CONNECTING MATHEMATICS WITH ITS HISTORY

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The purpose of this paper is to illustrate how historically based activities can be used in the teaching and learning of mathematics. Some illustrative examples of connecting mathematics with its history are presented. It is not a comprehensive paper, but is rather intended to discuss ideas that the teachers can use or modify depending on the particular needs and abilities of their learners at various mathematics levels. It is hoped that teachers can get more instructional insight from reading this paper.

INTRODUCTION

The history of mathematics, including its principles, procedures, and personalities, is often one of the most neglected areas in our teaching of mathematics. However, one of the specific aims for Curriculum and Assessment Policy Statement (CAPS) for mathematics in South Africa is to show mathematics as a human activity by including the history of mathematics (Department of Basic Education, 2011). Internationally, there is an overwhelming agreement among mathematics educators on the importance of introducing history of mathematics into the school mathematics curriculum. In this regard, the National Council of Teachers of Mathematics (NCTM) initiated a professional development scholarship emphasizing the History of Mathematics (NCTM, 2011). The goal of NCTM is to: *provide financial support for:*

- *completing credited course work in the history of mathematics,*
- *creating and field-testing appropriate classroom activities incorporating the history of mathematics, and*
- *preparing and delivering a professional development presentation to colleagues. (NCTM, 2011)*

Quite simply, these statements affirm the importance of connecting mathematics with its history.

According to Swetz (1994), many learners' think of mathematics as a very dull subject. The only reference to history in the mathematics class is by those teachers whose enthusiasm for mathematics has extended their knowledge to its historical development. Even then, reference to the history of mathematics is done at leisure depending on the teacher's pedagogic style.

There are various strategies that can be used for introducing a historical perspective into the teaching of mathematics:

- Using historically based films or videotapes in classroom instruction.
- Assigning classical or historical problems and noting their origins or significance.
- Obtaining information about the origins and meanings of mathematical terms, symbols, and words.
- A consideration of the people of mathematics – their lives and work of selected mathematical personages.

In this regard, two examples historically based activities will be shown in this paperm. It is not a comprehensive paper, but is rather intended to discuss ideas that the teachers can use or modify depending on their particular needs and abilities of their students at various mathematics levels.

There are various ways in which the examples cited in this paper can be conducted. This will depend on individual teacher's pedagogical preference. For instance, a single activity can be undertaken by the class as a whole; or learners can be divided into small groups for a specific activity or single one learner can undertake individual activities, either as an investigation or project. Each example provided in this paper begins with a historical introduction to the topic. Although much of the work can be completed during class time, all activities in this paper include suggested exercises at the end to test learners' understanding. Teachers' journals and periodicals occasionally carry articles on the history of mathematics and its use in teaching. And so for more activities, teachers are advised to consult them, and more importantly, books on the history of mathematics.

EXAMPLE1: FINDING THE PRODUCT OF NUMBERS

INTRODUCTION

In Medieval Europe the possession of a computing device such as an abacus and knowledge of the rules necessary to use it were limited to a few people, called masters of abacus or reckoning masters. Many of these men were merchants, and it is from this group that the concept of a professional mathematician arose. The master's jealousy guarded their special knowledge, sharing only with a few selected apprentices. These apprentices paid handsomely to learn the skills and arts of a mathematician. Gradually, from the 13th century onward, a new set of symbols; the Hindu-Arabic numerals were used to represent numbers. Now almost everyone could learn how to perform numerical calculations. We are going to examine one of the new ways people in the 15th century learned to do multiplication.

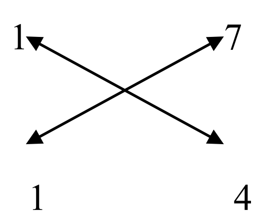
ACTIVITY 1: (MULTIPLICATION ALGORITHM OF TWO-DIGIT NUMBERS)

Consider the table given below:

1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36	42	48	54	60
7	14	21	28	35	42	49	56	63	70
8	16	24	32	40	48	56	64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

This table of numbers is known as Pythagorean table. Historically it was used among others to find the product two numbers. For example, the products of the numbers in the first row and first column can be read at the intersection of the row and column e.g. 7 x 6 = 42. Furthermore, the diagonal line on this table represent the fact that half of the table above the line is the same as half the of the table below the line (Symmetrical).

Now, let’s consider another multiplication algorithm of two-digit numbers from Italia called per croxeta, meaning “by the cross”. Let’s find the product of 17 and 14.



PROCEDURE:

First multiply 4 by 7. (A: 28). Write down the 8 and retain the 2. "by the cross", multiply 1 by 4 and 7 by 1. (A: 4 and 7), Add the results. (A: 4 + 7 = 11). Add the 2 retained from the previous computation. (A: 11 +2 = 13). Write the 3 to the left of 8. (A: 38). Finally, multiply the 1's together. (A: 1 + 1 = 2).Add the 1 retained from the previous computation. (A: 1 + 1 = 2).Write this 2 to the left of 3. (A: 238)

ACTIVITY 2: (Finding the product of numbers with more digits.)

