SNS students will acquire CC and CO language in both English and Spanish from the manner in which the classroom content is taught. The class is taught in both English and Spanish, and the mission behind that is to build the students’ vocabulary through the learning of content. Therefore, the teacher focuses on incorporating CC language in both English and Spanish.

Content-obligatory language is a necessity in any classroom. In a mainstream bilingual or non-bilingual classroom, all of the students must understand the vocabulary associated with the content being taught in the lesson. In many situations, some of the CO
words are new vocabulary for students in their native language. It is important that the students are learning both languages simultaneously. The CO language is necessary for the content instruction.

There is plenty of research in regards to the structure and instructional implications for ESL/ELL and immersion classrooms. There is little research, however, in regards to the implication and instructional strategies of mathematics in a two-way immersion classroom. Given the research on teaching mathematics and teaching mathematics specifically to ESL/ELL students in a mainstream classroom, there is an evident gap in the research of best practices for teaching mathematics in a two-way immersion classroom based on students’ prior-knowledge and experiences. My investigation will be on the similarities and differences in students’ prior-knowledge and experiences related to learning mathematics for primary grade elementary SLL students enrolled in a two-way Spanish immersion program and ESL and ELL students and providing implications for instruction in two-way immersion elementary mathematics classrooms.

**METHODOLOGY**

In order to investigate the similarities and differences between the prior knowledge in mathematics of primary school ESL/ELL students and immersion students, I focused on three research questions.

1. What does the extant research identify as best practices for teaching and learning content in two-way immersions programs, specifically a two-way Spanish/English mathematics classroom?
2. To what degree do ESL/ELL modifications included in commonly used research based elementary grades mathematics textbook, *Investigations (Investigation in number, data, and space, 2008)* align with research findings for teaching and learning content in a two-way immersion program?

3. How can identified best practice (e.g., content-obligatory and content-compatible language) be incorporated in a first grade two-way immersion mathematics lesson on addition and subtraction to meet content and language goals?

First grade was chosen primarily because of the students’ prior-knowledge. At this age there are fewer factors related to students’ prior-knowledge that the students bring into the classroom from previous years and outside the classroom. It is also early enough in the students’ educational career that a true foundation is necessary to build the students’ vocabulary through CC language.

First, I selected and reviewed a lesson plan on addition and subtraction from the research based mathematics textbook series *Investigations in number, data, and space* (2008). In reviewing the selected lesson, both the student and teacher editions, I specifically attended to the suggestions included for teaching the lesson and suggested adaptation and modifications for ESL/ELL students. Second, I compared and determined the degree to which the selected lesson and suggested adaptations for ESL/ELL students aligned with research findings for teaching in two-way immersion programs. Finally, drawing on the extant research I generated a modified lesson plan that could be implemented in an English/Spanish first grade two-way immersion program. Based on
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the literature, a two-way immersion lesson plan should place an even focus on the mathematics content and the languages being learned. In contrast, typical ESL/ELL accommodations and modifications focus primarily on the mathematical content by providing sufficient language support for ESL/ELL students to understand the mathematical content.

ANALYSIS

In general, commonly used elementary curriculum materials do not have modifications and resources for two-way immersion programs. However, elementary grade mathematics textbooks commonly used in the United States include accommodations or adaptations for ESL/ELL students. For my research, I reviewed a unit from the textbook series, Investigations (Investigation in number, data, and space, 2008). I reviewed the lesson and the ESL/ELL modifications to determine the degree to which the proposed accommodations addressed recommendations for two-way immersion lessons. I drew on the extant research to adapt the lesson to be used in a two-way immersion program. All of the standards will be based on the Texas Essential Knowledge and Skills (TEKS) (19 TAC chapter 74, Subchapter A, no date). Specifically, I identified components of the ESL/ELL adapted lesson that addressed and did not address recommendations for two-way immersion lesson to create a two-way immersion first grade mathematics lesson plan for English and Spanish.

Selected lesson. The unit includes a lesson focused on addition and subtraction through story telling problems. As a result of the story problems, students are given situational addition and subtraction problems. The story problems can be structured in multiple ways to meet the three structures of addition and subtraction. The first structure
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is start+change= result, where the change is the cause for addition. This structure is a cause for subtraction when the change or the start are unknown. The second plausible structure is part-part-whole. In this structure, if one part is unknown it is a cause for subtraction, and if the whole is unknown it is a cause for addition. The third structure is the comparison structure, where two amounts are being compared and the result is determining which amount is more and which amount is less (Van de Walle & Lovin, 2006).

