Teaching Mathematics to English Language Learners

Focusing on Comprehensible Input
Sheltered Instruction Observation Protocol (SIOP)

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Speaking the Same Language

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Teaching Mathematics to English Language Learners
# What Students Need to Learn: Language and Content

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Adapted from Juli Kendall (1998)
Identifying Levels of Second Language Acquisition

Teacher Assessment: Ongoing process for every lesson

Description:

It is very important that teachers determine the English language acquisition levels of their students. Once this is ascertained, teachers can make content comprehensible based on the language needs of each student. Teachers can also encourage students to increase their English proficiency by providing activities and opportunities for them to frequently use English. The following stages of language acquisition are fluid; that is, students do not move in concrete steps from one stage to the other. It is helpful for teachers to understand how their students are progressing in acquiring English, and how they might respond to classroom instruction. Also, note that the titles for these stages vary. It is important to remember that learning a language is a process and that the more students use English (including listening to conventional English usage), the more proficient they will become.

Beginning (Pre-Production):
Students have little comprehension of oral and written English, and they are unable to produce much if any oral or written English at this point. Teachers should provide abundant listening opportunities, use many physical gestures and movement to convey meaning, and include a great deal of context for shared reading and writing. If possible, partner beginning English speakers with others who speak the same primary language, and keep in mind that these students may understand more than they can communicate.

Beginning (Early Production):
Students have limited English comprehension but they can now give one or two word oral responses. For students learning to read in English, teachers can use predictable and patterned books and encourages them to label and manipulate pictures or fill in highly contextualized sentences.

Beginning (Early Speech Emergence):
Students speak in simple sentences and can comprehend highly contextualizes oral and written information. Teachers can expect these students to respond to simple open-ended questions. They should continue to provide sufficient language development opportunities and include many activities that require students to read, write, listen, and speak. Encourage students to talk and write about personal experiences.
Intermediate (Early):
Students have some proficiency in communicating simple ideas. They have comprehension of contextualized information. Teachers should continue to develop and extend sight word vocabulary. Teachers can encourage these students to expand on simple responses while developing critical thinking skills. These students should practice important grammatical structures to further their ability to generate and communicate ideas.

Intermediate:
Students have proficiency in communicating ideas and they can comprehend contextualized information in English. Teachers should provide explicit instruction in figurative language, making predictions, using text features to read a book, and English grammar. These students can participate in generative activities that promote higher levels of thinking.

Early Advanced:
Students can communicate well and have adequate vocabulary to achieve academically. They have good comprehension of information. Teachers should provide for a variety of realistic writing and speaking opportunities. These students can be exposed to many different genres, more advanced grammatical structures, and activities to further practice critical thinking skills.

Advanced:
Students have near native speech fluency and expanded vocabulary to achieve academically. They have very good comprehension of information in English. These students can lead group discussions, and they should be given the opportunity to do presentations and have many opportunities to produce oral and written forms of communication. Teachers should continue to provide explicit grammar instruction.

Remember that students at lower levels of English proficiency are not necessarily functioning at lower levels of cognitive ability. Frequently, these students are able to use higher level thinking skills in their primary language but have a more difficult time understanding the academic content and expressing their knowledge in English.

### Comprehensible Input Section of the SIOP

<table>
<thead>
<tr>
<th></th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. <strong>Speech</strong> appropriate for students’ proficiency level (i.e. slower rate, enunciation, and simple sentence structure for beginners)</td>
<td>Speech sometimes inappropriate for students’ proficiency level</td>
<td>Speech inappropriate for students’ proficiency level</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>11. <strong>Explanation</strong> of academic tasks clear</td>
<td>Explanation of academic tasks somewhat clear</td>
<td>Explanation of academic tasks unclear</td>
<td></td>
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<td></td>
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<tr>
<td>12. Uses a variety of <strong>techniques</strong> to make content concepts clear (i.e. modeling, visuals, hands-on activities, demonstrations, gestures, body language)</td>
<td>Uses some <strong>techniques</strong> to make content concepts clear</td>
<td>Uses few or no <strong>techniques</strong> to make content concepts clear</td>
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Alternate Materials

