The Foundation Program, Deanship of General Studies, cordially invites you to attend:

FP Virtual Academic Excellence Days Spring 2020

11 - 14 May 2020

Teaching Math Beyond the Facts

BY: DR. DIANA REYOS – MALABANAN
FOUNDATION PROGRAM, DEPARTMENT OF MATHEMATICS

Trying to teach in the 21st century without conceptual schema for knowledge is like trying to build a house without a blueprint.

-H. Lynn Erickson
Concept-Based Curriculum and Instruction

Introduction

METACOGNITION

John Flavell, a psychologist of Stanford University is regarded as a **foundation researcher in metacognition**. Metacognition was first coined by Flavell In the mid 1970s. The term Metacognition as used by Flavell (1979) **refers to an individual's awareness of his/her cognitive processes and strategies.**

Meta cognition

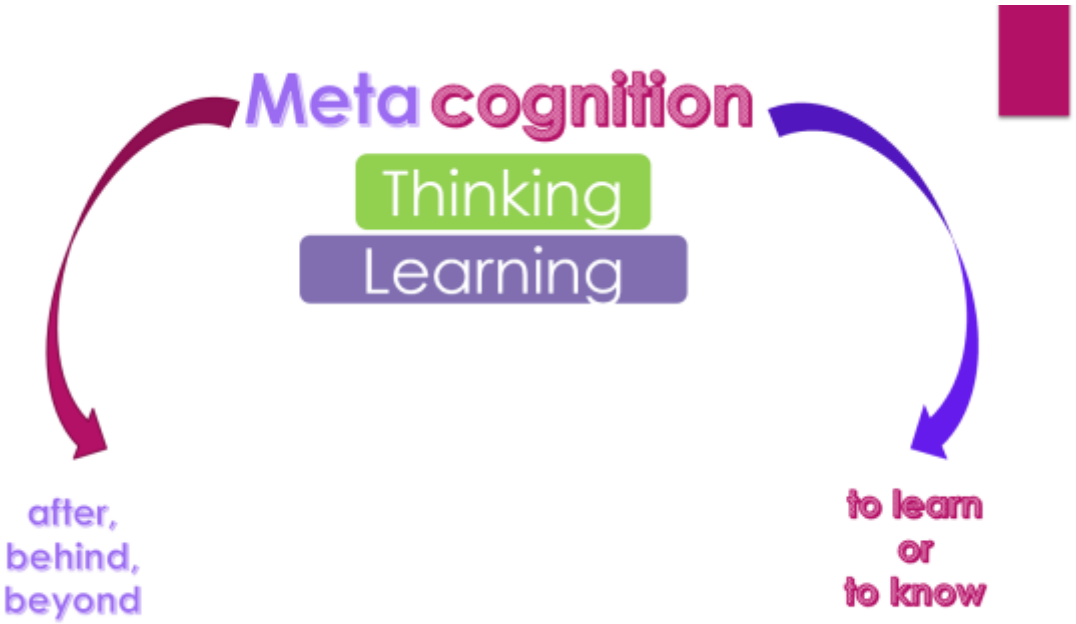
METACOGNITION is literally "beyond knowing".

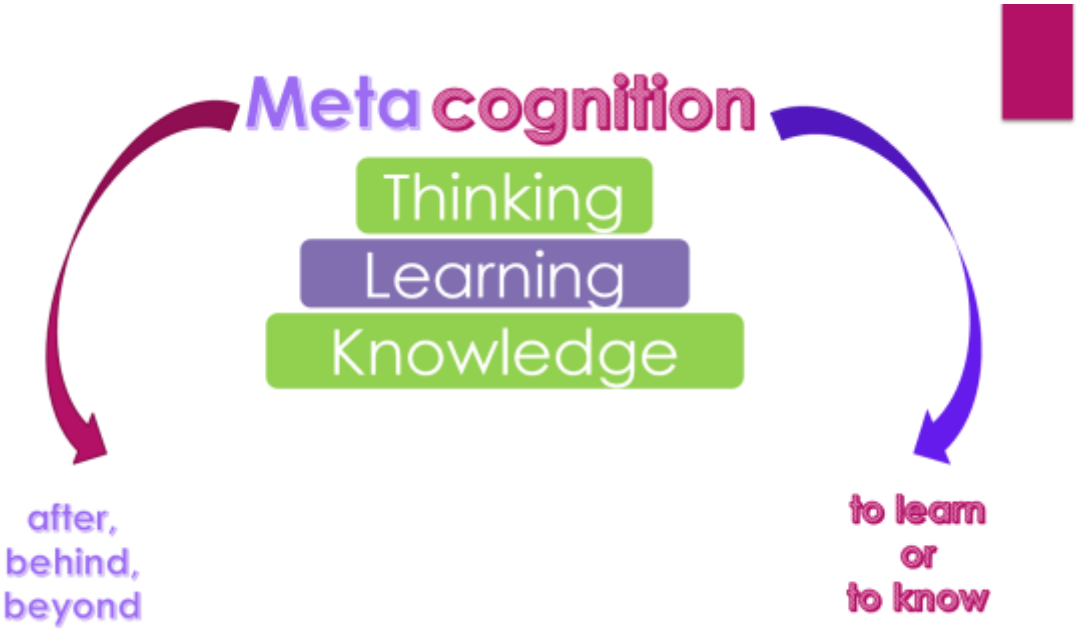
after, behind, beyond

to learn or to know

Meta cognition

Thinking


Meta cognition
Thinking
Learning
after,
behind,
beyond
to learn
or
to know


Meta cognition
Thinking
Learning
Knowledge
after,
behind,
beyond
to learn
or
to know