The lesson is designed to learn through group exploration. In groups, the students calculate the end of each story problem. There is discussion among the students on how to solve the story problems. As a conclusion to the lesson, the students and teacher have a large group discussion on the strategies and process used to solve the set of story problems. Tedick’s (2003) CAPRII model identifies the authenticity of the task being necessary in the lesson. The story problems provide realistic situations where the students would use addition and subtraction. All of the lessons in math need to connect to real life so the students can see how math is used in daily situations. She also focuses on the process; the students are encouraged to constantly explain their thinking process through both small group and large group discussion. There is also constant interaction with peers, manipulatives, and interaction with both English and Spanish. The non-native language is constantly integrated in the lesson. Based on the literature these best practices introduced by Tedick are easily applicable to a two-way immersion classroom.

**ESL/ELL standards.** The language standards for ESL/ELL are known as English Language Proficiency Standards (ELPS) that provide expectations of English language growth within an ESL/ELL classroom. The language standard in a two-way immersion
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Lesson focuses on use of both English and Spanish for an equal time and in multiple manners such as writing, discussing, and presenting. The TEKS addressed in the modified two-way immersion lesson plan are from first grade mathematics and the English Language Proficiency Standards (ELPS) (19 TAC chapter 74, Subchapter A) for ESL/ELL students.

Accommodations and modifications. The accommodations and modifications for a mainstream classroom are designed for students who are ESL/ELL, whereas, in the two-way immersion classroom these modifications are necessary for all students in the classroom. Every student in a two-way immersion classroom is at a disadvantage because they are speaking a second language; therefore, these modifications are a necessity in the lesson. The students should always have access to the CO and CC vocabulary, so it is easy for them to incorporate it in their explanation and practice speaking in their L2.

Based on the modifications the textbook provided for ESL/ELL, the suggestions were centered on the students understanding addition and subtraction. The suggestions enforced the importance of visuals. If the students do not understand what is written or what is being said, they can somewhat understand through pictures and visuals. Manipulatives allow the students to explain to their peers their thought process when they do not have sufficient English vocabulary to explain their thinking. The best manipulatives for addition and subtraction are counting cubes and number lines. The final suggestion was for the teacher to constantly review the CO language with the students in multiple manners.

All the content must be described and provided in both English and Spanish by the teacher, to provide the students with true immersion (Cummins 1998); however, the
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A hypothetical lesson plan is written in English. The standards for this unit of mathematical material focus on addition and subtraction. Based on the stories, the content obligatory (CO) and content compatible (CC) language in the story problems, and the action language of what happens in the story problems is all critical to the solving strategy the students will use to complete the story problems. For example, if an event was to occur such as the purchasing of fruit, then the strategy that would generally be used would be start + change = result.

**Lesson modifications for two-way immersion.** The literature researched was based on a two-way immersion classroom or a mathematics classroom. There was very little research provided for a mathematics two-way immersion classroom. Therefore, the findings are based on combining the best practice for a two-way immersion classroom and the best practices for an elementary mathematics classroom. The materials provided allow students to represent their thinking through more than just words. There will be a language barrier since the pairs will consist of an ENS and a SNS student. It is important that all of the materials are provided in both English and Spanish. Manipulatives such as counting cubes and number lines enable the students to explain their thinking and solving strategy if language becomes too much of a barrier. It is also important for the students to have access to visuals, so they are not just translating the English word to the Spanish word or vice versa. Providing the students with an image will help them associate the new language with the image and not always a direct translation between languages. Each group should be provided with a CO and CC reference sheet. When the students are trying to communicate with their partner whose native language is different, they can review the reference sheet to assist them in the using the CO and CC of the lesson.
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The focus of the lesson is based on the content and language objectives. The manner of which the content objective is taught, story problems, is based on the intention of using CO and CC language. CO and CC language is the primary focus of the language use in the lesson and provides the students with expectations for the extent of their L2 in the content focused activity. The words chosen as CO language are all words that can be found in an addition or subtraction story problem. Understanding the meaning of these words will allow students to determine whether the story problem calls for addition or subtraction. The CC language provides more description to the story problems; however, the student could solve the operational part of the story problem without the CC language.

