

Number Systems

Goals of this activity:

A. Math/content goals

1. Review number systems of different bases (e.g., base 2, 10, and 12)
2. Think concretely about how the numbers in English are alike and different from the numbers in your language.

B. Language and culture goals

1. Practice new vocabulary.
2. Consider one way people from Asia/Asian Americans are viewed in the US.

Before you read

Discuss these questions with your group.

- 1) Explain the number system you use in your native language.
 - b. Is it base 10?
 - c. Does it have special words for teen numbers (i.e., 11, 12, 13, 14, 15, 16, 17, 18, 19)? (For example, English uses “eleven”, “twelve”, and “thirteen”. It does not use “ten-one”, “ten-two”, and “ten-three”. What about your language?)
 - d. Does it have special words for decades (i.e., 20, 30, 40, 50, 60, 70, 80, 90)? (For example, English uses “twenty”, “thirty”, and “forty”. It does not use “two-ten”, “three-ten”, and “four-ten”.)
 - e. How is it the same as and different from the system used in English?
- 2) What difficulties did you have when you were learning numbers in English? Why do you think you had those problems?
- 3) Do you think your native language affects the way you think about math? Do you think your native language affects your math skills? Explain.
- 4) Do you think doing math is harder in English than in your native language? Why or why not?

As you read

Keep thinking about the questions you discussed. The most important points in the article are in gray. (Don't forget to note new words for your journal!)

(Retrieved Jan. 10, 2007 from APA Monitor Online, Vol. 30, No. 4, April 1999, <http://www.apa.org/monitor/apr99/english.html>.)

English words may hinder¹ math skills development The words and symbols used to represent numbers may interfere² with understanding of math concepts³.

By Beth Azar

Each time the government releases a new round of test scores, the United States laments⁴ the dismal⁵ performance of its children compared with children in other nations, particularly those from Asia.

And although differences in classroom instruction may be partly to blame, psychologists are finding that cultural differences in computational⁶ ability can begin before school and may have their roots in the words and symbols different cultures use to represent numbers.

For example, Asian children may get a head start⁷ in understanding that our number system is base 10 because their number words make that connection explicit⁸ whereas English does not. And fractions⁹ may pose a particular problem for all children in part because using the same numerals¹⁰ for fractions as for whole numbers may interfere with learning and in part because their brains are hard-wired¹¹ to deal with whole numbers.

Classroom instruction may be able to address these inherent¹² problems by explicitly teaching the concepts that children struggle with, says psychologist David Geary, PhD, of the University of Missouri, Columbia.

1 Hinder (verb): make more difficult

2 Interfere (verb): hinder, get in the way,

3 Concept (count noun): idea

4 Lament (verb): be sad about

5 Dismal (adjective): bad

6 Computational (adjective): adding, subtracting, multiplying, and dividing

7 Head start (count noun): early start

8 Explicit (adjective): clear, fully shown

9 Fraction (count noun): partial number like $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{9}$, etc.

10 Numeral (count noun): number, digit

11 Hard-wired (adjective): the way something is originally made to work, the way a child's brain works before the child learns

12 Inherent (adjective): natural

Words get in the way

For English-speaking children, number words may hamper¹³ learning before they even enter school: Studies by researchers including Kevin Miller, PhD, of the University of Illinois-Urbana-Champaign, consistently¹⁴ show that Asian children learn to count earlier and higher than their American counterparts¹⁵ and can do simple addition and subtraction sooner as well.

Researchers argue that differences in number words may be a major factor behind these differences. The culprit¹⁶ is the way English—as well as some other languages—treats numbers between 10 and 100. The teen numbers¹⁷ in these languages are irregular and difficult for children to learn, and the rest of the count is separated into decades¹⁸ with words such as "twenty," "thirty" and "forty."

In most Asian languages the number words are far more consistent. In China, for example, the teen words are presented as 10 plus some ones: Eleven is simply "ten one," 12 is "ten two" and 13 is "ten three." This pattern continues into the decade numbers where 20 is "two ten," 30 is "three ten" and 45 is "four ten five." The language makes it obvious that the number system is base 10.

This difference in language may partly explain why most Asian children learn by the middle of first grade to subtract and add by thinking of teen numbers as a 10 and some ones—an extremely helpful and efficient¹⁹ method of doing addition and subtraction, says Geary. In contrast, children in the United States, where much of the cross-cultural work has been conducted, rarely use such a method, even as they get older, Geary and other researcher find.

In fact, Chinese children who are good at counting at age 5 are already beginning to understand that teen words can be thought of as 10 plus some ones, find psychologists Karen Fuson, PhD and Connie Suk-Han Ho, PhD, of the Chinese University of Hong Kong. No children in the United States or England, regardless of their counting proficiency²⁰, understood this concept by age 5, they found in a series of studies published in the *Journal of Educational Psychology* (Vol. 90, No. 3, pp. 536–544).

Children in the United States eventually learn that the number system is base 10 and that teens are tens plus ones, but only the most mathematically adept²¹ children ever learn to add by adding up to 10 and then adding the remaining ones (as with adding 7+8 by breaking 7 into 5 and 2, adding 2 to 8 to get 10 and then adding 5 for 15), says Fuson.

13 Hamper (verb): hinder, interfere

14 Consistently (adverb): in the same way every time

15 Counterpart (count noun): the same person or thing in a different category; in this case, American children are the counterparts of Asian children

16 Culprit (count noun): the cause of a problem

17 Teen number (count noun): 11, 12, 13, 14, 15, 16, 17, 18, or 19

18 Decade (count noun): 10, 20, 30, 40, 50, 60, 70, 80, or 90

19 Efficient (adjective): quick and useful

20 Proficiency (non-count noun): skill

21 Adept (adjective): skillful

She has emphasized teaching about base 10 in a curriculum²² she's developed and is finding in preliminary²³ evaluations that when taught this way children from poor inner-city²⁴ schools districts quickly begin to outperform children from wealthier school districts. Countries that have similar language problems, but better math scores than the United States, may already use this kind of instruction.

After you read

A) Check your understanding

Go to the website and answer the comprehension questions and do the vocabulary crossword.

B) Discuss

Think about these questions and be ready to discuss them with your group.

- 1) Many Americans believe that Asian kids are better at math than American kids. Do you think that is true? Why? If Asian kids really are better at math, do you think the differences between numbers in English and Asian languages are enough to explain it? What might be some other factors?
- 2) Many Americans also believe that Asian American children are better at math than other children (white, black, Hispanic, etc.). Do you think this is true? Why?
- 3) Read this sentence again:

Chinese children who are good at counting at age 5 are already beginning to understand that teen words can be thought of as 10 plus some ones.

How do you think the researchers found this out? With your group, develop a test for this.

22 Curriculum (count noun): set of teaching materials

23 Preliminary (adjective): beginning, initial

24 Inner-city (adjective): in the downtown of a big city; usually a poor and unsafe area