Meta cognition

Thinking

Learning

Knowledge

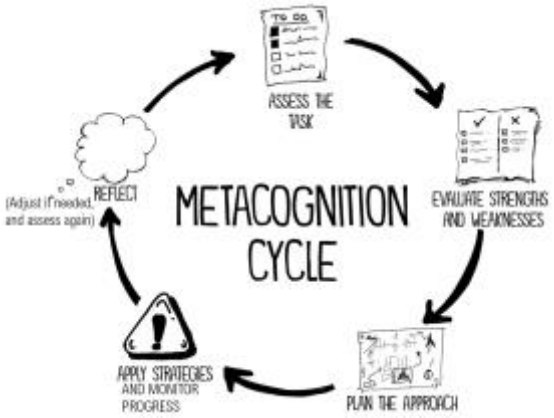
Strategy Transfer

after, behind, beyond

New Context

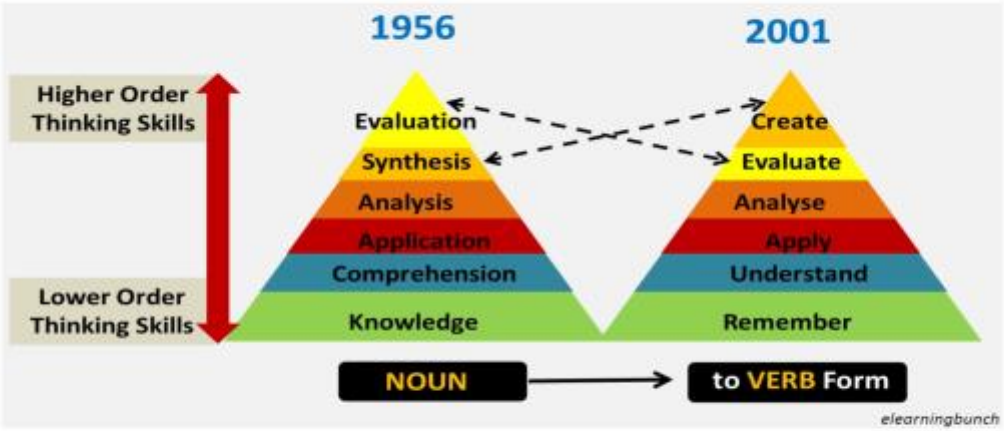
to learn or to know

What are you thinking?



Revised Bloom's Taxonomy and Research Studies

Revised Bloom's Taxonomy

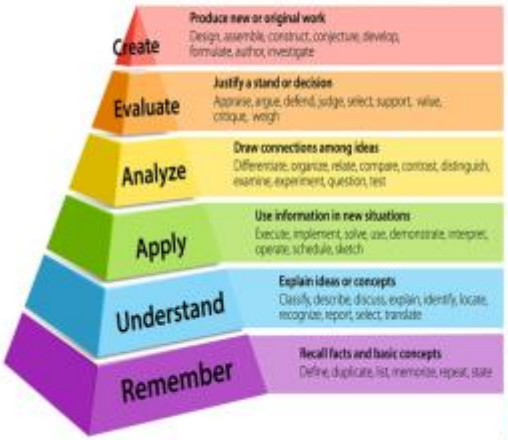


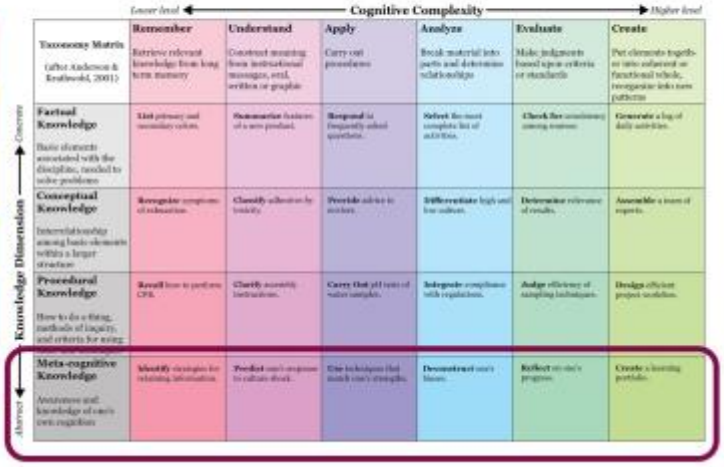
Revised Bloom's Taxonomy uses **verbs** to describe the levels of thinking

- swaps the order of evaluate and create to represent objectives addressing synthesis/creation as a highest type.
- Emphasis is placed upon its use as more authentic tool for curriculum planning, instructional delivery, and assessment.

Metacognition in Revised Bloom's Taxonomy

- Krathwohl and Anderson revised the version of Bloom's Taxonomy to represent the 21st Century learners.





Research Studies - metacognition

Suriyon, et. al., (2013)Students' Metacognitive Strategies in the Mathematics Classroom Using Open Approach

Research results illustrate the **importance of metacognitive strategies, which could bring about successful student mathematical problem solving.** It could be seen that students could solve problems successfully; they tried to find various problem-solving strategies and could continue solving problems without giving up their efforts to create new problem solving approaches and to express various ways of thinking by using problem solving tools of previously learned ideas and strategies.

Kwon, et al. (2010) Students' Retention of Mathematical Knowledge and Skills in Differential Equations

This study investigates students' retention of mathematical knowledge and skills in two differential equations classes. Posttests and delayed posttests after 1 year were administered to students in inquiry-oriented and traditional classes. The results show that students in the ***inquiry-oriented class retained conceptual knowledge****, as seen by their performance on modeling problems, and* ***retained equal proficiency in procedural problems, when compared with students in the traditionally taught classes****. The results of this study add additional support to the claim that* ***teaching for conceptual understanding can lead to longer retention of mathematical knowledge.***

Friedlander, Alex; Arcavi, Abraham (2012) Practicing Algebraic Skills: A Conceptual Approach

Learning rules and procedures should be linked to a deeper understanding of their meaning and to a flexible choice of solution methods (Kieran 2004; Star 2007; NCTM 2000). The authors write for mathematics teachers who wish to add a conceptual dimension to the practice of algebraic procedures. They describe an approach in which rules, procedures, algorithms, sense making, meaningful reading, and the creation of algebraic expressions are thoroughly integrated into the learning process. **These practice-oriented activities require the adoption of some additional higher-order thinking skills,** such as developing alternative solutions, evaluating the effectiveness of approaches, participating in class discussions, and reflecting on learned procedures and solution methods.

Aydina, Y. (2014) The effects of problem-based approach on student's conceptual understanding in a university mathematics classroom

The activities provided intensive treatment of a particular concept through student discovery and also gave students problem solving experience. The collaborative aspects of PBLA meet this challenge as students are provided a more customized teaching of calculus through personal interactions with group members and the instructor. **Project Based Learning activities with metacognitive regulations is an effective means for teaching mathematical concepts** which students generally enjoy working on the real world problems. PBLA with collaborative groups can help students to achieve to learn the function concept better than the traditional teaching method and make a successful transition to university mathematics study .

Research Studies - metacognition

Higher Order Thinking (HOT) – involves Metacognition

- HOT does not include memorization.
- HOT requires that we **do something beyond the facts**.

