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ABSTRACT

Math competency and bilingual education are among the most debated topics in public education. This paper discusses the common points that these two areas share and demonstrates ways for using foreign language instructional techniques in mathematics classrooms. Information on some techniques used in language education is also provided. (ASK)

Se Habla Mathematics? Consideration of Math as a Foreign Language

by
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¿Se Habla Mathematics?

Consideration of Math as a Foreign Language

Math competency and bilingual education are probably among the most debated topics in public education. Ironically, these two issues have much in common. The core commonality being that both focus upon a means of communicating useful ideas through verbal and written symbols. While Spanish, Swahili, and Japanese are easily conceded to be languages, apparently few consider mathematics in a similar light. A rethinking of pedagogic perspectives may be in order in light of the compelling similarities between math and language.

Math = Language?

Math as a language may not require as great a mental leap as some might first imagine. Commonalties between math and language:

- Abstractions (verbal or written symbols representing ideas or images) are used to communicate.
- Uniform symbols and rules are used consistently.
- Expressions are linear and serial.
- Memorization or "embedding" of symbols and rules are required for success.

- Meanings change according to symbol order.
- Encoding and decoding skills are required.
- Translations and interpretations can offer alternative meanings.
- Intuitive thinking or "speaking without thinking" emerge in intermediate levels of fluency.
- Previous applications are the foundation for future development.
- Lasts a lifetime if useful and used.

These similarities suggest math acts much like language or at the very least an extension of language. These similarities are significantly less true for physical education, social studies, science, and other general subject areas, thus making math distinctive. If one will allow that math does function in much the same way as a language, exploration of language acquisition techniques and their possible applications in math education are warranted.

<u>Immersion Vs Periodic Instruction</u>

Language educators are quick to agree that language acquisition is best accomplished through continuous immersion and that fluency is extremely marginal through periodic instruction. Periodic or intermittent teaching of a second language very rarely results in fluency. One need only recall his or her personal gains in most "required" language courses in high school to demonstrate this point.

After spending nearly 10 years in South Korea the author found that the average Korean student studies English for approximately 10 years in public schools through periodic study. Unfortunately, less than one in a hundred can carry on a simple conversation, much less discuss complex ideas in English. At the end of 10 years the average student has a fair grasp of vocabulary, but a very limited ability to actually communicate in English. Many words and symbols are mastered, but functions, operations, and rules are not. The primary reasons for this universally significant gap between time spent and benefits gained are likely attributable to the usefulness of English in Korea and periodic instruction.

Over the course of nearly two years the author had the opportunity to study the Korean language periodically for more than a thousand classroom hours. At the end of this period his linguistic ability was very limited and basic conversations were difficult, if not impossible. The gap between theory and practice was tremendous. Though these classroom hours of study were not without profit, fluency began when the author was immersed in the culture and found it necessary to speak Korean regularly to survive.

These two cases illustrate that language learning is not only progressive, but that fluency usually requires constant usage and practice. The similarities between US math students and Korean English students are striking. Both groups study diligently over long periods of time, yet few reap lasting benefits from their study. The frustration of novice language speakers mirrors the frustration of novice mathematicians. The fatigue factor in understanding seemingly useless abstractions, translating, and interpreting cause many students to despair and retreat. Those who cross the mystical "hump" of fluency find that the remaining learning experiences are natural and enjoyable.

Teaching Math as a Second Language

How can students be realistically immersed in math? The key to increased math learning may well rest in parents and teachers "speaking" useful math concepts throughout the day in a variety of situations.

Preschoolers

Parents and preschool teachers should be encouraged to make a conscious effort to include number and math concept conversations with their toddlers and preschoolers. Just as language ability is enhanced through long-term exposure, math ability will likely increase through conversation and play involving number concepts.

Math operations suitable for preschoolers:

Counting	Sorting	Arranging
Distributing	Sharing	Valuing

Games that utilize dice strongly reinforce counting and fundamental math functions. Conversations with preschoolers should include relevant discussions involving numbers, fractions, and ratios. Accountability for "right" answers among preschoolers should be marginal. "Fuzzy" thinking in a zone of proximal learning often proceeds understanding. Children should be allowed to play and experiment with number language just as they do with other verbal language elements.