Use many materials to make content comprehensible to students. The more variation you find, the better you will be able to connect with different students’ learning styles and background experience. For example:

1. Find pictures from books, magazines, photographs, and newspapers.
2. Use real objects when possible. For example, when students are studying geometric solids, have them find examples in their everyday lives and from around their house.
3. Find clip art on your computer that goes with the unit.
4. Field trips and excursions help students create first-hand knowledge about a subject.
5. Bring in people from the community and experts to share collections and experiences.
6. Use videos or snippets of videos to give picture support.
7. Let students’ create classroom materials.
8. Use various graphic organizers to help students visually organize and remember new information. Once they have organized information into a graphic organizer, simply seeing that visual cue will help students recall information.
VISUALIZING A 3-DIMENSIONAL SPACE

Materials: 3 Index Cards
          Hole Punch
          Scotch Tape
          Uncooked spaghetti for each group

Directions:
1. Punch a hole in each index card. Label the holes F, G, and H.
2. Tape the three index cards together to form a corner (i.e. two adjacent walls and a ceiling).
3. Draw a line through F. Label this line \( l \).
4. Put a piece of spaghetti through holes F and G.

What do the holes represent? _________________

What does the spaghetti represent? _________________

What do the index cards represent? _________________

How many points do line \( l \) and the spaghetti have in common? _________________

5. Draw a line on the same index card as \( l \) in such a way that it will not have any points in common with line \( l \), even though both lines continue FOREVER. Label this line \( m \).

How many lines can you draw that will satisfy this condition? _________________

6. Draw a line on an index card that does not contain line \( l \) in such a way that it will not have any points in common with the other lines, even though they continue FOREVER.

How many lines can you draw that will satisfy this condition? _________________

7. Draw a line that is completely contained in two index cards. Label this line \( n \).

How many lines can you draw like this using the same two index cards? _________________
8. Use your model to create each of the following situations, if possible. Describe what you were able to create or explain why the situation could not be created.

   • A line and a plane with exactly one point in common.

   • A line and a plane with exactly two points in common.

   • A line and a plane with exactly no points in common.

9. Use your model to create as many different situations as you can that involve two lines. Describe your results below.

10. Use your model to create as many different situations as you can that involve two planes. Describe your results below.
Vocabulary Activities

As teachers, we often think of vocabulary cards for review. However, they can also be used to introduce or frontload vocabulary at the beginning of a lesson. This process helps students build on background knowledge and increases comprehension of the lesson or unit they will be studying.

VISUAL BOXING

<table>
<thead>
<tr>
<th>Word</th>
<th>Personal Association</th>
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</thead>
<tbody>
<tr>
<td>Definition</td>
<td>Something NOT the Word</td>
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WORD PROBLEMS
(Math Connection)

Students see math vocabulary in the word problems both in their daily learning experiences as well as on the state mandated tests. The Word problems, Math connection is a way for students to be more familiar with mathematical terms and with word problems. The teacher gives students a list of vocabulary words from the chapter. Then the students, working either independently or in pairs, use two or three of the vocabulary words to create a word problem which can then be solved by other class members.
VOCABULARY NOTEBOOK

Students will create and maintain a notebook specifically for mathematic vocabulary words. The notebook will include the word, the textbook or dictionary definition, the student’s own definition, and an example. This notebook can be used as reference throughout the course.

You might want to introduce additional and different vocabulary words that also give meaningful clues for solving a specific word problem. For example, look at this problem:

"During an energy crisis there was a gasoline shortage. Because of this shortage, the price of a gallon of gas increased by 10 cents. A short time later, when gasoline was again plentiful, the price decreased by 5 cents, but soon inflation caused the price to rise again by 8 cents. If the original price was $1.37 per gallon, what was the final price?"

