

Elementary Math Focus Day January 26, 2018 – “Rich Investigations!”

Session: Math Mentor Teacher: Fred Harwood

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@HarMath

“Sum of the Square” Puzzles

Look at the following squares containing whole numbers:

Study the example and determine how to find the ‘sum of the square’ shown in the boxed number below right.

1)

4	7	11
3	5	8
7	12	9

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Using the same procedure discovered above, determine what whole number goes into the framed box. This number is called the sum of the square.

2)

11	4
3	23

Find the sum of the given squares below:

3)

7	13
25	8

4)

8	8
8	8

Determine the missing numbers of the square from the given information:

5)

		29
14	15	22
21	21	

6)

		10
		9
9	10	

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Integer Challenges:

Name: _____ Date: _____

Speed Drills: Add these 8 integers as quickly and cleverly as possible

1.) $-2 + 2 + 2 + -2 + -2 + -2 + 2 + -2 =$

2.) $-8 + 8 + 5 + -8 + -8 + 8 + 8 + 8 =$

3.) $1 + 1 + -1 + 2 + -1 + -2 + -2 + 1 =$

4.) $5 + 5 + -5 + -5 + -5 + -5 + 5 + -5 =$

Boggling Integer Challengers:

Record as many combinations of the 8 numbers to make the indicated totals

$-6 \quad 8 \quad 2 \quad -5 \quad -7 \quad 3 \quad -3 \quad 4 \quad = \quad 0$

$8 \quad -2 \quad 5 \quad -3 \quad -8 \quad 6 \quad -4 \quad 7 \quad = \quad 0$

$-3 \quad 5 \quad 7 \quad -8 \quad -2 \quad -3 \quad 6 \quad -5 \quad = \quad -1$

The 9 questions on the line's right each have one of the 9 answers to the left

0 2 7 | $-15 + 7$ $-22 + 8 \div -2$ $-2 \times -4 + 2 \times 4$

-26 -9 -8 | $-24 \div 4 - 6$ $-28 \div -7 + 3$ $-5 \times 3 + 6$

-12 11 16 | $-6 + -7 + 15$ $20 + 3 \times -3$ $-4 \times 5 + 4 \times 5$

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The **Mathematical Etudes Project** aims to find creative, imaginative and thought-provoking ways to help learners of mathematics develop their fluency in important mathematical procedures. Procedural fluency involves knowing when and how to apply a procedure and being able to perform it “accurately, efficiently, and flexibly” (NCTM, 2014, p. 1). Fluency in important mathematical procedures is a critical goal within the learning of school mathematics, as security with fundamental procedures offers pupils increased power to explore more complicated mathematics at a conceptual level (Foster, 2013, 2014, 2015; Gardiner, 2014; NCTM, 2014). The new national curriculum for mathematics in England emphasises procedural fluency as the first stated aim (DfE, 2013). But it is often assumed that the only way to get good at standard procedures is to drill and practise them *ad nauseum* using dry, uninspiring exercises.

The **Mathematical Etudes Project** aims to find practical classroom tasks which embed extensive practice of important mathematical procedures within more stimulating, rich problem-solving contexts (Foster, 2011, 2013, 2014, 2017a, 2017b). Recent research (Foster, 2017a) suggests that etudes are as good as exercises in terms of developing procedural fluency – and it seems likely that they have many other benefits in addition. <http://www.mathematicaletudes.com>

Etude 1: I am thinking of four numbers. When I add every possible pair of numbers, I get the six answers: 2, 3, 4, 5, 6 and 7. What might my four numbers be?

Etude 2: Think of a 3-digit number where all the digits are different (like 735 for instance). Multiply your number by 7; multiply the product by 11; multiply this product by 13. What do you notice? I can instantly tell if you’ve multiplied your own 3-digit number correctly. How can I do it?

Etude 3: Notice $12 = 3 \times 4$ where all the digits are in order. $56 = 7 \times 8 \rightarrow 5, 6, 7, 8$
What is 15×823 ?

Can you find other ones that do this? Which ones did you come up with? Which ones were easier to do? Why do you think this? Which ones are harder? Are there strategies to help you find them without just guessing and checking?