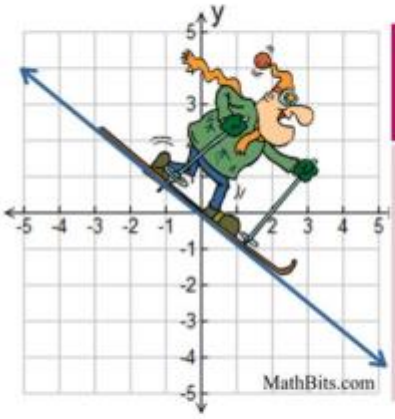
What am I learning?

How am I learning?

We all think…but are we using HOT skills?

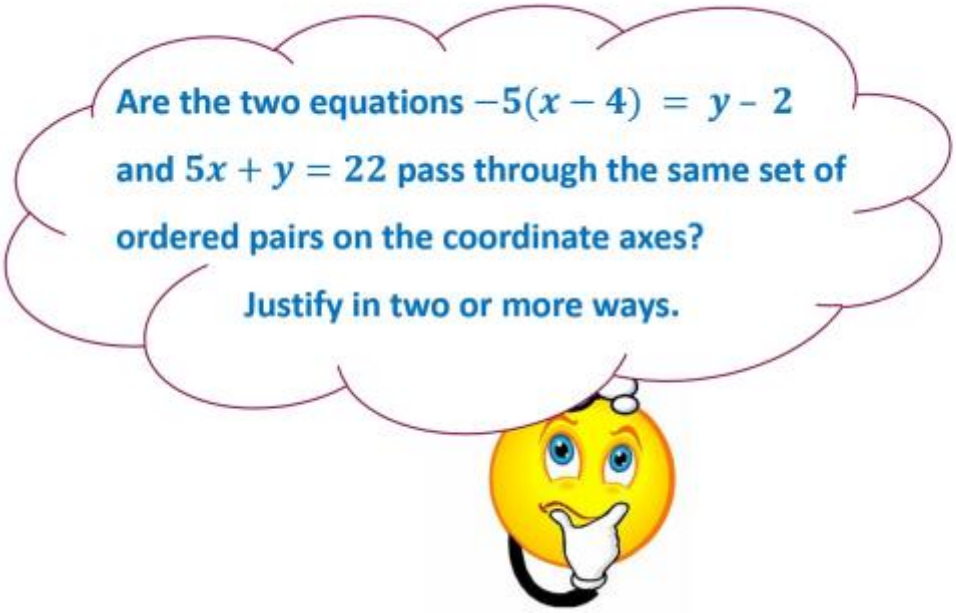
Enrich Math Questions

Instead of	Consider asking…
Solve: $16(4 - 3m) = 96\left(-\frac{m}{2} + 1\right)$	Determine whether the equation $16(4 - 3m) = 96\left(-\frac{m}{2} + 1\right)$ is an identity. Explain your answer.
Find p in the equation $-px + 1 = 13 - 4(x + 3)$.	a. The equation $-px + 1 = 13 - 4(x + 3)$ is an identity if p = __. b. Find the value of p in the equation $-px + 1 = 13 - 4(x + 3)$, when x is 2.
Solve: $2x + 7 = 2(x + 5)$	True of False: The equation 2x + 7 = 2(x + 5) has one solution. Justify your answer.
Find the slope of the line passing through points $(1, 17)$ and $(5, -3)$.	If the slope of the line passing through $(x, 17)$ and $(5, -3)$ is -5, then what is x?



Instead of

Find the slope of the line passing through points $(1, 17)$ and $(5, -3)$.



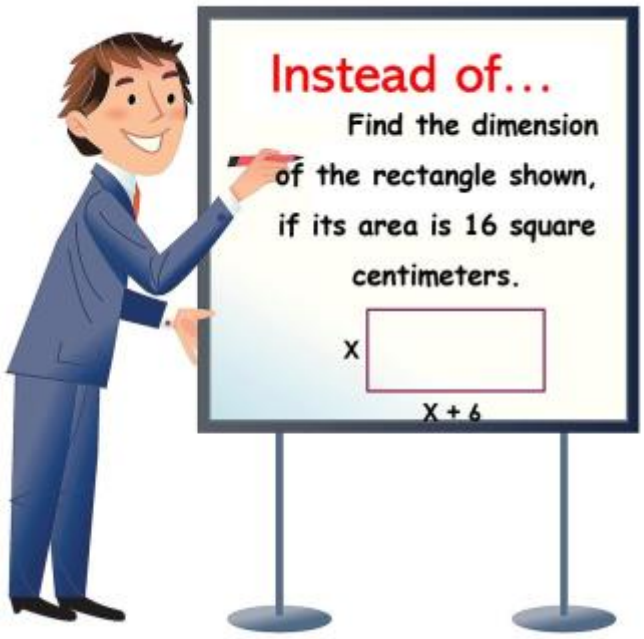
Hey, students!

Go to student.desmos.com
and type in:

G3N KB6

You can also share this link with your students:

https://student.desmos.com/?prepopulateCode=g3nkb6



The area of the table is given in polynomial form $x^2 + 12x + 36$. Find an expression that represents dimension of the table. What is its shape? Explain your answer.

