

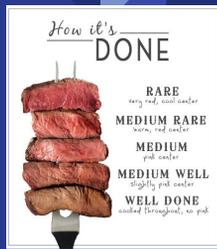
Engaging Students in Productive Struggle through Meaty Tasks

Pamela Quirk
pamela.quirk@muskegonorway.org
Mathematics Coach
Lake Denoon Middle School
Muskego, WI

Kimberly Crosby
kimberly.crosby@muskegonorway.org
Mathematics Coach
Bay Lane Middle School
Muskego, WI

Deepen Rigor Through:

1. Meatier Tasks
2. Actions of teachers & students



Four Levels of Cognitive Demand in Mathematics Tasks

Low Level Cognitive Demand	High Level Cognitive Demand
Memorization Tasks	Procedures With Connections to understanding, meaning, or concepts Tasks
Procedures Without Connections to understanding, meaning, or concepts Tasks	Doing Mathematics Tasks

PRINCIPLES TO ACTIONS: ENSURING MATHEMATICAL SUCCESS FOR ALL. RESTON: NATL COJN TEACHERS MATH. 2014. Print.

Math Tasks and Levels of Demand	
Procedures with Connections	Doing Mathematics
Some cognitive effort	Considerable cognitive effort May cause anxiety
Multiple pathways; show >1 way using diagrams, symbols, problem solving	No explicit pathway or worked example
Make connections between multiple representations	Complex problems with multiple steps (not just multiple procedures)
Compare & contrast with evidence	Explore relationships, concepts, processes, and limitations of solutions
Explanations to justify, written and/or verbal	Make real world applications in a new situation or to other content areas
More difficult numbers do not make it a level 5. If it's still just a procedure	Often requires extended periods of time

Examples: 1. Draw a model and explain. 2. Show how the area under the multiplication is proven? 3. Draw a model to show the steps of the algorithm. 4. Error analysis: locate error and justify why. 5.	Examples: • Create a real world situation for 14×5 , solve using long or equations, and explain the solution. • Create a task that does not have a clear solution path. Include one and justify why does step 4 of the long division take and changed to become more appropriate in the long run? Justify your answer. • Create a word problem regarding the volume of a rectangular prism and divided it all the dimensions. Explain how to find the volume of the prism. • Use integers to describe the temperature. Explain how to find the difference between two integers.														
<table border="1"> <tr> <td>Strategy 1</td> <td>Strategy 2</td> </tr> <tr> <td>Explain</td> <td>Explain</td> </tr> <tr> <td>Check</td> <td>Check</td> </tr> <tr> <td>Intelligent</td> <td>Intelligent</td> </tr> </table>	Strategy 1	Strategy 2	Explain	Explain	Check	Check	Intelligent	Intelligent	<table border="1"> <tr> <td>Explain</td> <td>Explain</td> </tr> <tr> <td>Check</td> <td>Check</td> </tr> <tr> <td>Intelligent</td> <td>Intelligent</td> </tr> </table>	Explain	Explain	Check	Check	Intelligent	Intelligent
Strategy 1	Strategy 2														
Explain	Explain														
Check	Check														
Intelligent	Intelligent														
Explain	Explain														
Check	Check														
Intelligent	Intelligent														

Source: www.illustrativemathematics.org/

Low Level Book Task (Grade 6)

Standard Rentals
\$3

New Releases
\$4

MOVIES You rent x new releases and y standard rentals.
Which expression tells you how much money you will need?

Larson, Ron, and Laurie Boswell. Big Ideas Math: A Common Core Curriculum. Erie, PA: Big Ideas Learning, 2012. Print.

Revise to High Level Cognitive Demand (Grade 6)

Standard Rentals
\$3

New Releases
\$4

On Saturday, you rented a total of 8 movies at the local Redbox. You rent x new releases and y standard rentals. Show two different ways to determine the total cost of your rentals.

$X = \#$ of new releases
 $Y = \#$ of standard rentals

- $x + y = 8$ total movies must be 8
- $4x + 3y$ expression to find total cost.