Etude 4: Here are six fractions: $\frac{1}{6}, \frac{1}{25}, \frac{3}{5}, \frac{3}{20}, \frac{4}{15}, \frac{5}{8}$

I want you to add together as many of these six fractions as you like to get an answer that is as near to 1 as possible. You can use each fraction only once in any one expression.

Etude 5: Star Arithmetic:

$a * b$ means $a \times b - (a + b)$ therefore: $5 * 6 = 5 \times 6 - (5 + 6) = 30 - 11 = 19$ so $5 * 6 = 19$

Find: i) $3 * 3$ ii) $2 * 8$ iii) $12 * 15$ iv) $6 * (3 * 7)$ v) $6 * \underline{\quad} = 44$

vi) $\underline{\quad} * \underline{\quad} = 20$ vii) $\underline{\quad} * 6 = 99$ viii) $10 * \underline{\quad} = 161$ ix) $\underline{\quad} * \underline{\quad} =$

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Etude 6: Find the sum of the following numbers 6 different ways:
(Show with work how you did each one)

$$4 + 3 + 2 + 1 + 9 + 8 + 7 + 6 + 2 + 4 + 6 + 8 + 3 + 3 + 3 + 7 + 7 + 7 + 9 = \underline{\hspace{2cm}}$$

$$4 + 3 + 2 + 1 + 9 + 8 + 7 + 6 + 2 + 4 + 6 + 8 + 3 + 3 + 3 + 7 + 7 + 7 + 9 = \underline{\hspace{2cm}}$$

$$4 + 3 + 2 + 1 + 9 + 8 + 7 + 6 + 2 + 4 + 6 + 8 + 3 + 3 + 3 + 7 + 7 + 7 + 9 = \underline{\hspace{2cm}}$$

$$4 + 3 + 2 + 1 + 9 + 8 + 7 + 6 + 2 + 4 + 6 + 8 + 3 + 3 + 3 + 7 + 7 + 7 + 9 = \underline{\hspace{2cm}}$$

$$4 + 3 + 2 + 1 + 9 + 8 + 7 + 6 + 2 + 4 + 6 + 8 + 3 + 3 + 3 + 7 + 7 + 7 + 9 = \underline{\hspace{2cm}}$$

$$4 + 3 + 2 + 1 + 9 + 8 + 7 + 6 + 2 + 4 + 6 + 8 + 3 + 3 + 3 + 7 + 7 + 7 + 9 = \underline{\hspace{2cm}}$$

Etude 7: Confident Addition: Show different methods for confidently adding the following:

$$48 + 67 + 93 + 24 + 51 =$$

$$48 + 67 + 93 + 24 + 51 =$$

$$48 + 67 + 93 + 24 + 51 =$$

Etude 7: Counting Factors:

Find 3 numbers with exactly 7 factors.

Find 3 numbers with exactly 8 factors.

Find 3 numbers with exactly 36 factors.

(It is sufficient to show prime factorization of a number)

How can you generate a “large” number with exactly 7 factors.

How can you generate a “large” number with exactly 8 factors.

How can you generate a “large” number with exactly 36 factors.

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0	10	20	30	40	50	60	70	80	90	100
1	11	21	31 ∅	41	51	61	71	81	91	
2	12	22	32 °°°°°	42 °Δ¥	52 °°≈	62 °∅	72 °°°ΔΔ	82	92	
3	13	23	33 ΔΩ	43 ∂	53 Á	63 ΔΔ¥	73 †	83	93	
4	14	24	34 °ç	44 °°Ω	54 °ΔΔΔ	64 °°°°°°	74 °π	84	94	
5	15	25	35 *¥	45 ΔΔ*	55 *Ω	65 *≈	75 Δ**	85	95	
6	16	26	36 °°ΔΔ	46 °μ	56 °°°¥	66 °ΔΩ	76 °°∫	86	96	
7	17 ç	27 ΔΔΔ	37 π	47 ∂	57 Δ∫	67 ˘	77 ¥Ω	87	97	
8	18 °ΔΔ	28 °°¥	38	48	58	68	78	88	98	
9	19 ∫	29 ¬	39	49	59	69	79	89	99	

TEATHERBOARD ACTIVITY: The numbers inside of the bold black boxes have a symbol or symbols shown.

The rest of the squares do not have any symbols yet. Which ones can you figure out and what would be their symbol(s)?