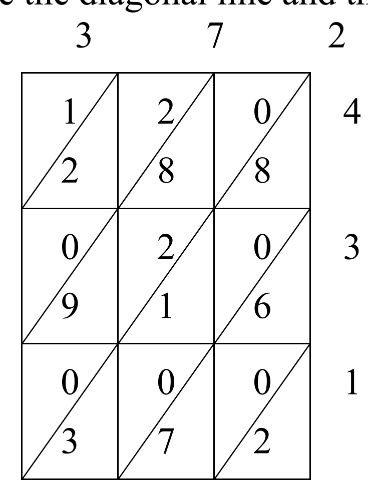
15th century mathematics employed several different schemes or algorithms in this regard. The word 'algorithms' comes from the Latin rendering of the name of the great Arabic mathematician al-khwarizmi (Ca. 800-8470), the author of the principal works that exposed Europians to the Hindu-Arabic numerals and their methods of computation. One of the most popular 15th century algorithms for multiplication was the gelosia method.

PROCEDURE:

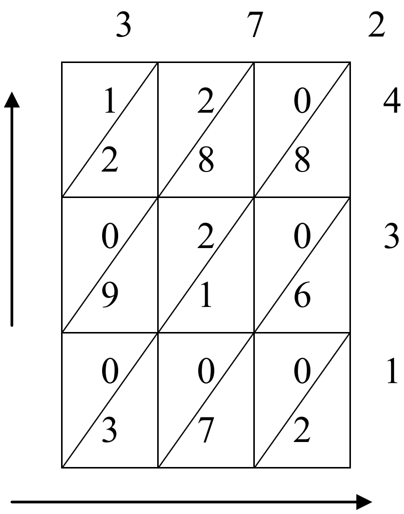
(a) Finding the product of 372 × 431:

- One number (372) must be written across the top of the grid. The other number (431) is written down the right side of the grid.

- Compute the product of each row number and column number and write in the particular cell shared by the row and the column. Write the individual products with their tens digit above the diagonal line and their units digit below the line.



- Starting at the lower right corner of the grids, sum the entries along each diagonal path within the grid. Write the units result at the end of each diagonal path and carry the tens digit to the path above and proceed in the same manner. When you are finished summing, read the product along the left and bottom edge of the grid: 160,332



EXAMPLE 2: NUMBER SHAPES

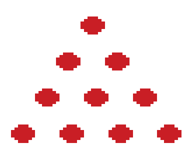
Greece produced great mathematicians whose work cannot be fully covered here. One of such great mathematicians is Pythagoras, who was born about 580 B.C. on the Island of Samos in the Aegean Sea. His teachings attracted student disciples who formed into a brotherhood of fraternity. These disciples were called Pythagoreans. They were obsessed with the concept of numbers; for the "all was number". They used geometric shapes to represent various whole numbers. Today such numbers are called polygonal or figurate numbers. These are numbers which are associated with geometric figures.

PROCEDURE:

Let's consider three classes of figurative numbers:

- Triangular numbers: These are numbers represnted by a triangle of dots. We will denote it by T_n, where n indicates the order of the number, i.e $T_4 = 10$

Example: $T_4 = 10$



This is number 10. (Count them. Rather, what exists is a system of numeration, presently the decimal system of positional numeration.

- Square numbers: these are numbers represented by a square of dots, denoted by S_n,

  Example: $S_2 = 4$

o	o
o	0

- Oblong numbers: These are numbers represented by rectangular dots, that has one more column than in rows. They are denoted by 0_n,

  Example: $O_4 = 20$

o	o	o	o	o
o	o	o	o	o
o	o	o	o	o
o	o	o	o	o

1. Complete the table given below to find the next few triangular, square, and oblong numbers:

	Square Number	**Triangular Number**	**Oblong Number**
1st			
2nd			
3rd			
4th			
30th			

2. Use the table above to find the following:

   (a) T_n = nth triangular number (Hint: draw a rectangle made up of two triangular numbers of the same size).

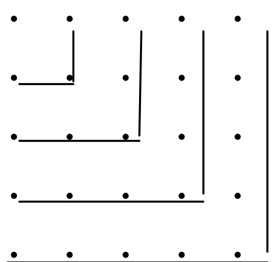
   (b) $S_n = T_n + T_{n-1}$

   Verify that the sum of the two consecutive triangular numbers is a square number, and find S_n = nth square number).

(c) 0_n = nth oblong number.

(d) The sum of the nth oblong number and the nth square number.

3. Consider a pattern found in a square number:



The number represented by each **L** configuration is an odd number. Use this pattern to find the sum on n consecutive odd positive integers.

4. The Greek mathematician Archimeded (287 – 212 B.C.) developed a formula for the sum of the square numbers:

$S_1 + S_2 + S_3 + \ldots + S_n = \frac{n\,(n+1)(2n+1)}{6}$. Verify this formula.

EXCECISES:

(a) Complete the table below to help you investigate other number shapes. You should find that there are many relationships among the various number shapes. Look for vertical and horizontal patterns that can help you.

	1st	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**
Triangular	1	3	6	10			
Square	1	4	9				
Pentagonal	1	5	12				
Hexagonal	1	6	15				
Heptagonal	1						

CONCLUSION

Teachers agree in principle, but many of them are concerned about adding yet another unit to an already crowded curriculum. It is my belief that including a historical dimension in the mathematics classroom does not mean replacing any part of the mathematics curriculum. We can include the historical perspective in our mathematics classroom lessons naturally. We do not have to view this as something extra, but rather as a complement to mathematics learning, a background, a perspective that helps clarify the topic under discussion. Students must clearly see the connections between the mathematics they are studying and are relevant historical facts.

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