

Mayan Mathematics: Connecting History and Culture in the Classroom

Joseph M. Furner

Abstract

This paper discusses incorporating historical and cultural connections into one's teaching to bridge cultural gaps, foster appreciation for diversity, and promote sound understanding of mathematics and other cultures' contributions to mathematics. Studying civilizations such as the Maya helps many young learners appreciate their heritage and the evolution and logic of today's mathematics.

Discussion And Reflection Enhancement (DARE) Pre-Reading questions:

1. What part of the population at the school(s) where you live/work is ELL?
2. How can using history and cultural components of our students help us better reach them in the teaching of mathematics?
3. Does integrating cultural connections better help to interest students when teaching mathematics?
4. What are some challenges or barriers to incorporating history in the teaching of mathematics?

“DARE” Post-Reading questions appear at the end of the article. This article (without DARE questions) originally appeared in Fall 2008 *Noticias de TODOS*.

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Just south of West Palm Beach, FL, in the City of Lake Worth, is one of the largest populations of Mayans outside of México and Guatemala. Schools like Highland Elementary School in Lake Worth on average have 93% English Language Learners (ELL), many whose parents are from México, Guatemala, and Central America originally, but with their children born here in South Florida. It is important that schools recognize the heritages of their populations now in the USA. Math can be made more meaningful for these ELL students and all students when educators make meaningful historical and cultural connections to the math they are learning while valuing the heritage of a large population of the students.

The study of the cultural and historical contexts of ancient civilizations can be an intriguing way to introduce students to the evolution and logic of today's mathematics (Bidwell, 1993; Furner, Doan-Holbein, & Scullion-Jackson, 2000; Furner, 2008; Zaslavsky, 2002; Farmer & Powers, 2005). While people in Europe were struggling with the Roman numeral system whose symbols lacked both representation for zero and a calculated correlation with the numbers they represented, the Mayans in Mesoamerica were developing a system which modern day scholars find to be sophisticated, beautiful, and logical (Gilbert, 2006; Hand Clow, 2007). The Mayans invented a counting system which could represent very large numbers by using only 3 symbols: a dot, a bar, and a shell symbol for zero (see Figure 1).

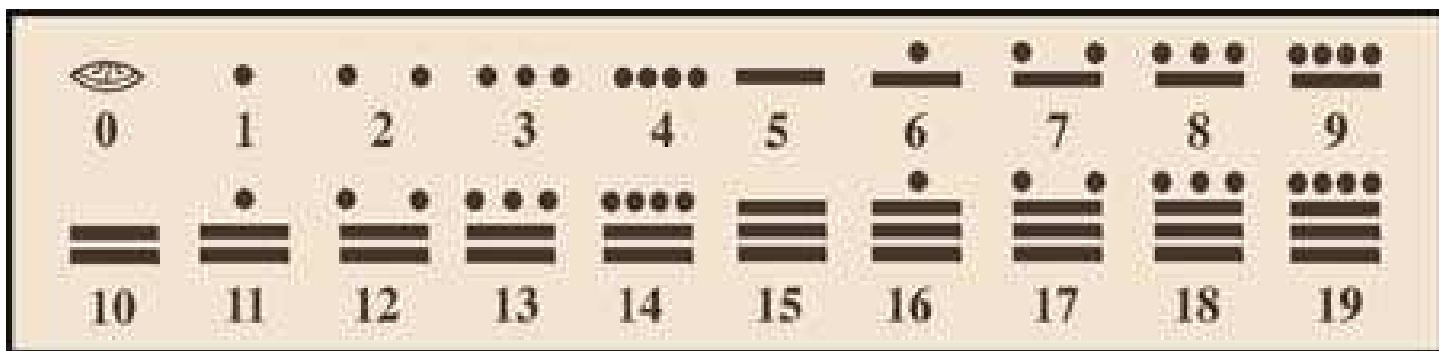


Figure 1.

Mayan Number base-20 System

The following lesson can serve to bridge historical and cultural connections while our students learn mathematics:

Mayan Mathematics Lesson Plan

The following are suggestions for incorporating the historical context and symbolic notation system of the Mayans into a teaching unit (see Figure 2). The lessons might be taught from an interdisciplinary, integrated curriculum perspective, and modified to meet age appropriate needs of the students. This lesson too can serve in reinforcing concepts related to place value and number systems with different bases in mathematics. The strategies specifically include effective learning techniques for ELL students or English for Speakers of Other Languages (ESOL) but also brings to the learning meaning for all students involved.

The students create base-20 Mayan counters with corn kernels and popsicle sticks as the teacher guides and questions them. The students make base-20 Mayan corn stick counters to learn about place value and base-20. The students glue corn kernels on popsicle sticks to make base-20 counters to learn about Mayan mathematics and place value.



Figure 2.

Students making base-20 corn stick counters

Objectives

Students will:

- (a) explore similarities and differences of number systems from other cultures, particularly the Mayan system.
- (b) calculate place value with base-10 and base-20 systems.
- (c) Reinforce student understanding of place value.
- (d) apply student technology skills.
- (e) develop an appreciation for the culture and math of the Mayans.

