Teaching Critical and Creative Thinking Skills Through Problem Solving in High School Math Classes

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Critical and Creative Thinking Program

Before we begin……a questionnaire!!

	Disagree	Somewhat Disagree	Somewhat Agree	Agree
1. I like math class.				
2. I enjoy learning new things in math.				
3. I always know how to approach new problems.				
4. I see math as useful to my future.				
5. I have learned things in my past math classes.				
6. When I start a problem I've never seen before, I try at least one thing to solve it.				
7. I know several problem-solving strategies.				
8. I have been taught problem-solving skills (ways to solve more than one kind of problem) in school.				
9. I want to do well in school.				
10. If I don't solve a problem on my first attempt, I will keep trying until I can get it.				

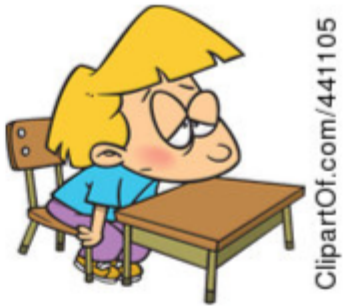
A Snapshot of my Students

- ~45 10th grade students
- Low level math class
- Preparing for MCAS

Question		Disagree	Somewhat Disagree	Somewhat Agree	Agree
1	I like math class.	3	9	18	10
2	I enjoy learning new things in math.	3	6	19	12
3	I always know how to approach new problems.	4	13	16	6
4	I see math as useful to my future.	0	3	22	13
5	I have learned things in my past math classes.	0	4	12	24
6	When I start a problem I've never seen before, I try at least one thing to solve it.	0	2	25	13
7	I know several problem-solving strategies.	4	9	19	8
8	I have been taught problem-solving skills (ways to solve more than one kind of problem) in school.	0	5	22	13
9	I want to do well in school.	0	0	7	33
10	If I don't solve a problem on my first attempt, I will keep trying until I can get it.	0	7	26	6

Students complain about math class because it's:

- not engaging
- not useful
- hard to understand
- made up
- in its own world



What can be done about this???

The research has shown benefits of different pieces…

Making Mistakes

Playing Games

Asking Questions

Explaining Yourself

Building Things

Seeing Different Points of View

I want to join them together!

What I did:

- Took Classes and did Research
- Singled out Skills
- Found Problem Situations
- Designed a Curriculum

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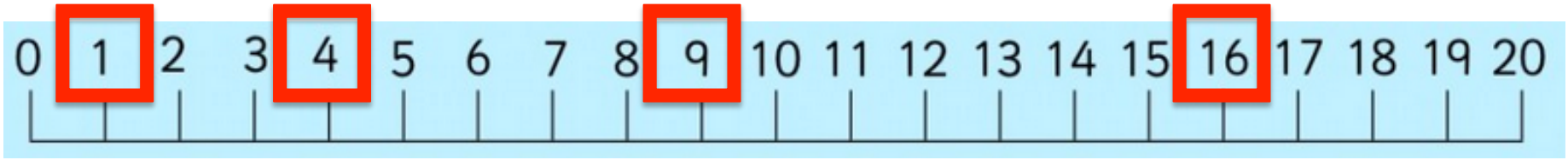
An example

There are 20 lockers in a row and 20 students.
The first student runs down the row of lockers and opens every locker.
The second student starts with locker #2 and closes every other locker.
The third student starts with locker #3 and opens or closes every third locker.
The fourth student starts with locker #4 and opens or closes every fourth locker.
This continues until all twenty students have taken a turn.