Early Childhood

Children in elementary schools should encounter useful math throughout the day in the context of the overall curriculum. Elementary teachers who develop the habit of including numbers and math concepts in their daily dialogue with students will likely enhance math acquisition. The recommendations for preschoolers continue to apply and may be expanded in the following suggestions:

- Speak in math concepts: half a pizza, one-third glass of milk, a quarter-way down the hall, twice as much, three times as many, and so on.
- Count things out loud and point out patterns in the presence of learners.
- Estimate everything! How much? How far? How long? How big?
- Compare things: More? Less? Longer? Shorter?
- Describe and rank things with numbers: If 1 = white and 10 = black, what shade is this?
- Build "clocks" with something beside 60 units.
- *Speak* math before *writing* math.
- Have math conversations involving predominately old ideas, but continually add new expressions.
- Create new ways to use numbers. Make number cookies!
- Repeat instances of "fuzzy" number logic until rules emerge.

Focused Math Classes

Concentrated math instruction should focus on relevant, real-life math situations. Math learners benefit when equations are considered from a subject and verb approach. The subject element is the reality part of the equation that makes it have sense to the learner. Absence of a subject in a sentence *or* equation leads to misunderstanding and confusion. The verb in an equation is the action taking place in light of the subject. For beginning mathematicians the "subject" and "verb" in a math problem are indispensable links to their native tongue. The more fluent the student is in math, the less reliant he or she will be upon subjects and verbs.

Most "non-math" people effectively quit learning math when it ceased to be personally relevant. For many this occurred when numbers were replaced with letters from the alphabet. At this point math began to focus upon distant abstractions that failed to make contact with *their* real world. Algebra and advanced math often become incomprehensible when fluency is weak and subject and verb clues are absent.

Realistic Expectations Regarding Fluency

Math probably owes its existence to its ability to function as a tool for survival. While theories regarding our innate ability to use math and contemplate a numerical infinity remain speculative, survival and relevance issues in math and language usage are evident.

While in South Korea the author discovered that most people master only the amount of language they need to survive and find satisfaction in the environments where they live and work. The average South Korean's failure to become fluent in English while living in Korea is obvious: It serves no useful purpose! The reverse is true with regard to expatriates learning Korean. There are natural limits to the language one learns which are predicated upon survival and/or enjoyment.

The language of mathematics is no exception to this rule. Students and adults use and remember that which they need or enjoy and forget the rest. The fact remains that most can survive in today's world without math fluency beyond basic addition, subtraction, multiplication, and division. If communication in higher math is ever seen as a necessary part of survival or a source of enjoyment, expanded learning will take place. The expectation of highly developed mathematicians being the norm in our culture is not realistic until such math becomes needed and is woven into the fabric of the average student's life.

Theoretically, no language learner becomes completely fluent in *all* aspects of language. The possibilities of letters making words and words making sentences, like numbers, are infinite. Specialized areas have discreet vocabularies. Medical language is an excellent example of specialized language that the average person fails to comprehend even though it is in his or her native tongue.

Parents and teachers should continue to remember that for the average student math must be an effective means of communicating needed information or having fun, not an end in itself. Math language and functionality go hand in hand. Languages that fail to communicate real ideas become gibberish of the highest order. Students who have "survived" without math speech prior to their formal education will not likely see its immediate usefulness. Frequently these students enter school ignorant of the language of math and are expected to begin mastering basic, abstract conversation (verbal and written) within a very limited time.

In truth, we are engaged in a sort of bilingual struggle whether we like it or not. The task of teaching children the language of math should be a comprehensive endeavor, not an isolated foray into a theoretical land of abstractions. Love of math for the sake of math usually comes to those who reach an advanced level of fluency. $E=mc^2$ is a wonderful and insightful idea…if you speak the language.

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