

## What is Math?

T. Gilsdorf, September 11, 2018

---

---

---

---

---

---

---

---

### Before we begin

- This is a talk mainly about mathematics and culture (ethnomathematics) and connections with communication.
- Our 2018 Fleming Speaker, Dr. Anna Sfard will discuss mathematics and education, and connections with communication.
- So, you may see some similarities in statements, but coming from two distinct viewpoints.

---

---

---

---

---

---

---

---

## What is Math?

- Let us look at two examples:
- Example 1: Making Aebleskivers. See the handout.
- A summary of the process: We must know something about **numbers**. We must **measure** some quantities. We mix certain ingredients together to form something new (batter), thus, we **design** something new. We must recognize, that is, **identify** the correct consistency of the batter. If we wish to share the recipe or teach someone how to make aebleskivers, we must **explain** it.

---

---

---

---

---

---

---

---

### Aebleskivers



---

---

---

---

---

---

---

---

### Example 2, carpeting a room

- We must know something about **numbers**. The information might have come from a **measurement** of a room. We recognize, that is, **identify**, a rectangular shape. We use the information to create an equation, that is, we **design** something new. If we want to show our work, or teach someone how to solve such a problem, we **explain** it.

---

---

---

---

---

---

---

---

### What is Math?

- Thus, if we are willing to agree that solving an equation is mathematics, then we must be willing to agree that making aebleskivers also involves mathematics.
- (Alan Bishop, 1988) proposed a definition of mathematics as a set of activities.

---

---

---

---

---

---

---

---

### What is Math?

- **Number (counting).**
- **Measurement.**
- **Identify.**
- **Design.**
- **Play.**
- **Explain.**
- These are usually referred to as “Bishop’s Six”.

---

---

---

---

---

---

---

---

### How do we know if someone from another culture knows something about mathematics?

- There are some obstacles, like language.
- There are some other considerations, like:
- (Marcia Ascher, 1991): Most cultures do not consider mathematics to be an independent discipline.
- People from distinct cultures interpret and express mathematics in distinct ways (ethnomathematics). In particular, an understanding of mathematics can be expressed without the use of typical Western mathematical terminology.

---

---

---

---

---

---

---

---

### Some methods

- Direct Observation:
- (Jacques Soustelle [1937], 1993): Observed Mesoamerican traditional artists, noting reversal of patterns to create symmetric patterns, precise measurements.
- Interviews:
- (Miwa Takeuchi, 2018): Interviews with low income Filipino immigrant parents in Japan, regarding learning mathematics in a multilingual setting.

---

---

---

---

---

---

---

---

**Interviews**

(Gary Urton, 1997): Interviewed traditional Inca weavers regarding use of number, thread counts, symmetry, etc.  
See the table of thread counts of a traditional Inca weaving product.

number of parts (threads per part)	section name
4 (2x)	stiman
3 (3x)	ch'aska
40 (2x)	karutu
10 (2x)	ch'aska
10 (2x)	ch'aska
3 (3x)	ch'aska
40 (2x)	ch'aska
3 (3x)	ch'aska
10 (2x)	ch'aska
45	
90 (2x)	Champi / saucay
45	
3 (3x)	ch'aska
10 (2x)	ch'aska
3 (3x)	ch'aska
20 (2x)	ch'aska
3 (3x)	ch'aska
10 (2x)	ch'aska
3 (3x)	karutu
40 (2x)	ch'aska
4 (2x)	stiman

---

---

---

---

---

---

---

---

---

---

**An Inca textile example**




---

---

---

---

---

---

---

---

---

---

**Methods of determining if a person knows a mathematical concept.**

- Analysis of rules or procedures:
- (Marcia Ascher, 2002): Analysis of a dice game of the Cayuga culture. (TG, 2012): Analysis of a dice game of the Ojibwe culture.
- Conclusion: outcomes with lower probabilities are generally worth more points (outcomes with higher probabilities are generally worth fewer or no points).