The activities involved in the lesson plan must be hands-on to allow the students to use something other than words as a description if necessary and, to engage the students in collaborative learning with their peers. The activities should not be independent, therefore, allowing students to foster discussion in multiple languages about the story problems. Student to student communication is most important because all of the students are in the process of learning a second language. In the classroom environment, the students should feel comfortable to make mistakes and try new strategies. If the students are not comfortable with making mistakes, then they will be cautious when speaking in their second language. The students must also feel comfortable to try their solving strategies for addition and subtraction. If there is not a collaborative environment where the students feel comfortable making mistakes, then there will be minimal discussion in the classroom and the students will not be practicing their second language or hearing different solving strategies.
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The addition and subtraction lesson allows for implications of CC language through stories. To determine the relevant CC language, it must be relevant to the students’ lives and easily accessible—language they can use every day in the classroom beyond this lesson. Fruit and colors were selected for the context of the problems due to students’ previous work and familiarity with these words. Met (1994) focused on long-range vocabulary implementation from earlier in their schooling as well as from other contents. Therefore the students are constantly practicing and re-visiting their second language vocabulary.

The textbook series provides materials needed for the lesson, however, the materials provided must be modified to meet standards of a two-way immersion classroom. All of the materials must be available in both Spanish and English. Pictures must be included as much as possible. All of the materials are designed to facilitate use of language while learning the new content.

Within the lesson plan, there is a summary of the previous lesson and the following lesson. The awareness of these lessons helps with the flow of the classroom. The teacher is aware of specific chronology of the content. The modifications of the lesson come from the ESL/ELL suggestions that the textbook provides (*Investigation in number, data, and space*, 2008). The other modifications are based on the suggestions of teaching from the literature researched about two-way immersion, where the students use discussion as a manner of explaining their mathematical thinking and practicing their use of language (cf. Ganesh and Middleton, Draper and Siebert, and Met). These modifications represent the differences between ESL/ELL and two-way immersion instruction.
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The lesson planning sequence was developed based on the lesson from *Investigations*. It was altered, however, to support the use of CO and CC language. The probing student thinking questions are designed to have the students think a little deeper as well as facilitate the use of their second language. The lesson was written in order to provide a lens into a two-way immersion classroom and how it functions differently than a mainstream classroom with ESL/ELL students.

FINDINGS AND RESULTS

Based on the development of the lesson plan, student to teacher communication is necessary. Only the student is learning a second language the teacher has already mastered the second language. The probing questions are intended for the teacher to ask the students to assist the students in meeting both the language and content objectives. These questions can help guide students who may be struggling with interpreting what is happening in the story problems or the next step the students should take in determining the end to the story. These questions also allow differentiation. Those students who are accelerated can think deeper about what is happening within each story. The probing questions are intended to help the person answering them as well as the other student in the pair listening to the responses and contributing to the discussion.

There are many responsibilities for the teacher. The teacher must be bilingual and constantly monitoring the students. It is the teacher’s responsibility to make sure the students are speaking in both Spanish and English. If the students are favoring one language, the teacher must step in and facilitate the conversation in the language the students are avoiding. Conversation is the manner in which the students will build their fluency, so their conversations must be in both languages.
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The assessment for the lesson must be based on content as well as CO and CC language. The CC language is there to expand the language knowledge of the student; therefore it important that the student is assessed on the use of this vocabulary throughout the lesson. The teacher must also make the language understood. This understanding can come from pictures used to describe vocabulary words, repetition of language, and clarifying of misconceptions associated with vocabulary and content. The teacher must be constantly monitoring because the students are in mixed groups of ENS and SNS students. The teacher must help with clarification of difficult vocabulary in the second language.

Throughout the students solving the story problems, the teacher must monitor for which students should present their mathematical thinking in the large group discussion. The teacher does this so the students aren’t seeing all of the same mathematical process. The teacher must constantly be aware of what is happening throughout the pairs.

The final discussion with the entire class is designed to share multiple solving strategies and listen to both English and Spanish being spoken. As the students are discussing, it is important the first student explains their process in L2, then someone whose native language is that same language repeats the explanation in their native language. This way, every student is hears the explanation twice. One will be in a very broken language and that is why a native will then go and repeat it so everyone hears both. The more the students hear an explanation, the more they are hearing the language, and the better they understand addition and subtraction.

The teacher has to be extremely flexible during the large group discussion. The teacher can plan how he or she wants the explanations to go by close monitoring.
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However, there is a chance that the students might say something about their mathematical thinking with a misconception or might say something wrong grammatically. At this point, the teacher should take advantage of that as a teaching moment for the students.