The Locker Problem



Factor Pairs of 12

1, 12

2, 6

3, 4

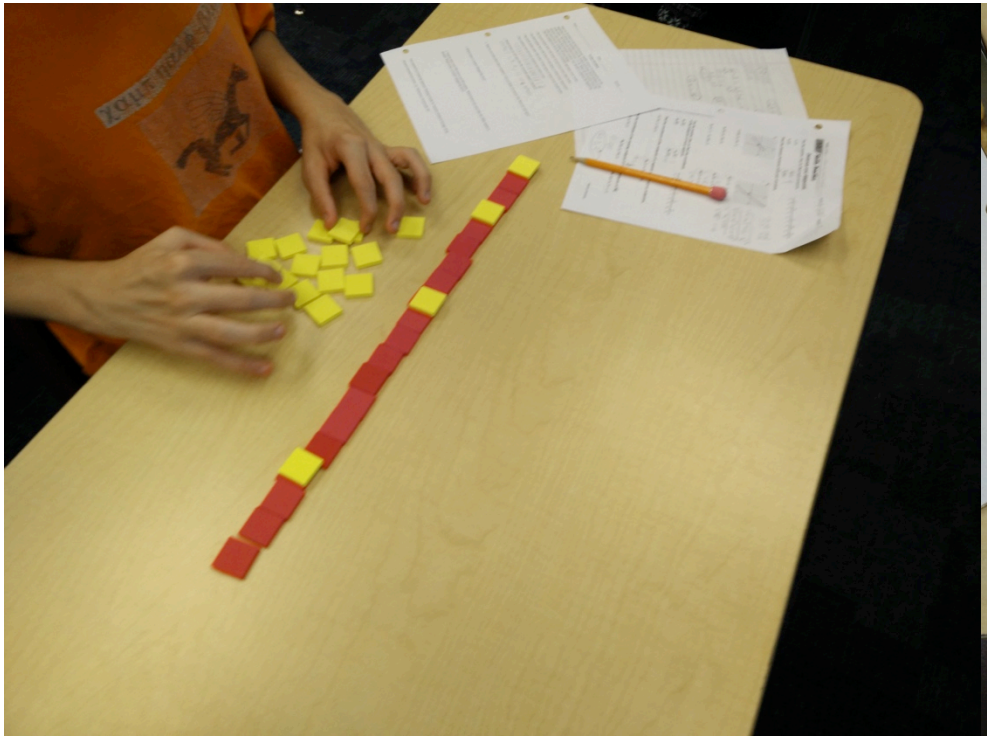
Factor Pairs of 16

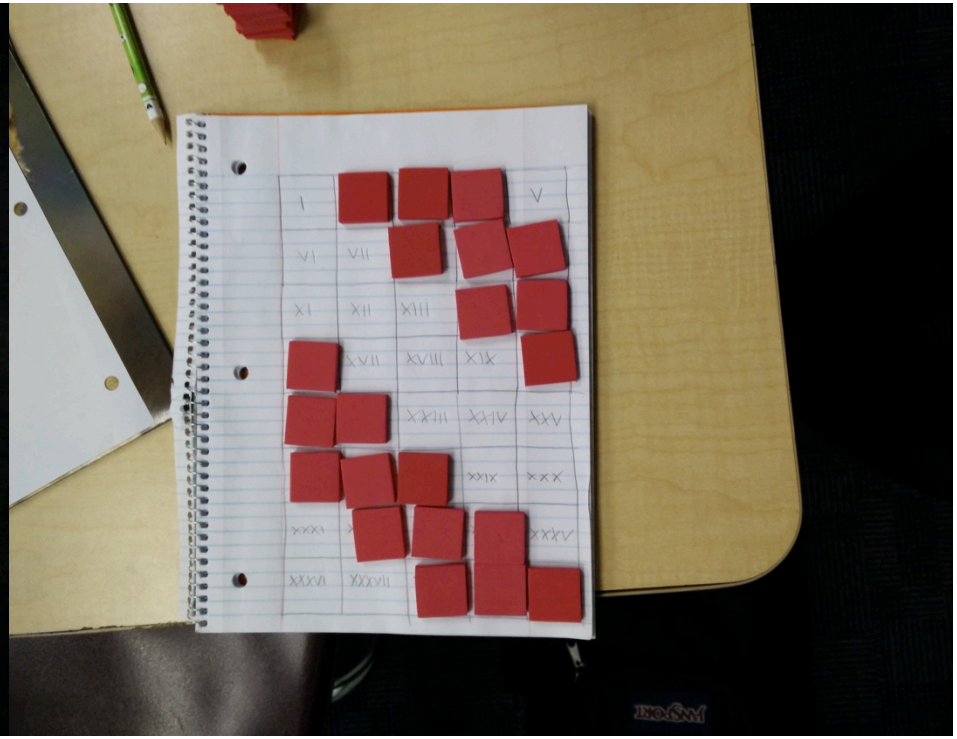
1, 16

2, 8

4, 4

Student examples from this problem:

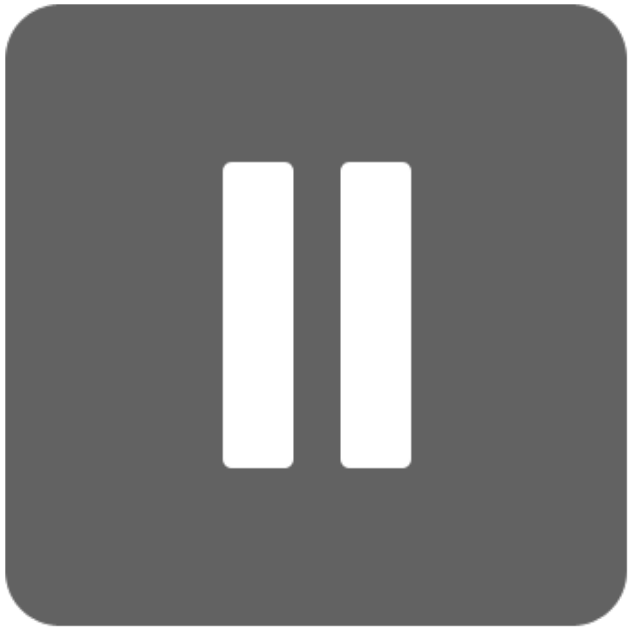




What I want them to Learn

- How to start a problem
- How to understand a problem
- Strategies to find patterns
- How to use patterns
- That they can do this
- Persistence