---

---

---

---

---

---

---

---

---

---

### Examples of math as it relates to schooling.

- (TG, 2011): Interviewed 18 traditional artists of the P'urhépecha culture (central Mexico), regarding their use of mathematics in creating art, and its connection with mathematics they learned in school.
- Of the eighteen artists interviewed, nine had attended at most through elementary school, and of those nine, five had never attended any school.
- All five who never went to school insisted they know nothing about mathematics.
- I observed an understanding of concepts of symmetry, complex thread counts, and precise measurements without rulers, by way of direct observation and interview questions.

---

---

---

---

---

---

---

---

### P'urhépecha Art examples



---

---

---

---

---

---

---

---

### P'urhépecha Art examples



---

---

---

---

---

---

---

---

### More examples of expressing mathematics

- Does understanding mathematics require complex counting?
- **Example:** Warlpiri of Australia: (Brian Butterworth and Robert Reeve, 2008): Warlpiri counting: Singular (jinta), dual plural (-jarra, jirrama), and greater than dual plural (jirrama manu jinta): "One, two, many".
- (Marcia Ascher, 2002): The Warlpiri kinship system utilizes calculations based on non-abelian group operations. In fact, the Warlpiri kinship system is mathematically equivalent to the dihedral group of symmetries of the square.
- Conclusion: Complex counting systems are not necessary for understanding nontrivial mathematics.

---

---

---

---

---

---

---

---

### Summary of observations

- Mathematics is best defined as a set of activities (Bishop's Six).
- A person can understand nontrivial mathematical concepts independently of the level of formal schooling.
- A person can understand nontrivial mathematical concepts without the necessity of a complex counting system.
- What do all of these have in common?
- **They all have to do with mathematics as a form of communication.**

---

---

---

---

---

---

---

---

### Connection to Dr. Sfard's research

- (Anna Sfard, 2007): The learning of mathematics is closely related to language development.
- Dr. Sfard proposes that mathematics be taught in schools within the context of mathematics as a form of communication.

---

---

---

---

---

---

---

---

Thank you for your  
attention!

gilsd1te @ cmich.edu

---

---

---

---

---

---

---

---

References

- Ascher, Marcia. *Mathematics Elsewhere*. Princeton University Press, 2002.
- Ascher, Marcia. *Ethnomathematics: A Multicultural View of Mathematical Ideas*. Brooks/Cole, 1991.
- Bishop, Alan. *Mathematical Enculturation, A Cultural Perspective on Mathematics Education*. Kluwer Academic Publishers, 1988.
- Butterworth, Brian, Reeve, Robert. Verbal counting and spatial strategies in numerical tasks: Evidence from Indigenous Australia. *Philosophical Psychology*, 21, no. 4, August, 2008, 443 - 457.

---

---

---

---

---

---

---

---

References

- Gelman, Rochel, Butterworth, Brian. Number and language, how are they related? *Trends in Cognitive Science*, 9, no. 1, January, 2005, 6 - 10.
- Gilsdorf, T. Ethnomathematics of the Purépecha. *Jacobs Research Grants*. <http://depts.washington.edu/jacobs/f/pastRecipients.html>, 2011.
- Gilsdorf, T. *An Introduction to Cultural Mathematics, with Case Studies in the Otomies and Incas*. Wiley & Sons, 2012.
- Sfard, Anna. When the rules of discourse change, but nobody tells you: Making sense of mathematics learning from a commognitive standpoint. *Journal of Learning Sciences*, 16, no. 4, 2007, 565 - 613.

---

---

---

---

---

---

---

---

References

- Soustelle, Jacques. *La famille Otomi - pame du Mexique Central*, Travaux en Mémoires de l'Institut d'Ethnologie. 1937. Translation into Spanish: *Centro de Estudios Mexicanos y Centroamericanos*, Fondo de Cultura Económica, 1993.
- Takeuchi, Miwa. Conversations for life: Transnational families' mathematical funds of knowledge. In T. Bartell (Ed.), *Toward equity and social justice in mathematics education*, 2018, 127 - 143.
- Urton, Gary. *The Social Life of Numbers, A Quechua Ontology of Numbers and Philosophy of Arithmetic*. University of Texas Press, 1997.

---

---

---

---

---

---

---

---