Please have a seat at the content level you are *most familiar*.

Coaching teacher teams through the process of Vertical Articulation: Secondary Mathematics
Let’s get Vertical!

Coaching teacher teams through the process of Vertical Articulation: Secondary Mathematics
Round Table

Please Introduce yourself to your table members.

Share the State, County, School and Grade Level you teach, support, coach.
Please Stand Up!
If you are a...

- A Teacher
- An Instructional Coach or Teacher on Special Assignment
- An Administrator
Central Valley of California

Examples

Non-Examples
About VUSD...

- Large suburban school district in the Central Valley of California
  - 12 Secondary Schools
  - 3 Alternative Education Schools
  - 26 Elementary Schools
  - 3000 Employees
  - 29,000 students
  - 14.4% English Language Learners
  - 62.1% Free/Reduced Lunch
Today’s Objectives

We will:

▫ Discuss various activities involving *vertical articulation*.
▫ Participate in one Vertical Articulation Activity.
▫ Develop Next steps for your district.
What is Vertical Articulation?

Whip Around

Efforts to improve the understanding of the progression of mathematics across grade levels in order to improve coherence.
Different Types of Professional Development

**Lead Teachers only**
- All Day PDs
- Mini PDs delivered within Curriculum Development Meetings
- District Office

**ALL Teachers**
- Led by Lead Teachers
- During PLC time
- On Site
Today’s Focus will be the work we have done with our...

**Lead Teachers only**

- 3 All Day PDs
- At our District Office
Our ‘guides’ as we planned for Lead Teacher Teams

- Progression Documents
- Our Mathematics Vision
- CA CCSS-M Frameworks
- Big Ideas of each grade level
- “REAL” Priority standards
Progression Documents.

http://ime.math.arizona.edu/progressions/
Vision for... Mathematics

The VUSD math program will surpass expectations in student learning as a result of collaboration, goal setting and the implementation of the Standards for Mathematical Practices.

C - Collaborative Culture
L - Learning is Visible
A - Access and Equity
S - Student Centered
S - Standards for Mathematical Practices
What Students Learn in Mathematics I

Students in Mathematics I continue their work with expressions and modeling and analysis of situations. In previous grade levels, students informally defined, evaluated, and compared functions, using them to model relationships between quantities. In Mathematics I, students learn function notation and develop the concepts of domain and range. Students move beyond viewing functions as processes that take inputs and yield outputs and begin to view functions as objects that can be combined with operations (e.g., finding $(f + g)(x) = f(x) + g(x)$). They explore many examples of functions, including sequences. They interpret functions that are represented graphically, numerically, symbolically, and verbally, translating between representations and understanding the limitations of various representations. They work with functions given by graphs and tables, keeping in mind that these representations are likely to be approximate and incomplete, depending upon the context. Students’ work includes functions that can be described or approximated by formulas, as well as those that cannot. When functions describe relationships between quantities arising from a context, students reason with the units in which those quantities are measured. Students build on and informally extend their understanding of integer exponents to consider exponential functions. They compare and contrast linear and exponential functions, distinguishing between additive and multiplicative change. They also interpret arithmetic sequences as linear functions and geometric sequences as exponential functions.

Students who are prepared for Mathematics I have learned to solve linear equations in one variable and have applied graphical and algebraic methods to analyze and solve systems of linear equations in two variables. Mathematics I builds on these earlier experiences by asking students to analyze and
“Big Ideas”

Developed by the Lead Teachers on Day 1 of Vertical Articulation.

Based on ideas from the California State frameworks

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**Math 1**

**Algebraic Manipulation**
- Rearranging and collecting terms
- Factoring and canceling common factors in rational expressions
- Properties of Exponents
- *Model and analyze situations by interpreting expressions and create equations

**Understand Functions**
- Function Notation
- Domain and Range
- Interpret and Translate between representations
- Compare linear (arithmetic) and exponential (geometric sequences)

**Congruence based on rigid motion.**
- Definition of Congruence
- Triangle congruence
- Formal Constructions

**Applications of Pythagorean Theorem**
- In the regular coordinate system
- Verify geometric relationships including
  - special triangles and quadrilaterals
  - Slopes of parallel and perpendicular lines.

