Using Identity and Agency to frame Access and Equity

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NCTM and Texas Instruments collaborate on lessons for Principles to Actions

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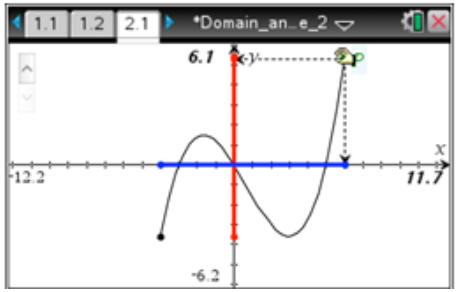
For decades, both NCTM and Texas Instruments have been dedicated to providing the tools and support needed by mathematics teachers. NCTM offers a myriad of resources in the pursuit of high-quality mathematics education for all students, including research, professional development and regional and national conferences. TI is committed to delivering innovative technology alongside world-class professional development and classroom activities to increase student engagement and achievement in their mathematics coursework.

Now, NCTM and Texas Instruments have joined forces to highlight classroom lessons that support the teaching practices outlined in NCTM's new publication *Principles to Actions: Ensuring Mathematical Success for All*. These activities, using TI-Nspire™ technology, align to the Eight essential Mathematics Teaching Practices.

Free Webinar (on Demand)
View for Ensuring Mathematical Success with NCTM's Principles to Actions and TI Technology

TI-Nspire™ Teacher Software
Download a free trial of TI-Nspire™ Teacher Software.

Video: Slanting a Quadrilateral
See this activity presented in a real classroom.



Domain and Range 2

This lesson involves identifying a set of x-values in both symbols and words, identifying the set of x-values used in generating the function as the domain of the function, and identifying the set of y-values used in generating the function as the range of the function.

» View Companion Guide (PDF)
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Domain and Range 2

MATH NSPIRED

TEACHER NOTES

ENHANCED FOR THE ESSENTIAL MATH TEACHING PRACTICES

These Teacher Notes were enhanced to demonstrate how to integrate the Eight Essential Mathematics Teaching Practices into a lesson, with specific examples for when and how to address students' questions and work in class. Look for the Math Teaching Practices, which have been noted in italics, throughout the lesson to encourage student thinking and create effective mathematical discourse.

Math Objectives and Learning Goals

Establish mathematics learning goals to focus learning. *Prior to doing this lesson with students, you should establish the math objectives – which state what students will do as a part of the lesson – and the learning goals –which state what the students will understand as part of the lesson. Knowing those goals and objectives will help you focus your questions and guide discussions with students.*

- ***Learning Goal:*** *Students will understand what the domain and range of a function or relation is, and that they refer to the set of all possible values at which the function or relation is defined. By looking at the graph of a function or relation, students should understand that the domain refers to the x-coordinates and the range to the y-coordinates for every point in the function or relation. As such, they will understand that a function assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).*

Principles to Actions:

This lesson includes a guide to using the Essential Mathematics Teaching Practices, as described in *Principles to Actions: Mathematics Success for All.*

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire™ CX handheld. It is also appropriate for use with the TI-Nspire™ family of products including TI-Nspire™ software and TI-Nspire™ App for iPad®. Slight variations to these

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Principles to Actions: Ensuring Mathematical Success for All

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Principles to Actions: Ensuring Mathematical Success for All

Essential Elements of School Mathematics Program

- Access and Equity
- Curriculum
- Tools and Technology
- Assessment
- Professionalism

Access and Equity Principle

- An excellent mathematics program requires that all students have access to a high-quality mathematics curriculum, effective teaching and learning, high expectations, and the support and resources needed to maximize their learning potential.

Calvin's Story

- Talker-Listener Exchange:
  - One person is the talker and the others are listeners.
  - The talker will talk continuously and the listeners listen but may respond non-verbally with gestures (but not words).

Interwoven Identities

- Am I not being recommended for placement in pre-algebra course because I am no longer a good student who is good at mathematics?
- Am I not being recommended because I am perceived as a behavioral problem?
- Am I not being recommended because middle school is different from elementary?
- Am I not being recommended for placement in pre-algebra course because I am a Black boy?