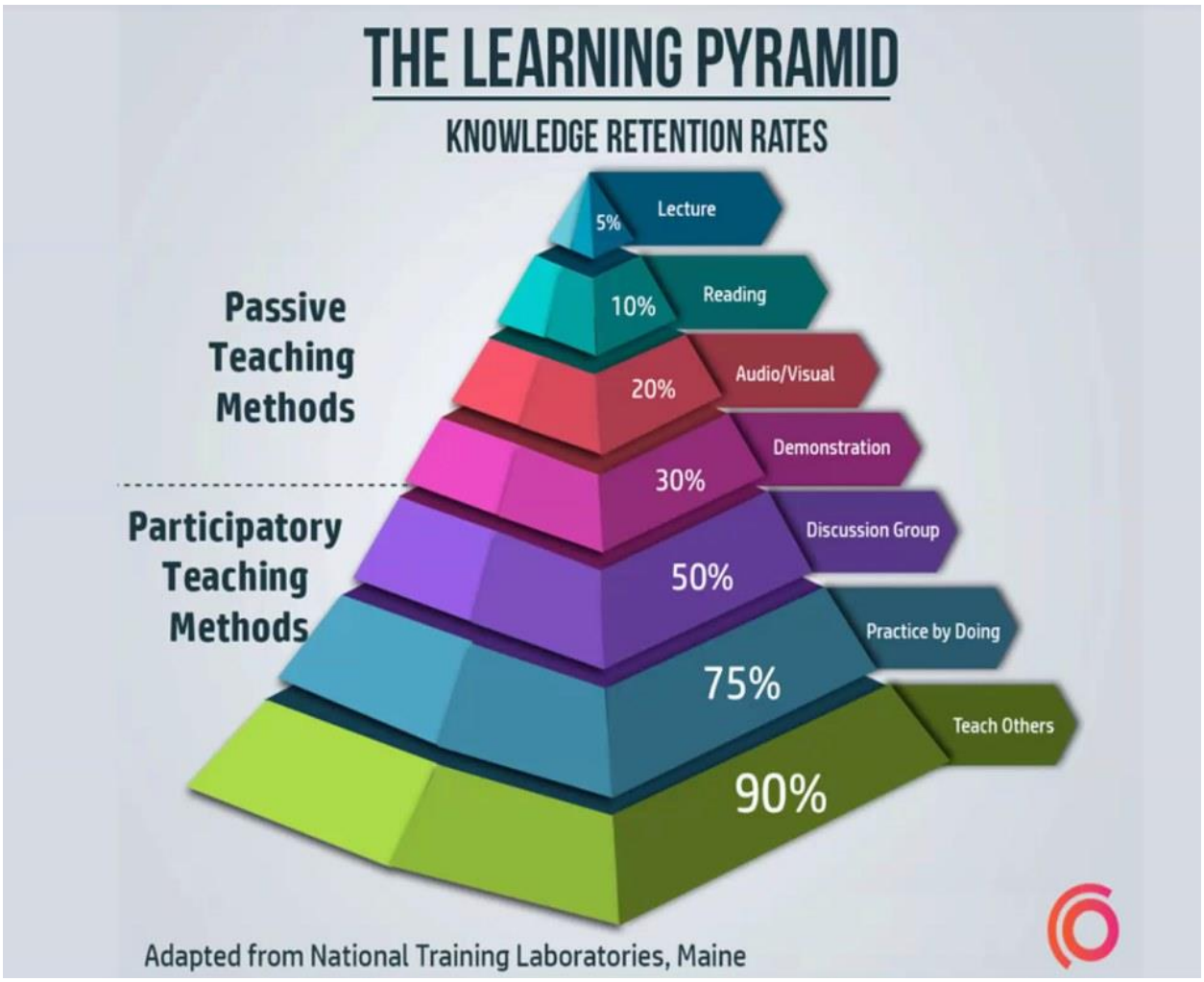
Instead of

Is the relation

$$R = \{(4,3),(4,2),(1,6),(-4,0)\}$$

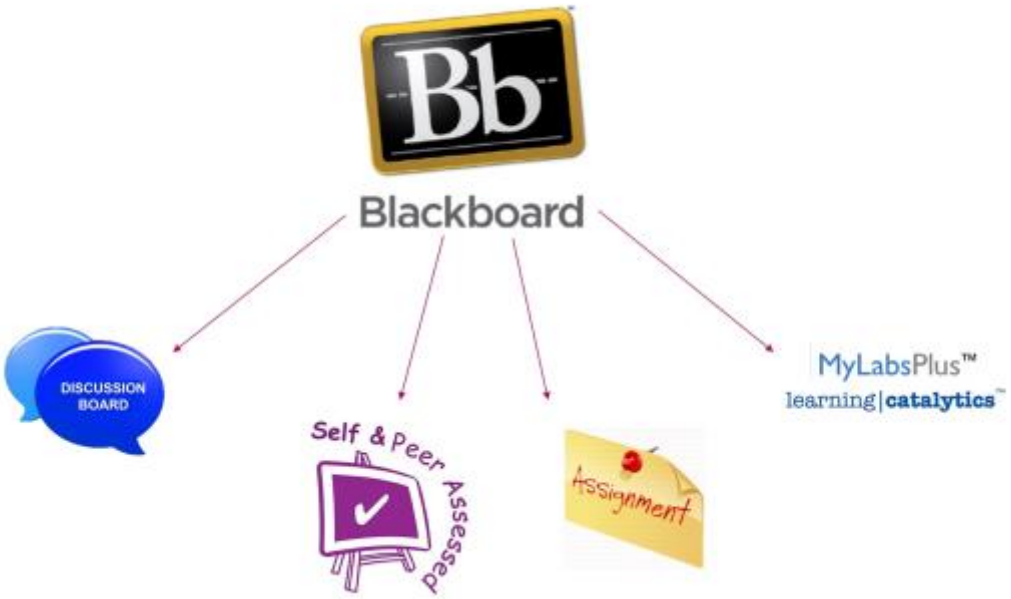
a function or not?

Assessment Methods and Tools


THE LEARNING PYRAMID
KNOWLEDGE RETENTION RATES
Passive Teaching Methods
Participatory Teaching Methods
5%
Lecture
10%
Reading
20%
Audio/Visual
30%
Demonstration
50%
Discussion Group
75%
Practice by Doing
90%
Teach Others
Adapted from National Training Laboratories, Maine


FINISH
START
2014 Top 100 Tools for Learning
MGDA

Less is More


Bb
Blackboard
DISCUSSION BOARD
Self & Peer Assessed
Assignment
MyLabsPlus™
learning|catalytics™