**Statistics and Probability**
- Compare two data distributions and differences between populations
- Drawing inferences from random sampling to create data sets.
Priority standards should be...

R.E.A.L.

R: Readiness Standard
Do students need this skill for the next level of instruction level or as a foundation for the next grade?

E: Enduring Standard
Does this standard appear at multiple grade levels?

A: Assessed (CAASPP, SAT)
Is the standard assessed as a major or additional/supporting standard?

L: Leverage Standard
Does this standard provide knowledge and skills that are valuable in multiple disciplines?
Planning For Day 1

What aha’s do we want teachers to have?
How should Teachers be grouped?
Planning For Day 1

We wanted our teachers to:

- Have a better understanding of their grade level content.
- To better understand how our assessments aligned to our Big Ideas.
- To recognize that connectedness between each grade levels’ Big Ideas.
All Day PD for Leads
The Teams

**Horizontal Teams**

1. Grade 7
2. Grade 8
3. 8th grade Integrated Math 1
4. 9th grade Integrated Math 1
5. Integrated Math 2
6. Integrated Math 3

**Vertical Teams**

1. Green: Grade 7 → Math 3
2. Blue: Grade 7 → Math 3
3. Gold: Grade 7 → Math 3
4. Red: Grade 7 → Math 3
All Day PD for Leads
The Product

Day 1 Developing our Big Ideas:

- Teachers read standards frameworks section “What students Learn in Math __.”

- Postered their color coded Big Ideas of each Grade Level

- Aligned Final Assessment items with Big Ideas using color coding.
| 3 | **Vertical Teams**  
GWHS-VO-Breanne  
RHS-GA-Cassie  
EDHS-LJ-Laurie  
MWHS, Divis- Debbie | **Math 3** begins:  
Our standard is A.APR_____ which is _____ describe standard________. We solve this problem by **Solution Pathway**.  
Students need to know **Learning Progression** before learning this standard.  
**Math 2:**  
We support Math 3’s standard by teaching standard ____. We solve this problem by **Solution Pathway**.  
Students need to know **Learning Progression** before learning this standard.  
Math 1, Math 8 and Math 7 follow, respectively, using Math 2’s frame. | **Algebra Problem from each vertical team and Note-taking Guide Poster:**  
Give each team blank copy of problems.  
Teams poster student friendly language for vertical learning progression. | **To make vertical learning progressions visible.** |
|---|---|---|---|
| 4 | **Vertical Teams**  
GWHS-VO-Breanne  
RHS-GA-Cassie  
EDHS-LJ-Laurie  
MWHS, Divis- Debbie? Phil? | **Repeat Steps 2,3 for:**  
\[ \begin{align*}  
a. \ & \text{Functions}  
b. \ & \text{Geometry}  
c. \ & \text{Statistics}  
\end{align*} \] | **Vertical Problems template for Algebra--grade level specific:**  
Algebra Problem from each vertical team and Note-taking Guide  
Give each team blank copy of problems.  
Teams poster student friendly language for vertical learning progression. | **To**  
- Continue to deepen connections between grade levels  
- relate our Big Ideas to our daily lessons |
Day 2 continued

- Used color coded team documents to create Big Ideas and color coded assessments.

- Algebraic Manipulation
  - Rearranging and collecting terms
  - Factoring and canceling common factors in rational expressions
  - Properties of Exponents
  - *Model and analyze situations by interpreting expressions and create equations

- Understand Functions
  - Function Notation
  - Domain and Range
  - Interpret and Translate between representations
  - Compare linear (arithmetic) and exponential (geometric sequences)

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    - special triangles and quadrilaterals
    - Slopes of parallel and perpendicular lines

- Statistics and Probability
  - Compare two data distributions and differences between populations
  - Drawing Inferences from random sampling to create data sets.
Day 2 cont’d: Vertical Articulation Activity

Horizontal Teams

1. Solve one problem from four domains.
2. Describe Solution Pathway for each problem.
3. Describe the learning progression for each problem.