To understand this word problem, students must know the following terms as they relate to math: shortage, increased, plentiful, decreased, and inflation. They must then be able to paraphrase the language in order to understand the meaning and translate the information into an equation. Have students start a math vocabulary notebook, or add a new section in their reading vocabulary notebook just for math terms.

VOCABULARY CARDS

Good readers make visual images while reading. Making vocabulary cards is one way to help students either build on or learn to develop creating visual images. One side of the card is reserved for the term/concept word and illustration. The drawing is a visual clue that is significant for the student making the card, and will help trigger the meaning of the word. The definition of the word is written on the reverse side of the card. Generate a class definition that is relative to the topic of study. Use a dictionary as a resource rather than the sole source for a definition. Write the student generated definition on an overhead, chalkboard, or chart paper so that it is visible for all students to copy onto the vocabulary card. A sentence that uses the word in a rich context may also be included. It is essential to model as often as necessary the writing of sentences that are contextually meaningful. Incorporate the use of the vocabulary cards in your lessons. Use the cards as a reference for class discussions, spelling and/or meanings. Develop review or word games that require the use of the cards. If you have a word wall, include words from the vocabulary cards.
Students need to be able to see connections between the various concepts they are learning about in mathematics. This is extremely important for vertical alignment as well as for horizontal alignment. Once students have their vocabulary for the unit, ask them to choose two words from their list. Students will then make connections with the two mathematical words they have chosen. This may be done as a written paper or a page with words and graphics as illustrations.

Understanding the connections and relationships among words and concepts is one way to encourage independent vocabulary development. Assist students in using personal experiences and what they already know to make connections to new concepts and/or words. Include concepts students have previously learned in class. Present and use unknown or difficult vocabulary in contexts that are familiar and rich in meaning. Students need to do more than memorize definitions. The opportunity to think about and think through meanings of vocabulary words and/or concepts will help solidify ownership of the words. Reinforcement of the relationships among words and concepts should occur through a variety of experiences that include speaking, writing, reading, and listening.
GRAPHIC ORGANIZERS
CONCEPT MAPPING

Graphic organizers are a way for students to make connections between concepts and vocabulary words. There are five basic steps to follow.

Step 1: Students write down as many different words as they can that relate to a word the teacher gives them (For example: Measurement).

Step 2: Students work in small groups. Each group must sort the cards they just created into at least four different categories.

Step 3: Students check to see if they put their cards into appropriate categories.

Step 4: The teacher leads the class in a discussion of the categories the students decided on and create a class concept map on the board.

Step 5: The teacher then recreates the class map on a worksheet and gives each student a copy of the map. The students then adjust and refine their maps as they learn more about the concept.

EXAMPLE:
Every Student Gets a Chance

The teacher writes a new concept or idea on the board and reads it aloud. He or she then asks for a volunteer to read aloud what was written. Then, instead of moving on to another concept or example, the teacher asks for a second volunteer to read aloud the same information. This continues so that each student who feels comfortable can choose to read the information aloud. Students who are at beginning levels of English proficient will feel more comfortable repeating information after they have heard it spoken by each of their classmates. Note that in this activity, students are hearing the same input over and over from other students, rather than from the teacher, thus they hear other pronunciations, inflections, and intonations.

This activity is very effective for teaching, practicing, and reinforcing a concept such as place value and reading large numbers, and for helping students remember important definitions and vocabulary. For example, English learners need to learn the words *million*, *thousand*, *hundred*, and *tens* and *ones* in order to read the number 196,325,704. Teach students to identify the numbers in their sets of three:

- 196 (one hundred ninety six) *million*
- 325 (three hundred twenty five) *thousand*
- 704 (seven *hundred* for)

Boost students’ confidence by showing them that if they know their numbers from 1 – 999 they can easily read any number, simply by grouping them together in threes, and adding the label of *million*, *thousand* or *hundred*. Remember that, depending on students’ schooling experiences in their native language, they may already know these concepts. These students will just need to learn the English counterparts for the place value vocabulary. The repetition will enable them to learn the words more quickly.
References


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