Blackboard

DISCUSSION BOARD

Evaluate student's performance through discussion using pre-defined rubric

Deliverables:
- Open-ended questions
- Video Clips, Project-Based
- Concept map

Self & Peer Assessed

Provide feedback to themselves and their peers based from pre-defined criteria

Assignment

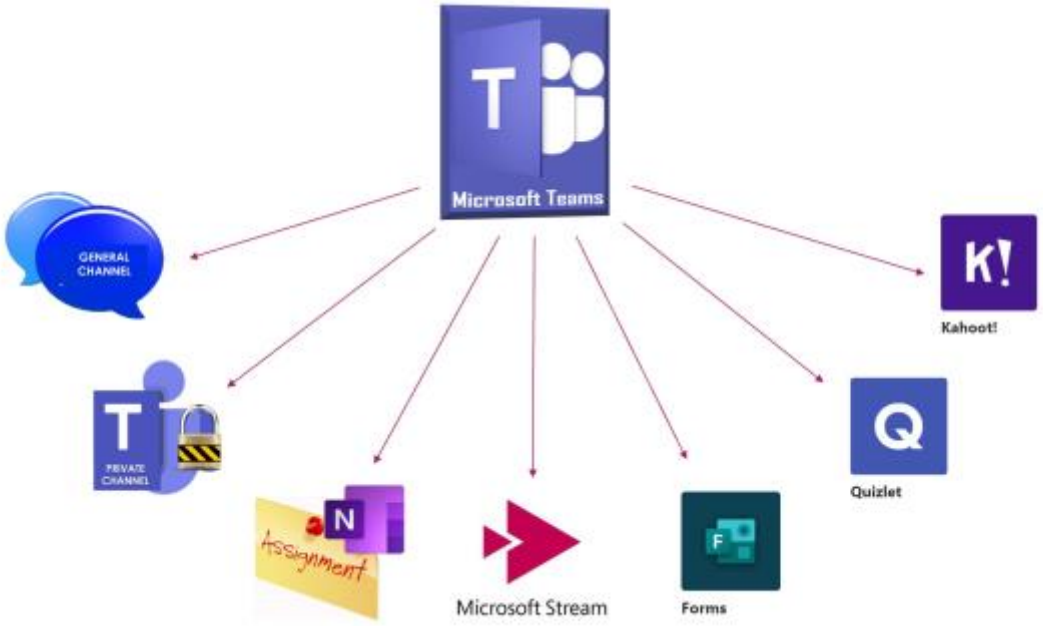
Annotate and grade student assignment files using drawing annotation mode icon

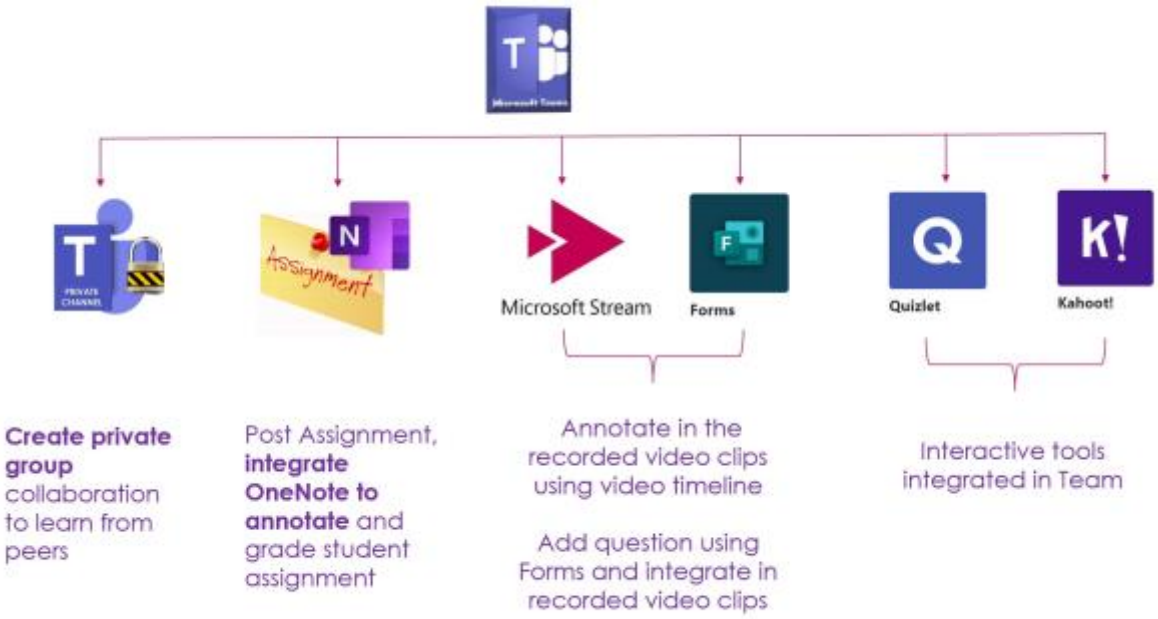
Deliverables:
- Written Assignment
- Quiz/Exam

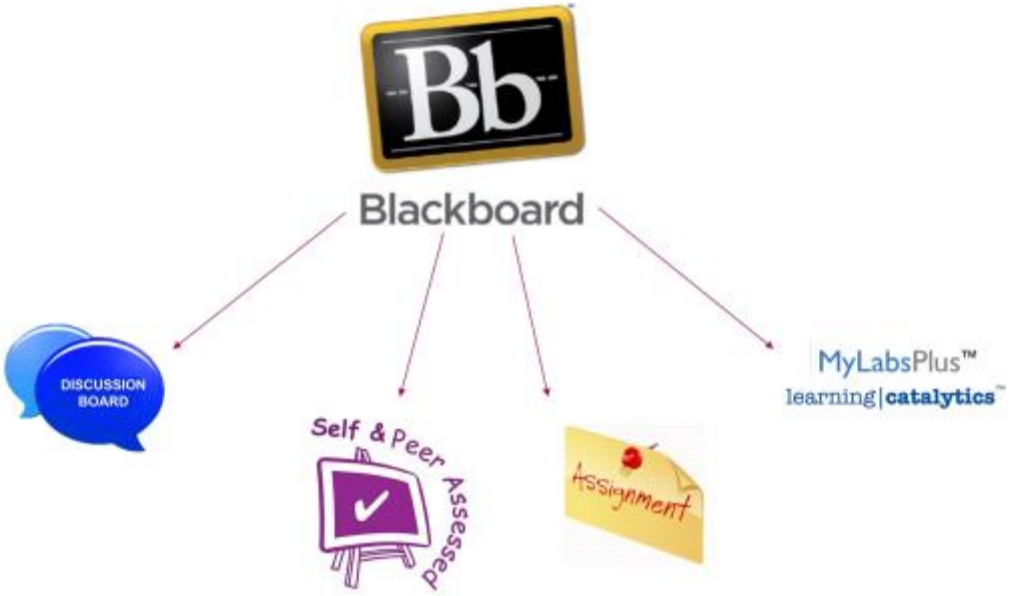
MyLabsPlus™
learning|catalytics™

interactive response tool that encourages team-based learning to engage students in interactive tasks and thinking

Deliverables:
- 16 different question types




Microsoft Stream
Forms
Quizlet
Kahoot!
Create private group collaboration to learn from peers
Post Assignment, integrate OneNote to annotate and grade student assignment
Annotate in the recorded video clips using video timeline
Add question using Forms and integrate in recorded video clips
Interactive tools integrated in Team