**IMPLICATIONS FOR INSTRUCTION**

Based on the best practices from the findings for instruction, the teacher must identify the CO and CC for each lesson. When writing a lesson, it is important to develop and structure the mathematics lesson to incorporate the relevant CO and CC that was selected for the unit. The lesson should contain meaningful questions, which result in the students thinking deeper on why the mathematical process works and how it happens, not just solving a problem and giving an answer. Along with those meaningful questions, the students need to be provided with multiple ways to hear and talk about mathematics. This can occur in small group discussion, large group discussion, conferences with the teacher, and more. It is important that the students are talking and hearing the mathematical process and languages in order to build that content and language simultaneously.

Throughout the discussion, the students should be using the proper mathematical vocabulary to explain their mathematical thinking, as well as accuracy and understanding of mathematical symbols to represent their thinking. It is important within every lesson the students have the opportunity to talk about mathematics, fostering their mathematical thinking and developing a broader vocabulary in their non-native language.

**LIMITATIONS**

One limitation of this project and lesson plan was its specificity. The two-way immersion modifications were only created to fit this specific lesson. The sole focus was
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A first grade two-way Spanish/English immersion mathematics classroom studying the unit of addition and subtraction using solving story problems. The lesson is also created with the assumption that the classroom has an even population of ENS and SNS speakers. With this even population, the students can work in pairs of one ENS and one SNS. This lesson is also under the assumption that the students have some understanding of both English and Spanish languages at this point of their academic year.

This lesson was written based on the combination of suggestions of best practices for teaching mathematics and best practices for a two-way immersion classroom. There is little research on two-way Spanish/English immersion mathematics classroom. This lesson has not been taught in a first grade two-way Spanish/English classroom. All of the modifications and sequence are based on research and modifications provided in the textbook. Therefore, there is no evidence that this lesson will be successful when taught in the classroom.
APPENDIX

Two-Way Spanish/ English Immersion Lesson Plan

**Title/ Topic:** Addition and Subtraction Story Problems

**Content Objective:**
- Students will solve addition and subtraction structure problems presented in contextual story problems.

**Language Objectives:**
- Students will use fruit and color vocabulary and action verbs to understand the context of the story problems.
- Students will discuss, explain, and justify their strategies and solutions in small and large groups using their native language and second language.

**TEKS:** Grade 1 Mathematics
(3) Number and operations. The student applies mathematical process standards to develop an understanding of addition and subtraction situations in order to solve problems. The student is expected to:
- (A) model the action of joining to represent addition and the action of separating to represent subtraction;
- (B) solve word problems using objects and drawings to find sums up to 10 and differences within 10; and
- (C) explain the strategies used to solve problems involving adding and subtracting within 10 using spoken words, concrete and pictorial models, and number sentences.

**Previous Lesson:**
Counting On: The students were assessed using the assessment checklist. Prior to assessment, the students practiced subtraction games. Follow, the assessment the students continued to work on addition and subtraction with story problems.

**Next Lesson:**
Solving Story Problems: A discussion among students focused on their strategies for solving problems with addition and subtraction, and students continue to solve story problems.

**Accommodations/ Modifications:**
- *Small group discussion*
- *Large group discussion*
- Manipulatives
- Pictures
• Reading Support and Guiding questions
  o How does the story start?
  o What happens next?
  o Are there more or less at the end of the story than at the beginning?

Symbols:
• + (addition)
• - (subtraction)
• = (equal)

Materials:
• Counting cubes
• Number Lines
• Flipchart with pictures to represent vocabulary
• Vocabulary lists
• Story Problems Worksheet

Technology:
• Flipchart or presentation of vocabulary. This should include pictures and the vocabulary words in both Spanish and English.

<table>
<thead>
<tr>
<th>Launch/Engagement</th>
<th>Lesson Plan Sequence</th>
<th>Anticipated Student Prior Knowledge</th>
<th>Content- Obligatory</th>
<th>Content-Compatible</th>
<th>Probing Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Review CC and CO vocabulary for the lesson. Explain that is Spanish the noun goes before the adjective and in English the adjective goes before the noun. This is not the first time the students have heard this vocabulary. This vocabulary was used as CC vocabulary previously this year in a science lesson. Confusion with the word orange. In addition-suma, add-sumar, plus/more-más, subtraction-sustracción, minus/less-menos, equal-ser igual, equal sign.</td>
<td>This is not the first time the students have heard this vocabulary. This vocabulary was used as CC vocabulary previously this year in a science lesson. Confusion with the word orange. In addition-suma, add-sumar, plus/more-más, subtraction-sustracción, minus/less-menos, equal-ser igual, equal sign.</td>
<td>Addition-suma, add-sumar, plus/more-más, subtraction-sustracción, minus/less-menos, equal-ser igual, equal sign.</td>
<td>Fruits: Fruit: Fruta Applemanzana Grape- uva Pineapple-piña Banana-plátano</td>
<td>What color is an orange? Do we eat more than one piece of fruit a day? After we eat a piece of fruit, do we</td>
</tr>
<tr>
<td>Lesson</td>
<td>Students will solve a set of story solving problems in pairs. As evenly as possible each pair.</td>
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| | Addition and subtraction strategies:  
  - Start, change and result (Most common for story) |
| | The students will use the CO to explain how they are solving the story |
| | The story problems will incorporate the fruit with descriptive |
| | Can you explain to me what’s happening in this story? |

- **When using the CC vocabulary:**
  - Explain that the students will need to find the ending to the story for their story problems.