New DVD's		Standard DVD's		Total Cost
#	cost	#	cost	\$
0	0	8	24	24
1	4	7	21	25
2	8	6	18	26
3	12	5	15	27
4	16	4	12	28
5	20	3	9	29
6	24	2	6	30
7	28	1	3	31
8	32	0	0	32

domain _____ Name _____

Levels of Demand Template:

e: Content Standard(s) & Math Practice Standards

<p>Misty Problem or initial problem</p> <ul style="list-style-type: none"> -no explicit pathway or worked example -multi-step, not just multiple procedures 	<p>Choose one:</p> <p>Procedures with connections:</p> <ol style="list-style-type: none"> Compare & contrast Show a 2nd strategy or representation Create equivalencies <p>Doing Mathematics:</p> <ol style="list-style-type: none"> Create a real world situation for the problem Solve the problem without using the rule
<p>Written Explanation: Explain the strategy you used and why you chose it.</p>	<p>Written Explanation:</p> <ol style="list-style-type: none"> Explain a connection between multiple representations Describe how each term in the equation relates to the situation (math practice #2) Describe any limitations to the solution Explain what would happen if one term increased by ____ There may be just 1 explanation along the bottom (3 boxes)

Low Level Book Task (Grade 7)

Procedural:

Solve the equation.

1 6. $2v + 7 = 3$

Solution = -2

Revise to High Level Cognitive Demand (Grade 7)

EXPRESSIONS AND EQUATIONS

Ch. 3 7.EE.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
 MP.42 Reason abstractly and quantitatively; communicate and construct viable arguments

NAME: _____

<p>Create a 2-step equation where the solution is -2</p>	<p>Describe a real-world situation where this equation and solution make sense</p>
<p>Explain the strategies you used to create your equation.</p>	<p>Describe how each term in the equation relates to the situation</p>

EXPRESSIONS AND EQUATIONS

Ch. 3 7.EE.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
 MP.42 Reason abstractly and quantitatively; communicate and construct viable arguments

NAME: _____
DATE: _____

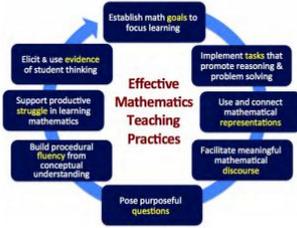
<p>Create a 2-step equation where the solution is -2</p> <p>$5x + 10 = -2$</p> <p>$5x = -2 - 10$</p> <p>$5x = -12$</p> <p>$x = -12 / 5$</p> <p>$x = -2.4$</p>	<p>Describe a real-world situation where this equation and solution make sense</p> <p>You have money to spend \$2 on your lunch. You must pay for the change to with \$5 spent to take money off your bill with discount. In the end, all you have to spend is \$2. How much are your coupons take off?</p>
<p>Explain the strategies you used to create your equation:</p> <p>One strategy I used was when I figured out the problem I knew that it had to be negative. So I placed x in my problem as -2 and asked the problem from there. Since I know x equals -2 I could just do it. I know normally and came up with the number in the same number to work with.</p>	<p>Describe how each term in the equation relates to the situation.</p> <p>I used terms like take off and in the end to represent parts in my equation like negative number with equal sign. This helped me further explain my info/word problem in one easy line. I can use each word in my equation again.</p>

Student Example (Grade 7)

Deepening the Level of Demand

1. Choose a grade level task
2. Create a new question that raises the cognitive demand of the task.

Dr. DeAnn Huinker
University of Wisconsin–Milwaukee
huinker@uwm.edu

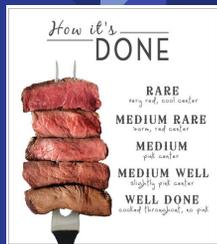


Teacher's Words

Goals
Reasoning
Productive Struggle
Representations
Discourse

Deepen Rigor Through:

1. Meatier Tasks
2. Actions of teachers & students



Resources:

1. [Principles to Actions](#)



2. www.mathgalore.com

2016 NCTM ANNUAL MEETING
& EXPOSITION
April 14-17, 2016



Rate this presentation on the conference app!
Search "NCTM 2016" in your app store or follow
the link at nctm.org/confapp to download



Join in the conversation! #NCTMannual



Download available presentation handouts
from the online planner at nctm.org/planner