Pause for Questions



Another Problem

2 Quarters

1 Quarter and 1 Penny

2 Quarters and 1 Penny

1 Quarters and 2 Penny

3 Quarters

3 Pennies

2 Quarters and 1 Penny—Three Ways

1 Quarters and 2 Penny—Three Ways

3 Quarters—One Way

3 Pennies—One Way

3 Quarters and 1 Penny

2 Quarters and 2 Pennies

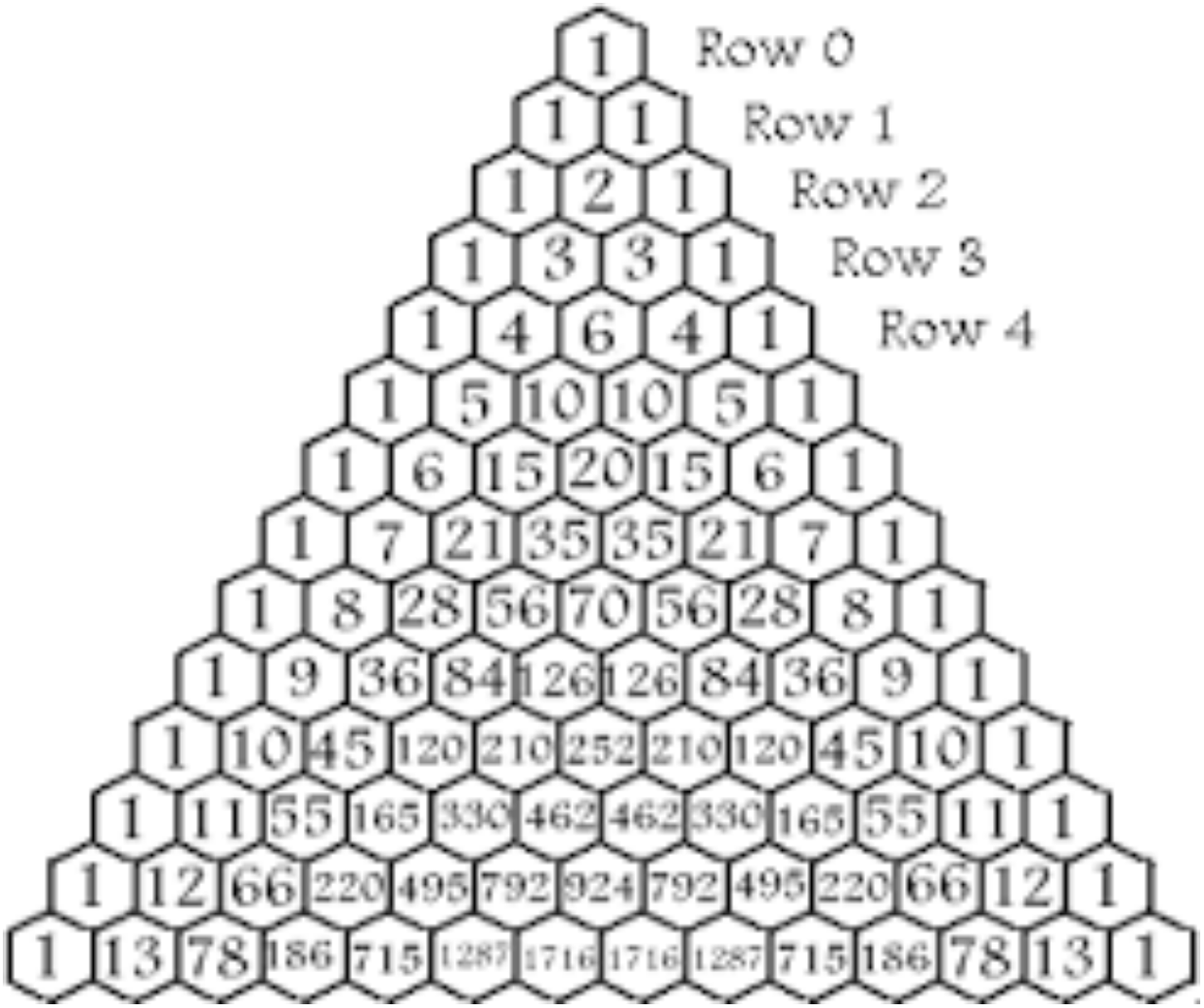
3 Quarters and 1 Penny—Four Ways

2 Quarters and 2 Pennies—Six Ways

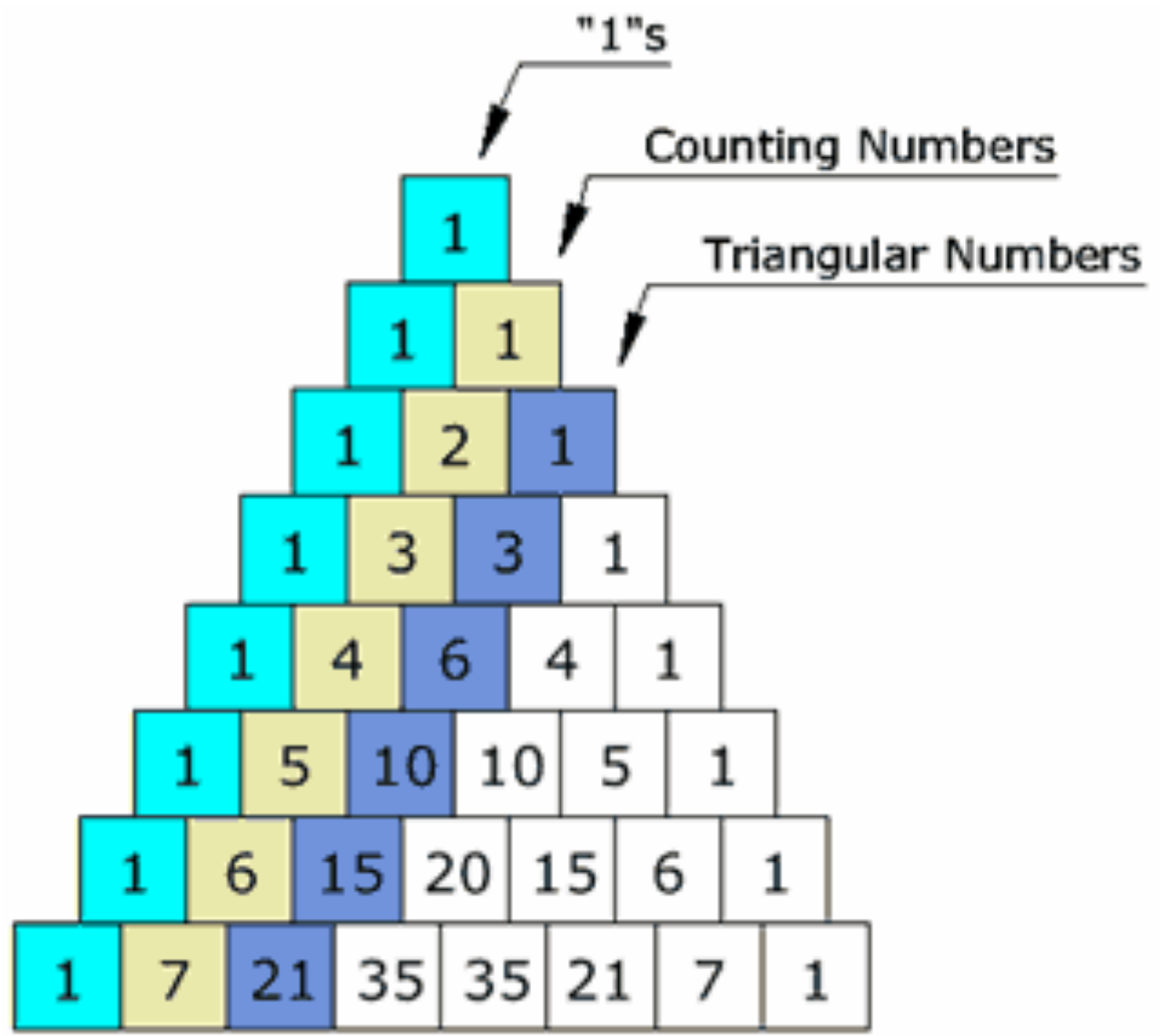
Fewer Coins

	1 coin total			1	1	
	2 coins total		1	2	1	
	3 coins total	1	3	3	1	
All Quarters	4 coins total	1	4	6	4	1 All Pennies

More Coins


Row 0
Row 1
Row 2
Row 3
Row 4
1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
1 6 15 20 15 6 1
1 7 21 35 35 21 7 1
1 8 28 56 70 56 28 8 1
1 9 36 84 126 126 84 36 9 1
1 10 45 120 210 252 210 120 45 10 1
1 11 55 165 330 462 462 330 165 55 11 1
1 12 66 220 495 792 924 792 495 220 66 12 1
1 13 78 186 715 1287 1716 1716 1287 715 186 78 13 1

3 Quarters and 2 Pennies—Ten Ways


"1"s
Counting Numbers
Triangular Numbers
1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
1 6 15 20 15 6 1
1 7 21 35 35 21 7 1

In the end, I'd like to both inspire students to expand their thought processes AND inspire other teachers to do the same.