Cross Subject

Characteristics	Cordell	Clayton	Jabari	Darren	Phillip	Akil	Bilal	Andre
Strong academic identity	x	x	x		x	x	x	x
Likes mathematics	x	x	x	x	x	x	x	
Religious identity	x	x	x		x	x	x	x
Co-curricular identity	x	x	x		x	x	x	x
Athletic identity	x	x	x	x	x	x	x	
Positive preschool experiences	x	x	x		x	x	x	x
AG placement	x	x	x		x		x	
Not recognized as AG by teacher	x	x			x		x	
Parents discussed race as factor in experiences	x	x	x	x	x	x	x	x
Parents as guardian of opportunities	x	x	x	x	x	x	x	

Interwoven Identities

"I want to go to the Air Force Academy and become a pilot. You have to be good at math to get into the Academy." Andre

- Identities are not mutually exclusive
- Identities serve as motivation to persevere

Mathematics Identity

- Mathematics identity includes:
  - beliefs about one's self as a mathematics learner;
  - one's perceptions of how others perceive them as a mathematics learner,
  - beliefs about the nature of mathematics,
  - engagement in mathematics, and
  - perception of self as a potential participant in mathematics (Solomon, 2009).
    - Think about you as a student in your classroom

Identity & Motivation

- Understanding the strengths and motivations that serve to develop students' identities should be embedded in the daily work of teachers.
- Mathematics teaching involves not only helping students develop mathematical skills but also empowering students to seeing themselves as being doers of mathematics.

Supporting Teaching

- Mathematics teaching should leverage students' culture, contexts, and identities to support and enhance mathematics learning (NCTM, 2014).

Agency

- Agency is our identity in action and the presentation of our identity to the world (Aguirre, Ingram & Martin, 2013).
- Social and behavioral expectations are associated with agency .

Agency

- If one identifies themselves as being smart and good at mathematics, then they present themselves and adopt behaviors and actions of smartness and being good at mathematics.
    - Once this presentation of smartness and good at mathematics is affirmed, then students see themselves active participants and doers of mathematics (Berry, 2014).

Identity Affirming

- Identity-affirming behaviors influence the ways in which students participate in mathematics and how they see themselves as doers of mathematics.
  - We see identity-affirming criteria emerging as learners are labeled as “smart,” “gifted,” “proficient,” “at-risk,” or “on grade-level”

Identity Affirming

- We affirm mathematics identities by providing opportunities for students to make sense of and persevere in challenging mathematics.
  - Facilitate meaningful mathematical discourse
  - Support productive struggle in learning mathematics
  - Elicit and use evidence of student thinking
    - This kind of teaching cultivates and affirms mathematical participation and behaviors (NCTM, 2014)

High Sense of Agency

- Students with a high sense of agency make decisions about their participation in mathematics.
  - "I gotta excel in everything I do. Be the best that I can be…being the best means doing your work, asking questions, and being involved in class." (Bilal)
  - "Good math students are focused, do their work, and want to make A's all the time…I am a good math student." (Andre)

Shaping Identity & Agency

"I don't know how she does it, but sometimes she know what we are going to say before we say anything…she knows us so well that she gets us out of trouble before we get in trouble…In math, she know the right thing to say to help us with our work (Jabari)."

Shaping Identity & Agency

"… Ms. Blaine, cared about all of us. She would bend over backwards to help us when we needed it. She really helped me. She talked to me and told me that I had a lot of potential in math and that I should use it to get ahead in life. [She thought] I was capable of doing a lot in math. That's what really motivated me…She lets me know I can be cool and smart at the same time (Darren)."

Content-Context-Mode

- Content-Context-Mode (CCM) is a process-oriented model, for as teachers grow in their knowledge of students, continual revision and adaptation are necessary for effective teaching and learning (Berry 2012; Vasquez, 1990)

Content-Context-Mode

- Content is the tasks and use of representations for teaching and learning mathematics
- Context is the setting in which instruction takes place.
  - Psychological setting
  - Physical setting
- Mode is the method, form, style, or manner of instructional delivery.

"THE KIDS"

- Do you know "THE KIDS."
- What are the promises and challenges for the individuals in the group of "THE KIDS?"
  - (adapted from Brodesky et al 2004 and Spitzer 2011)

Content-Context-Mode

Matching Numbers, Stories, and Graphs

Cut out the charts, stories, and graphs. Group them to make three sets that match.