Menu of Motivation (Initiating) Activities

1. Pairs of students (one of which is an ESOL student) will take a web quest and visit websites to read about Mayan numerical systems.
2. Students view the video *Mystery of the Maya* (see References).
3. Students meet in discussion groups. Possible topics for discussion might be:
 - a. defining terms such as decimal system, non decimal system, place value.
 - b. describe similarities and differences between (among) systems.

Menu of Core Activities

1. Create Mayan manipulatives to use in Mayan calculations.
2. Calculate and solve problems using their Mayan manipulatives.
3. Create and solve coded puzzles (see Example 1).
4. Read literature which relates to cultural differences in mathematics (particularly Mayan Mathematics). Suggested books are *Arithmetic in Maya* and *Skywatchers of Ancient México* (see References).

5. Develop and refine discussion groups and paired activities. Possible questions:
 - a. Can you translate Mayan numbers into our numeral system?
 - b. How about translating our numbers into Mayan numbers?
 - c. Why do you think the Mayans chose a base-20 numeral system?
 - d. How does the Mayan system compare to that of the Egyptians or Romans?
 - e. Why do you think the Mayans chose a seashell to symbolize zero?
 - f. What symbol for zero would you choose? Why?
6. Practice writing Mayan numerals 0 to 100.
7. Write reflective essays on website visits.
8. Create a fictional number system with a unique base and symbols.
9. Keep a journal of math activities and ideas.
10. Illustrate Mayan mathematics with a selected artistic medium such a magazine photo collage, penciled sketch, etc.
11. Locate additional books and websites about Mayan math and other math systems.
12. Invite parents and selected community guest speakers who are knowledgeable about the Mayan or other number systems (e.g., Lake Worth, FL has the Guatemalan-Mayan Center).

The lesson plan suggestions include provisions which are appropriate for all students/grade levels and especially ELL students. Realia and demonstrations develop vocabulary through WebQuests, literature, and study of artifacts of the culture. Prior knowledge and background are enriched

Example 1: Can you translate this into an equation using our base-10 number system?

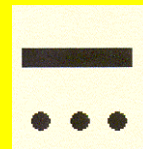


Example 2: Can you write the number 103 using the base-20 Mayan Number system? (Remember to write from top to bottom, group in 20's, and use Mayan symbols.)

ANSWERS:

Example 1: $6 + 7 = 13$

Example 2: (5 twenties and 3 ones; remember to leave a little space between the twenties place and the ones place)



through the study of the historical context of the evolution of number systems while developmentally appropriate activities using manipulatives provide concrete examples which reinforce concept development.

Exploring various media such as drawing, painting, sketching, and creating collages addresses learning styles and promote creativity. Discussion about readings, web quests/field trips (actual or Internet), activities, and guest speakers prompt analytical and critical thinking as well as metacognition by encouraging students to verbalize their perceptions of learning. Interdisciplinary and cultural connections are established through historical and literary readings, discussions of economic and marketplace functions, and explorations of artistic and scientific contributions such as the Mayan calendar.

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Map of Ancient Maya



The above map is reprinted (with permission) from www.mesoweb.com/resources/maps/crystal_map.html

“There is no conflict between equity and excellence.”

—Principles and Standards of School Mathematics (NCTM, 2000, p. 5)

Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. What might be some specific ways in which teachers can reach a particular ELL population based on their cultural background in mathematics? i.e. teaching Mayan math to children of Mayan descent (México, Guatemala, and Central America). Choose a cultural population and create some math activities around that particular culture.
2. How might you adapt one of the examples from the movie/DVD *Mystery of the Maya* for use in your classroom?
3. In an effort to reach “all students” in our classrooms today, how can using history and culture help to create stronger mathematics students in our ever-growing globally competitive world and provide equity for all learners? What are other methods?
4. Victorian-era math professor James W. L. Glaisher stated: “I am sure that no subject loses more than mathematics by any attempt to dissociate it from its history.” How can mathematics teachers incorporate more history into the teaching of mathematics?
5. Visit the website <http://www.lost-civilizations.net/mayan-history.html> and create a lesson plan/activity to use in the classroom to integrate Mayan culture and mathematics.
6. Interdisciplinary and cultural connections are established through historical and literary readings, discussions of economic and marketplace functions, and explorations of artistic and scientific contributions such as the Mayan calendar. Explore some of the special occurrences the Mayans believed would happen in 2012.
7. The Mayans are well known for their expertise in astronomy. In fact, their calendar system by some scientists is believed to be more precise than what we currently use today. With the emphasis on strengthening math, science, and technology education, can we infuse more cultural connections like Mayan math into the curriculum to better reach minority students in the STEM (science, technology, engineering, and mathematics) fields?
8. Why do you think our society has recently given increased attention and emphasis on reaching the larger ESOL populations in our schools?

“DARE to Reach ALL Students!”