Blackboard
DISCUSSION BOARD
Self & Peer Assessed
MyLabsPlus™
learning|catalytics™

Evaluate student's performance through discussion using pre-defined rubric

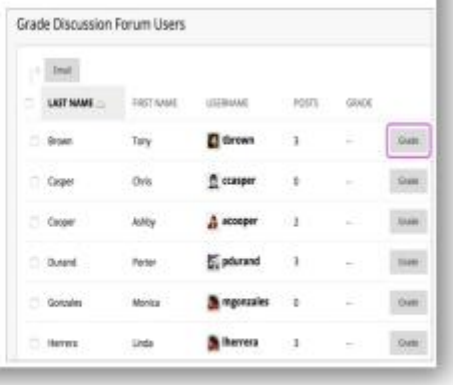
Deliver Individually or by Group

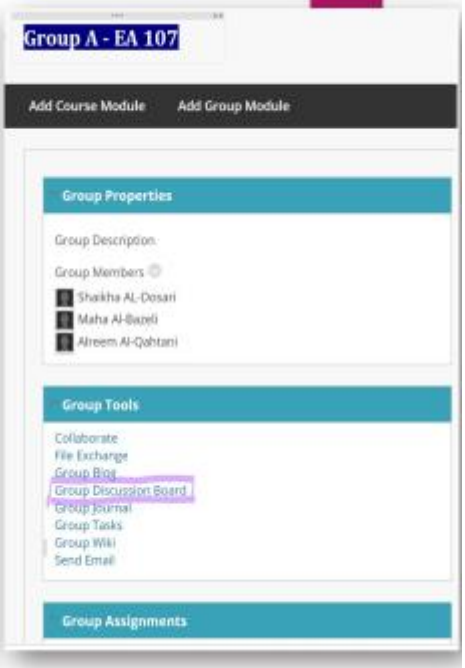
Deliverables:
- ConcepTest
- Open-ended questions
- Video Clips
- Project-Based
- Concept map

Grading Forum Participation

You can assign discussion grades to evaluate participants on performance throughout a forum. Only users with the role of manager or grader can assign grades for posts. Graders can't view their own work.

1. In the forum where you enabled grading, select *Grade Discussion Forum*.
2. On the *Grade Discussion Forum Users* page, select *Grade* in a student's row. The student's posts are counted in the *Posts* column.





Self and Peer Assessment: Submission and Evaluation Settings

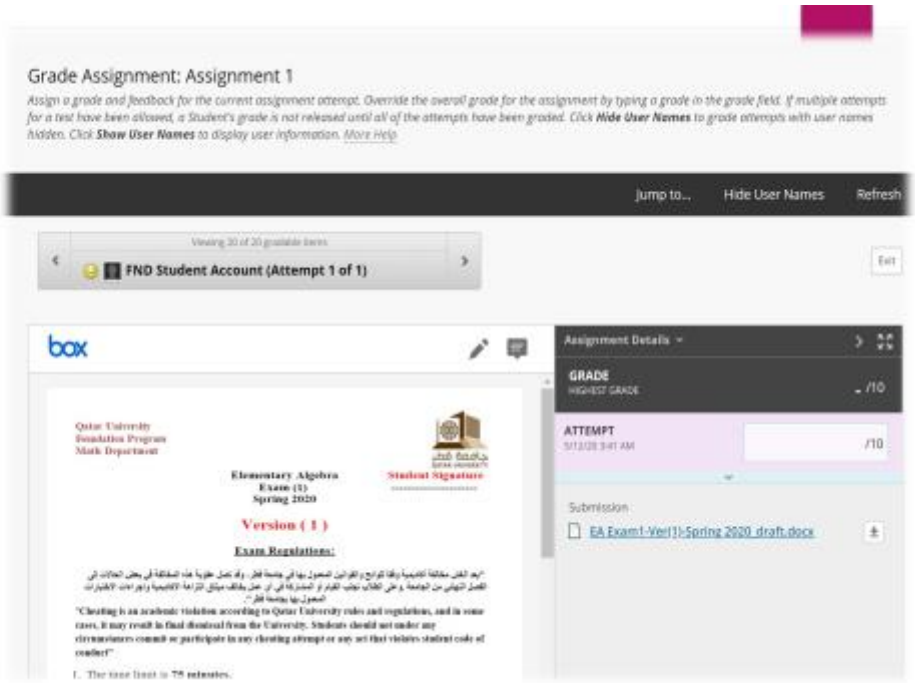
Provide feedback to **themselves** and their **peers** based from pre-defined criteria

Deliverables:
- ConcepTest
- Open-ended questions
- Video Clips
- Project-Based
- Concept map

annotate and grade student assignment files using drawing annotation mode icon .