- **English it represents both the color and the fruit but in Spanish there are two different words.**
  - Confusion with lemon and lime both being limón in Spanish.
  - A lot of the CO vocabulary in Spanish, one word has multiple meanings and matches up with multiple English words.
  - Grammatical use of adjectives, in English the adjective goes before the noun and in Spanish the adjective goes after the noun.

- **Signo igual**
  - Addition sign: signo más
  - Subtraction sign: signo menos
  - More: más
  - Less: menos

- **Mango:** mango
  - Strawberry: fresa
  - Orange: naranja
  - Lemon: limón
  - Lime: limón
  - Coconut: coco

**Colors:**
- Red: rojo
- Blue: azul
- Yellow: amarillo
- Green: verde
- Orange: anaranjada
- Purple: morado
- Brown: café
- Pink: rosado
- White: blanco
- Black: negro
should have one ENS and one SNS to facilitate second language discussion.

- Teacher will be monitoring students understanding, facilitating discussion.
- As for assessment the teacher will monitor for the following questions:
  - Can students make sense of the action in the problem?
  - What tools and strategies do students use?
  - Do students get the right answers?
  - How do the students record their work?

problems)

- Part, part, whole
- Compare (also common in story problems)
- Students will have minimal second language skills.
- Use the skill of grouping to create numbers that they are more comfortable adding or subtracting with.
- Students will use their native language that they are most comfortable with to describe difficult operations.
- Students will have a language barrier among partners that will cause them challenge with discussion.

problems.
- CO will also be used to describe the symbols associated with the operation such as addition and subtraction.
- Use the skill of grouping to create numbers that they are more comfortable adding or subtracting with.
- Students will use their native language that they are most comfortable with to describe difficult operations.
- Students will have a language barrier among partners that will cause them challenge with discussion.

words such as which color the fruit is and how many of each color the student finishes the story with.
- Each pair will have a couple of the story problems in both English and Spanish.
- Students will need to incorporate the correct order of noun and adjective for the appropriate language

- Have you drawn a picture to represent the story?
- How much of each fruit do you have?
- Are you losing your fruit or getting more?
- Are you combining your fruit or splitting it up?
- If I take something away do you have more or less?
- Can you explain that using the new vocabulary?
- Can you show me how you solved the
| Summary | Large group discussion on solving story problems.  
• Alternate between English and Spanish explanations from students.  
• To practice discussion, have the student explain in their second language. Then another student explains it in the same language but for this student it is their first | • The teacher should focus on students’ use of CO and CC language to communicate their strategies and solutions.  
• The focus should not be on complete grammar and vocabulary in the second language. The priority for speaking is that the student uses the CC and CO language and the proper noun and adjective order. The | • The CO vocabulary will be necessary for students to explain their think process and the operations they used to solve the story problems.  
• The teacher will focus on having the students to incorporate the CC vocabulary into their explanation of their process and thinking.  
• These words are not necessary to explain their process, however, they should be focused on to | • What was the operation (addition or subtraction) used in this story?  
• Can someone explain that again for me in English/Spanish?  
• Did you end up with more or less fruit?  
• Why do we combine fruits? |
| language. | whole description can be in their native language as long as they are using the CO and CC language in their second language. These words are meant to facilitate and expand vocabulary, as a result facilitating discussion, not hindering it. | enhance the children’s second language vocabulary. |

**Lesson Notes:**
- The materials provided such as the vocabulary list and the story problem worksheet will be in both English and Spanish. Everything that is a further modification not provided from the lesson plan or the ESL/ELL modifications is italicized. This information represents the two-way immersion specific modifications to the lesson.
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LIST OF REFERENCES


DIFFERENCES IN MATHEMATICAL INSTRUCTION FOR ESL/ELL AND TWO-WAY IMMERSION PROGRAMS


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*Educating second language children: The whole child, the whole community.*

New York: Cambridge University Press.


