



Non-Cognitive Skills in US and Kenyan Mathematics Curriculum

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Introduction

- Teaching and learning of mathematics address both the cognitive and non-cognitive skills. Often, the content-oriented portion tend to overshadow the non-cognitive aspects.
- This talk attempts to address the little understood non-cognitive skills yet they are quite important and needed by all.
- Non-cognitive skills are also considered as soft skills



Soft skills in Kenyan Math Class	Soft skills in US Math Class
Communication & Collaboration	Make sense of problems and persevere in solving them
Critical thinking & Problem solving	Reason abstractly and quantitatively
Creativity and Imagination	Construct viable arguments and critique the reasoning of others
Self-efficacy	Model with mathematics
Citizenship	Use appropriate tools strategically
Digital literacy	Attend to precision
Learning to learn	Look for and make use of structure
	Look for and express regularity in repeated reasoning

Soft skills in Kenyan Math Class (KICD 2017 p. 9)

1. Collaboration—working together through a learning experience and contributing to one another's understanding of the ideas under consideration
2. Communication—ability to interact and express oneself during the learning process
3. Critical thinking and Problem Solving—ability to explore and be open to different and new ways of looking at a problem, reason and logically arrive at a solution
4. Creativity and Imagination—Ability to use knowledge and skills to create new ideas and products that can add value to the people around.
5. Digital Literacy—Knowledge and skills concerning the appropriate application of a variety of hardware platforms and their software including but not limited to web search or internet application software
6. Self efficacy—Self-awareness, confidence and courage to take on learning tasks even those that maybe unfamiliar.
7. Citizenship—A sense of belonging to one's nation, respect for other people and ability to deal with conflict knowledgeably and tolerantly.

	Examples of soft skills in Kenyan math class
Communication & Collaboration	Discussion, partner work, group work,
Critical thinking & Problem solving	Recognizing concepts i.e., measuring, simplifying, matching and pairing objects by shape and size, ordering objects according to size
Creativity and Imagination	Estimation
Self-efficacy	Making oral presentation, sing and dance number songs
Citizenship	Fairness, sharing, taking turns, honesty, patriotism i.e. paying taxes,
Digital literacy	Usage of ICT devices i.e. clocks, videos, internet, radio,...complete number puzzles using ICT
Learning to learn	Interpretation, exploration, identify numbers of objects found in the environment

Soft skills in US Math Class	Common Core
Make sense of problems and persevere in solving them	Plan a solution pathway rather than simply jumping into a solution attempt. Analyze givens, constraints, relationships, and goals.
Reason abstractly and quantitatively	Make sense of quantities and their relationships in problem situations.
Construct viable arguments and critique the reasoning of others	Understand and use stated assumptions, definitions, and previously established results in constructing arguments.
Model with mathematics	Apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.
Use appropriate tools strategically	Use tools e.g., pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software.
Attend to precision	Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.
Look for and make use of structure	To discern a pattern or structure.
Look for and express regularity in repeated reasoning	Notice if calculations are repeated, and look both for general methods and for shortcuts.

How are soft skills talk in a math class?

- Soft skills are not taught as stand alone topic but are integrated during instruction with math content. They do require math content.
- For example regarding soft skills such as communication and collaboration or critique argument of others, the content enables students' to discuss the embedded math principle or concepts or facts or strategies etc.
 - *Three friends accidentally meet at a diner on October 1. Tom is at the diner every other day, Sue is at the diner every third day, and Brooke visits every fifth day. When will they meet at the diner again?*
- Students can solve the problem in small groups and since the problem task can be solved in several ways, groups can share their various strategies i.e. use of number line, use of calendar, find LCM ...
- The soft skill of collaboration and communication are strengthened as students work together, as they explain, elaborate and justify their strategy.



The success of integrating soft skills in math class effectively depends on the choices the classroom teacher makes, including selection of math tasks as well as assessment.

On the right see the two problem tasks (From an excerpt by Peg Smith's 2020 webinar). Attempt the two. Then compare and contrast the tasks.

Which task easily integrates soft skill discussed herein?



- How are the tasks the same and how are they different?
- How might the differences matter?



Hexagon

Trains 1, 2, 3 and 4 are the first 4 trains in the hexagon pattern. The first train in this pattern consists of one regular hexagon. For each subsequent train, one additional hexagon is added.



1. Compute the perimeter for each of the first four trains;
2. Draw the fifth train and compute the perimeter of the train;
3. Determine the perimeter of the 25th train without constructing it;
4. Write a description that could be used to compute the perimeter of any train in the pattern and explain why it works; and
5. Determine which train has a perimeter of 110.

The table of values below describes the perimeter of each figure in the pattern of blue tiles. The perimeter P is a function of the number of tiles t .

t	1	2	3	4
P	4	6	8	10



- a. Choose a rule to describe the function in the table.
A. $P = t + 3$ B. $P = 4t$
C. $P = 2t + 2$ D. $P = 6t - 2$
- b. How many tiles are in the figure if the perimeter is 20?
- c. Graph the function.

Rigor in soft skills

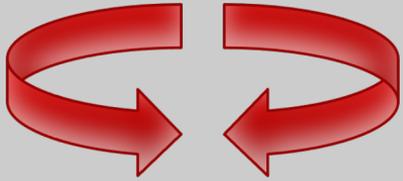
- For example, with respect to “Reason abstractly and quantitatively,”—all students regardless of their age are expected to reason in a math class keeping in mind, developmental appropriateness.
 - A 2nd grade student maybe asked to identify and name a square shape and justify their answer. This student may say: *This is a square. I know it is a square because it has four equal sides.* However, if the same question is asked of a 5th grader – then the student would have much more to say about a square, such as, *A square is a 2-D shape and is a parallelogram with four congruent angles and sides.*
 - Rigor in reasoning is expected as one matures.
- Similarly this is true of all soft skills.





Conclusion

- Better learned than educated. Despite your location on the globe, be it Kenya or US, there is need to garner expertise in non-cognitive skills.
- For instance, the aftermath of solving a math problem to its end, to a solution set, is crucial since the ensuing attributes of endurance, determination and resiliency are examples of non-cognitive skill sets that will carry one outside the mathematics classroom, or in problem solving real life opportunities and its challenges or in serving a country.
- There is need for both cognitive and non-cognitive skills in math class and beyond. Non-cognitive skillsets embedded in math classrooms carries more significant weight to learning, much more than mere memorizing of procedural routine of finding an answer to a math problem.



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