Heights	Heights	Heights
1	1	2
3	1.5	4
5.5	2	6
8.5	2.5	8
6	3.5	9
6	5	10
7	7	11

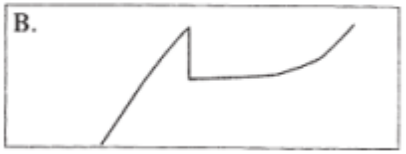
Your plant was growing very slowly on a window sill that got no sunlight. You moved it to a sunny window. Then it started growing more quickly.

Your plant was growing quickly for a while. Then you forgot to water it for several days. That made it grow more slowly.

Your plant was growing quickly for a few days. Then you dropped it and the top of it broke off. It stopped growing for a while before it started growing again.

A.

B.



C.

D.

Content-Context-Mode (Affirming)

Teacher observe and learns more about students	Observations are passed through a filter of three questions to identify which aspects of teaching are affected	Linking Teaching Practices

• Eric does his work but many problems are incorrect or incomplete.
• Eric can recite math facts and use them proficiently for computation problems.
• Eric is quiet but relates well with two people in class
• Eric is a reader and loves to draw
	Content
	Does any aspect have implications for the kind of materials and mathematics content to be taught and learned?
	
	Context
	Does any aspect have implication for the physical or psychological environment of the mathematics classroom?
	
	Mode
	Does any aspect have implications for how the mathematics content should be presented?
		• **Build procedural fluency from conceptual understanding.**
		  • Show connections among mathematical ideas
		  • Show general connections then make specific connection
		• **Facilitate meaningful mathematical discourse.**
		  • Provide opportunities where students may have individual think time then work in pairs or small, groups.
		  • Students must exchange ideas and share their thinking
		• **Use and connect mathematical representations.**
		  • Incorporate connections between manipulative use and drawings.

Identity Affirming

- Students need opportunities to learn using their strengths and opportunities to learn by compensating for their the challenges (Sternberg, 2007)
  - We must provide opportunities that play to the strengths and challenges of students.

Five Equity Based Teaching Practices

- Go Deep with Mathematics
- Leveraging multiple mathematical competencies
- Affirm mathematics identities

(Aguirre, Ingram & Martin, 2013)

- Implement tasks that promote reasoning…
- Build procedural fluency from conceptual understanding
- Support productive struggle…
- Elicit and use evidence of students' thinking

Five Equity Based Teaching Practices

- Challenge spaces of marginality (students experiences and knowledge are legitimate)
- Draw on multiple resources of knowledge (math, language, culture, family…)
- Facilitate meaningful discourse
- Use and connect mathematical representations
- Elicit and use evidence of students thinking.

(Aguirre, Ingram & Martin, 2013)

Caroline & Craig

- Talker-Listener Exchange:
  - In the Caroline and Craig vignette, we see experiences that potential shape Caroline and Craig's identities and dispositions towards mathematics.

Mathematics Identity

- Mathematics identity includes:
  - beliefs about one's self as a mathematics learner;
  - one's perceptions of how others perceive them as a mathematics learner,
  - beliefs about the nature of mathematics,
  - engagement in mathematics, and
  - perception of self as a potential participant in mathematics (Solomon, 2009).

Beliefs about Access and Equity

Unproductive Beliefs	Productive Beliefs
Students possess different innate levels of ability in mathematics, and these cannot be changed by instruction.	Mathematics ability is a function of opportunity, experience, and effort—not of innate intelligence.
Students living in poverty lack the cognitive, emotional, and behavioral characteristics to participate and achieve in mathematics.	Effective teaching practices have the potential to open up greater opportunities for higher-order thinking and for raising the mathematics achievement of all students

Overcoming Obstacles

- Educators need to identify, acknowledge, and discuss the mindsets and beliefs that they have about students' abilities.
  - Fixed Mindset: Believe that you are either smart or you are not
  - Growth Mindset: Intelligence and "smartness" can be learned and that the brain can grow from exercise (Dweck, 2006)

Overcoming Obstacles

- Access to rigorous, high-quality mathematics, taught by teachers who not only understand mathematics but also understand and appreciate learners' social and cultural contexts in meaningful ways.
- Classroom environments that foster a sense of community that allows students to express their mathematical ideas.