Deliver Individually or by **Group**

Deliverables:
- Written Assignment
- Quiz/Exam



Blackboard

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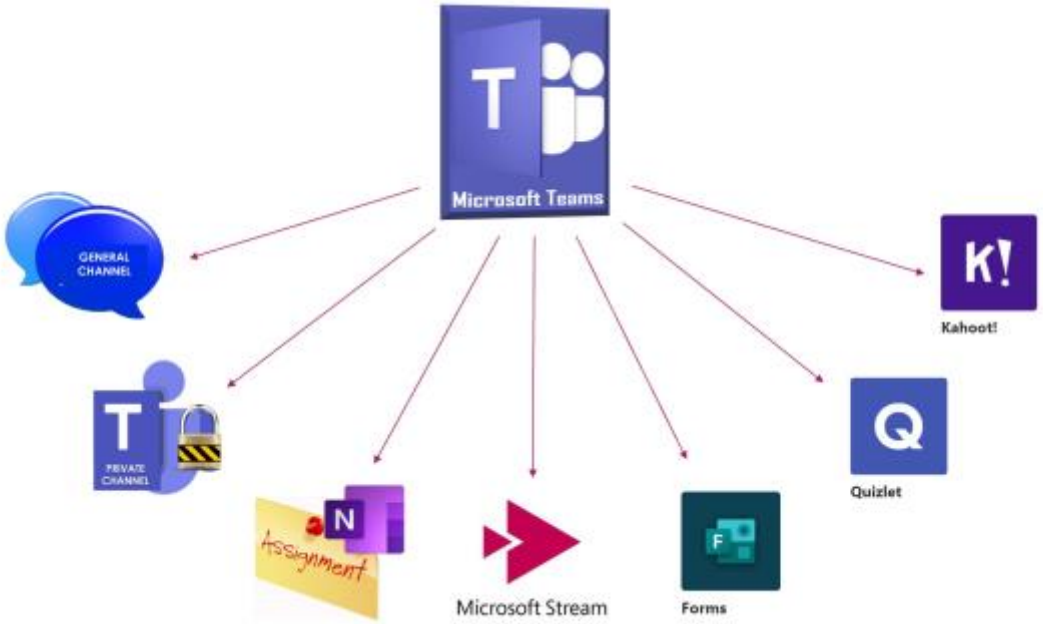
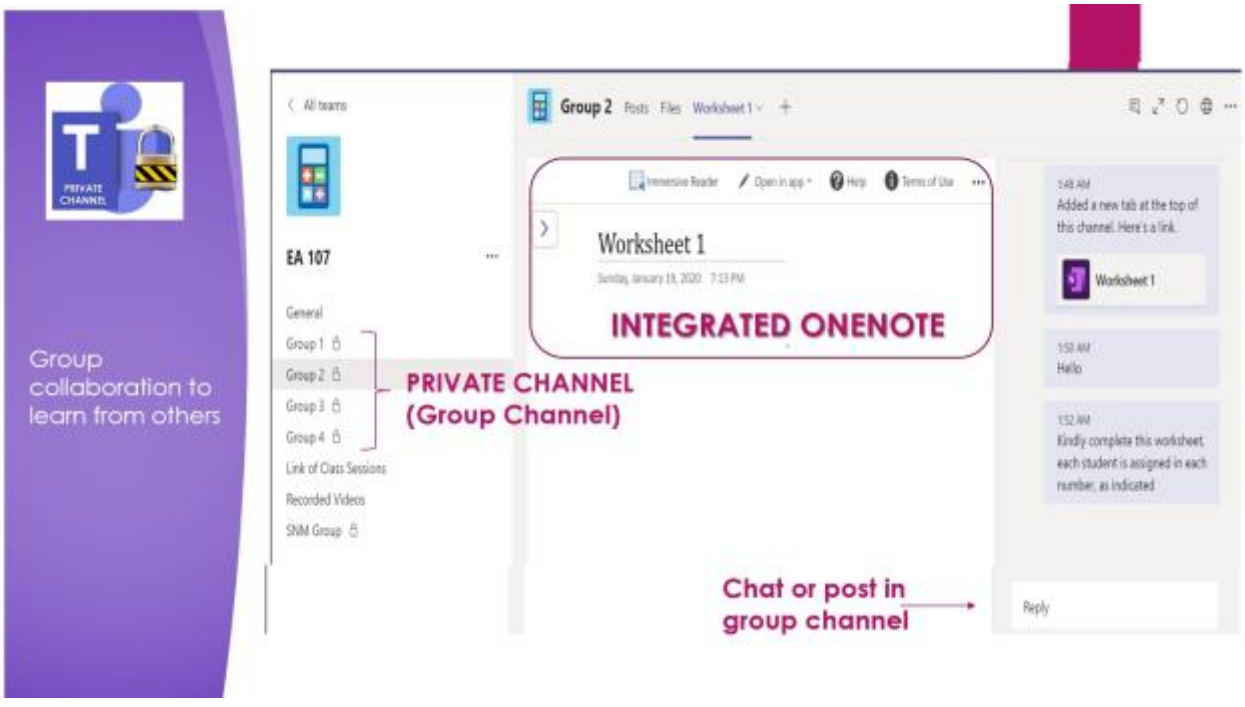
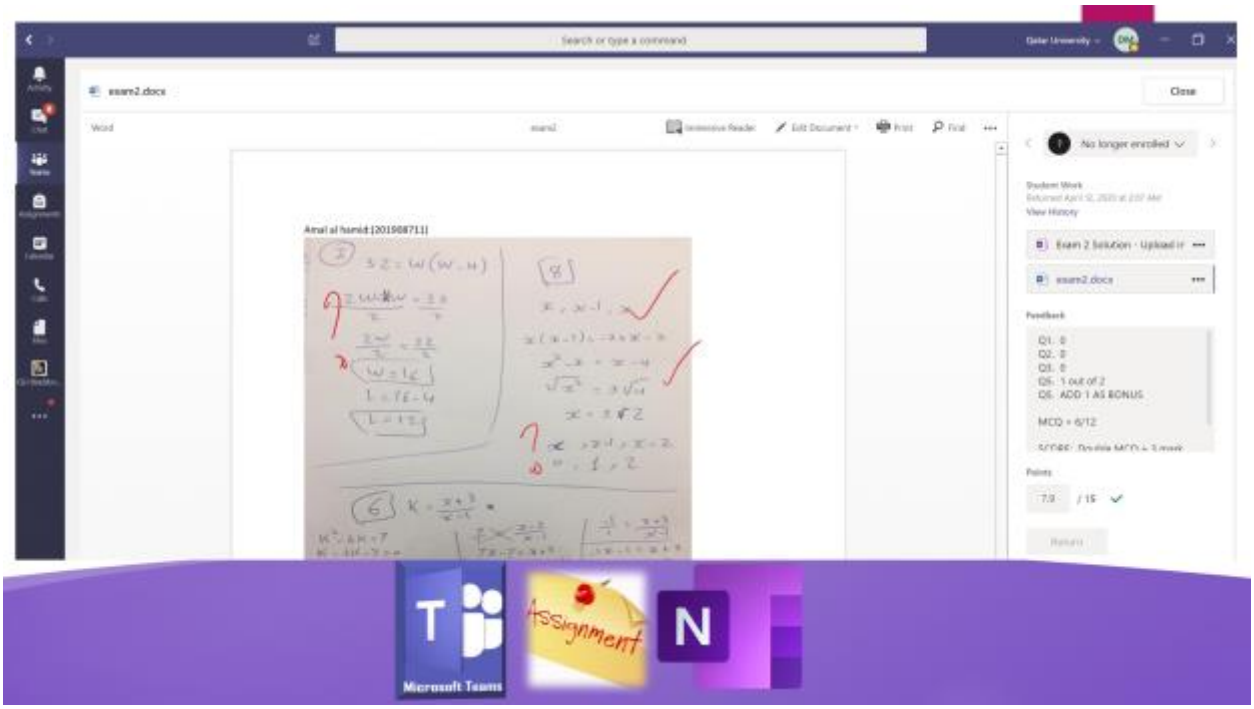

Microsoft Teams
GENERAL CHANNEL
PRIVATE CHANNEL
Assignment
Microsoft Stream
Forms
Quizlet
Kahoot!