Let’s Do This!
Please move into Vertical Teams
Vertical Articulation Activity

Vertical Teams

1. Vertically align problems on poster paper.
2. Write Learning Targets for each assessment item to demonstrate the learning progression from grade 7 through Integrated Math 3
3. Record on note taking guide how one grade level supports the next.
Gallery Walk

As a group, begin visiting posters.
Leave feedback on posters using sticky notes.
Feedback can be questions, comments or even “a-ha’s”
End of Day Two

The Product

- Student Friendly Learning targets for each domain.
- Gallery Walk and Post its revealed further questions and comments for consideration
### Category: (F.TF.) Trigonometric Functions

#### Cluster: Extend the domain of trigonometric functions using the unit circle.

#### Standard:

<table>
<thead>
<tr>
<th>Math 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In the unit circle below, the arc between points P and Q has length m.</strong></td>
</tr>
</tbody>
</table>

**Solution Pathway**

**Learning Progression**

If the coordinates of point Q are \((-\frac{1}{2}, \frac{\sqrt{3}}{2})\), then what is the value of \(\tan(m)\)?

- A. \(-\sqrt{3}\)
- B. \(-\frac{\sqrt{3}}{3}\)
- C. \(-\frac{1}{2}\)
- D. \(-\sqrt{2}\)
<table>
<thead>
<tr>
<th>Notes</th>
<th>7th Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard:</td>
<td>Standard:</td>
</tr>
<tr>
<td>Supports M2 by:</td>
<td>Supports M3 by:</td>
</tr>
<tr>
<td><strong>PEF 3</strong></td>
<td><strong>PEF 3</strong></td>
</tr>
<tr>
<td>( y = mx + b )</td>
<td>Quadratic function</td>
</tr>
<tr>
<td>transform</td>
<td>std vs. vertex form</td>
</tr>
<tr>
<td>make table</td>
<td></td>
</tr>
<tr>
<td>( \text{Subst. values} )</td>
<td></td>
</tr>
<tr>
<td>Affected by ( K )</td>
<td>affected by ( a, h, k )</td>
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</table>
Day 3: Planning

- Planning 7-11 Math Articulation
- What do you want teachers to know / be able to do by the end of the day?
  - FOCUS ON STUDENTS
  - 7th/8th: See the importance of their standards for upper grades
  - 7-11: What is priority / supporting?
- Math 1: See what students do in 7th/8th (they think kids know nothing - pre-assess)
- Which standards are in multiple grade levels?
- 7-11: Want to fix things
- Math 1/2: Focus on teaching practices
- 7-11: How to integrate standards (cohesive)

What would make me, as a teacher, feel good about the way I spent the day?
- Have an "aha" experience
- Address my "felt need"
- Something I want to use
- Gain clarity + insight
- Validation of work already done
- Have my questions answered
- Feel connected with colleagues
- Feel comfortable (we’re all on the same side)

Issues
- Teaching topically
- Forgetting
  1. How to teach so they remember
- Re-engage who re-teaching
  - What is being taught? Re-engage?
  - When

Barriers: if learned procedurally (only), harder to retrieve
- "Not assessed at our grade level; therefore not a priority."
R: Readiness Standard
Do students need this skill for the next level of instruction level or as a foundation for the next grade?

E: Enduring Standard
Does this standard appear at multiple grade levels?

A: Assessed (CAASPP, SAT)
Is it assessed as a major or additional/supporting standard?

L: Leverage Standard
Does this standard provide knowledge and skills that are valuable in multiple disciplines?
Day 3: Process

Horizontal Teams

- Sort Standards into Big Ideas
- REAL: Prioritize standards
- Cluster remaining standards under each priority
Day 3: Process

Horizontal Teams

- Sort Standards into Big Ideas
- REAL: Prioritize standards
- Cluster remaining standards under each priority
Next Steps

What will you do to ensure that your teacher teams continue to learn about the progression of mathematics across grade levels?
We are Visalia Unified. We educate kids. We create futures.

#OTOM
One Team One Mission
Stay Connected

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#NCTMAnnual  #Math Angels