Actions: Leaders and Policymakers

- Allocate resources to ensure that all students are provided with an appropriate amount of instructional time to maximize their learning potential.
- Ensure that teachers at all levels are emphasizing the mathematical practices as a key element of their instruction for all students.

Actions: Leaders and Policymakers

- Eliminate the tracking of low-achieving students and instead structure interventions that provide high-quality instruction and other classroom support, such as math coaches and specialists.
- Provide support structures, co-curricular activities, and resources to increase the numbers of students from all racial, ethnic, gender, and socioeconomic groups who attain the highest levels of mathematics achievement.

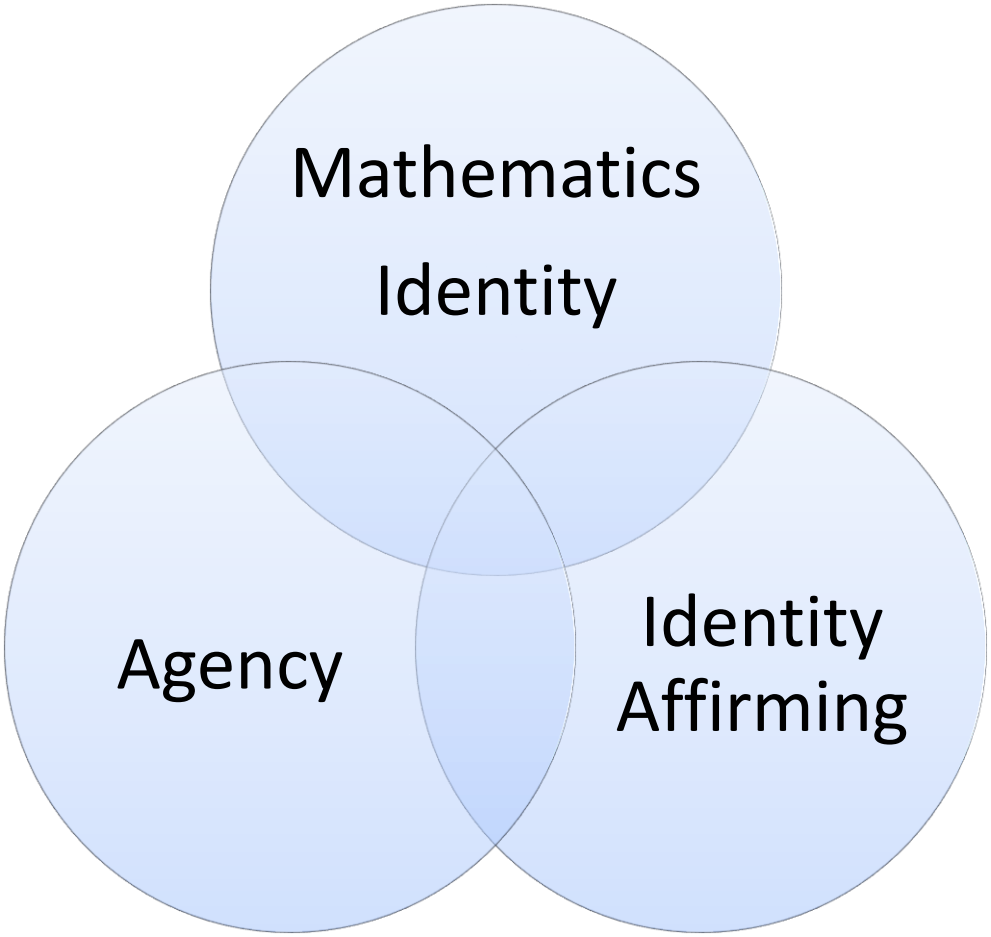
Actions: Principals, Coaches, & Specialist

- Consider teacher assignment practices to ensure that struggling students have access to effective mathematics teaching…
- Maintain a school-wide culture with high expectations and a growth mindset.
- Develop and implement high-quality interventions.
- Ensure that curricular and extracurricular resources are available to support and challenge all students.

Actions: Teachers

- Develop socially, emotionally, and academically safe environments for mathematics teaching and learning…
- Understand and use the social contexts, cultural backgrounds, and identities of students as resources to foster access, motivate students to learn more mathematics, and engage student interest.
- Model high expectations for each student's success in problem solving, reasoning, and understanding.
- Promote the development of a growth mindset among students.

Interwoven



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