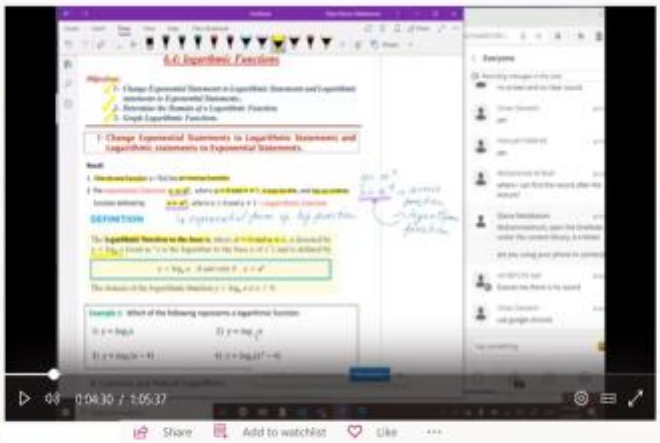

PRIVATE CHANNEL
Group collaboration to learn from others
All teams
EA 107
General
Group 1
Group 2
Group 3
Group 4
Link of Class Sessions
Recorded Videos
SNM Group
PRIVATE CHANNEL (Group Channel)
Group 2 Posts Files Worksheet 1
Worksheet 1
INTEGRATED ONENOTE
Added a new tab at the top of this channel. Here's a link.
Worksheet 1
Hello
Kindly complete this worksheet, each student is assigned in each number, as indicated
Chat or post in group channel
Reply



Microsoft Teams

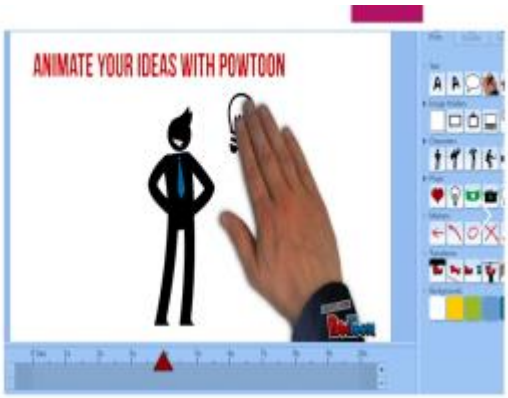
Microsoft Stream

Add question and annotate in the recorded video clips



Added Question in recorded video

Annotation in recorded video by writing the video timeline



E-portfolio

CareerApp

Math Blog

Project-Based

Sway Office 365 Powtoon

Other Tools

Group Member Evaluation

The tool streamlines how students assess their peers' collaboration skills. The teacher specifies the criteria students use to evaluate their peers' contribution to group work.

Interactive Study Material

This tool supports the flipping the classroom method. Teachers can share media sources (audio, document, video) for students to discuss, answer practice questions and/or collaborate on discussion topics. This can be a graded activity.

Interactive Presentation

This tool gives instructors the chance to interact with their audience and increase deeper learning.

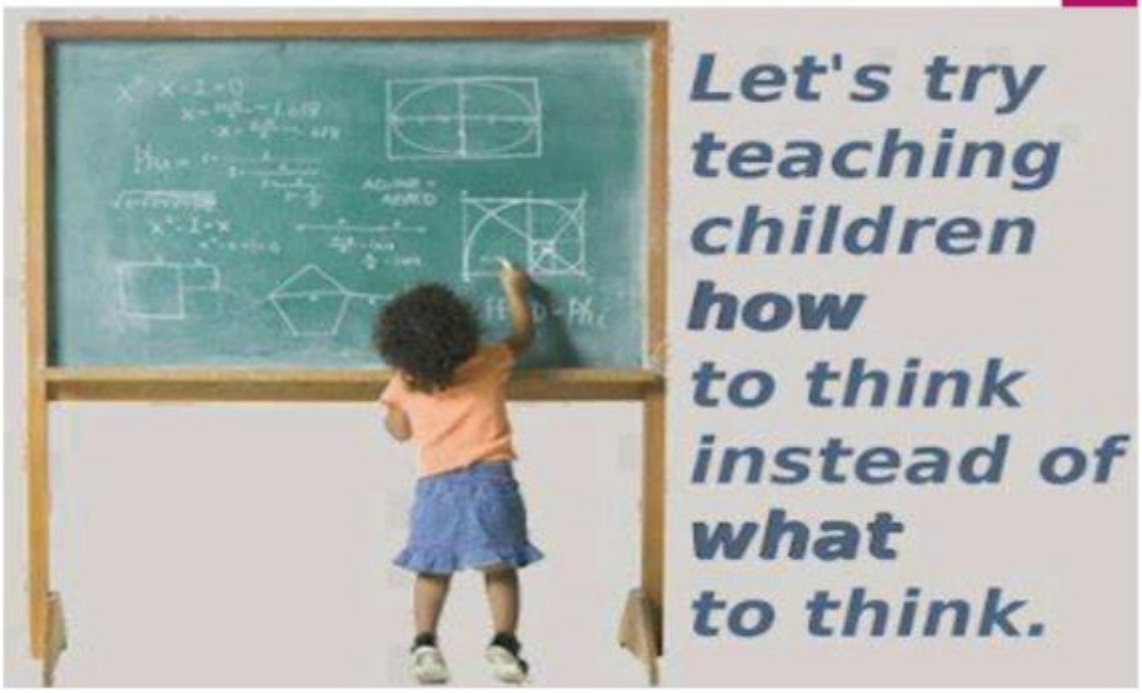
More Thinking Beyond the Facts

The future belongs to a very different kind of person with a very different kind of mind – creators and empathizers, pattern recognizers and meaning makers. These people – artists, inventors, designers, storytellers, caregivers, consolers, big picture thinkers – will now reap society's richest rewards and share it greatest joys.

-Dan Pink
A Whole New Mind

"Education is not the learning of facts, but the training of the mind to think."

-Albert Einstein



References

References:

Friedlander, Alex; Arcavi, Abraham, **Practicing Algebraic Skills: A Conceptual Approach,** *Mathematics Teacher*, v105 n8 p608-614 Apr 2012

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