


Maximizing Academic Opportunities for Students in CTE Programs

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The Oregon Applied Academics Project



Developing Technical Math Curriculum

How would you go about using math to build this staircase?



Our Intent

- Create a collaborative model for developing applied math courses that:
 - Meet Oregon graduation requirements.
 - Improve student performance.



Informed by the new Oregon Diploma

...the math standards may also be met through courses that incorporate the standards such as Integrated Math, Applied Math, Construction Math, and Business Math..”

Oregon State Board of Education, 2007



Based on Sound Principles

- Start with the context
- Teach to standards that make sense
- Carry through the red thread
- Maintain the rigor of the math
- Engage students in doing math



While Preserving Rigor

- Rigor and Relevance framework
- Higher levels of math knowledge--
concepts/principles (standards; Algebra 1 +)

AND

- Higher levels of application to real-world
problems (synthesis and innovation)



And Promoting Deeper Learning

- Use multiple and varied representations of concepts and tasks.
- Encourage elaboration, questioning and explanation.
- Engage learners in challenging tasks.
- Teach with examples and cases.
- Prime student motivation.
- Use formative assessments.



Using a Problem-Based Approach

Newmann, Fred M. and Gary G. Wehlage. "Five Standards of Authentic Instruction."

<http://www.ascd.org/publications/educational-leadership/apr93/vol50/num07/Five-Standards-of-Authentic-Instruction.aspx>

- Connection to the World
 - Connected to real-world public problems
- Higher-Order Thinking
 - Combine facts and ideas in new ways
- Depth of Knowledge
 - Focused on the central idea of a topic



Using a Problem-Based Approach

- Substantive Conversation
 - Ideas are shared
- Social Support
 - High expectations



Developing Technical Math Curriculum

The Process

Planning a unit (back to the staircase...)

- What is the “real-world” problem or “big question?”
- What are the math concepts/constructs in the problem?
- In what CTE content will the math be learned?
- What are the core standards that will be addressed by the unit?



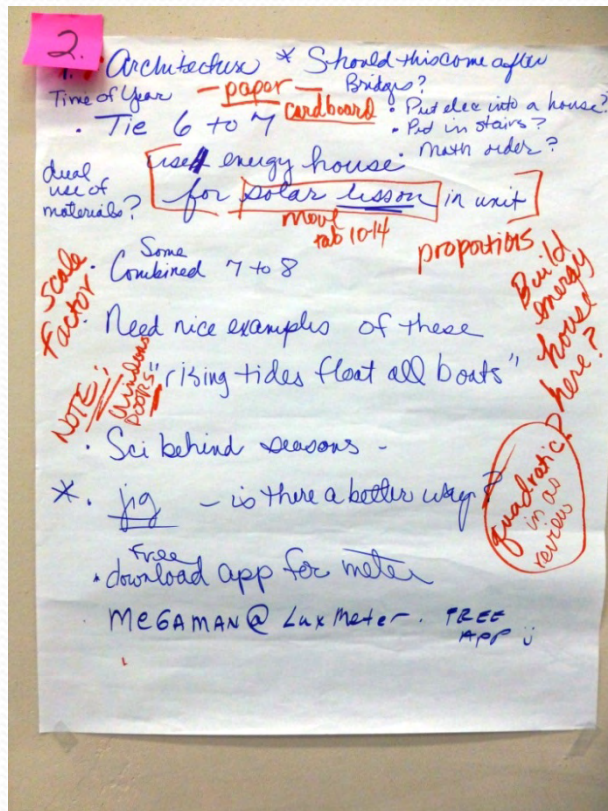
Lesson development...key elements

- Introduce the real-world problem
- Assess students' pre-knowledge of math
- **Instruct math concepts/principles embedded in the problem**
- **Reinforce instruction with related real-world examples**
- **Present the math as it looks in traditional courses**
- Provide students authentic opportunities to demonstrate their ability to solve the problem.
- Use traditional math assessments that address standards

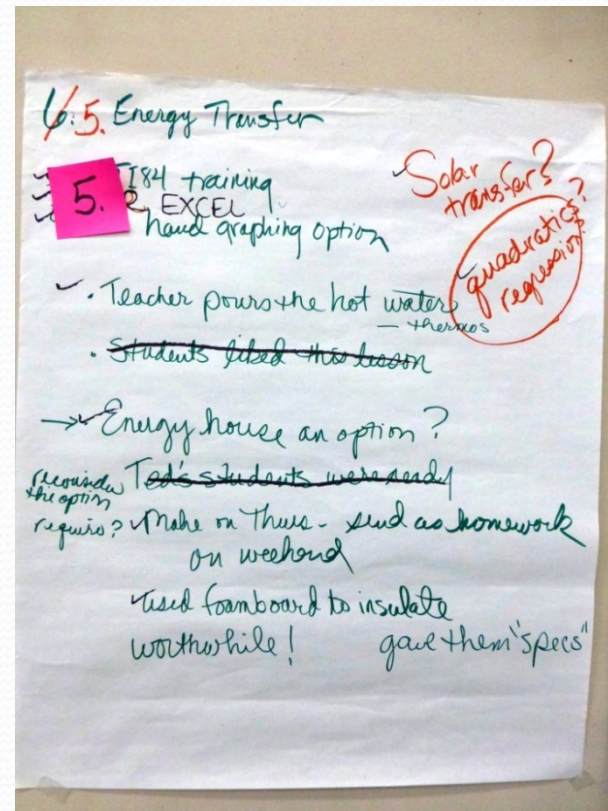


Everything captured on paper...

Unit Development



Lesson development



Updating and changing lessons



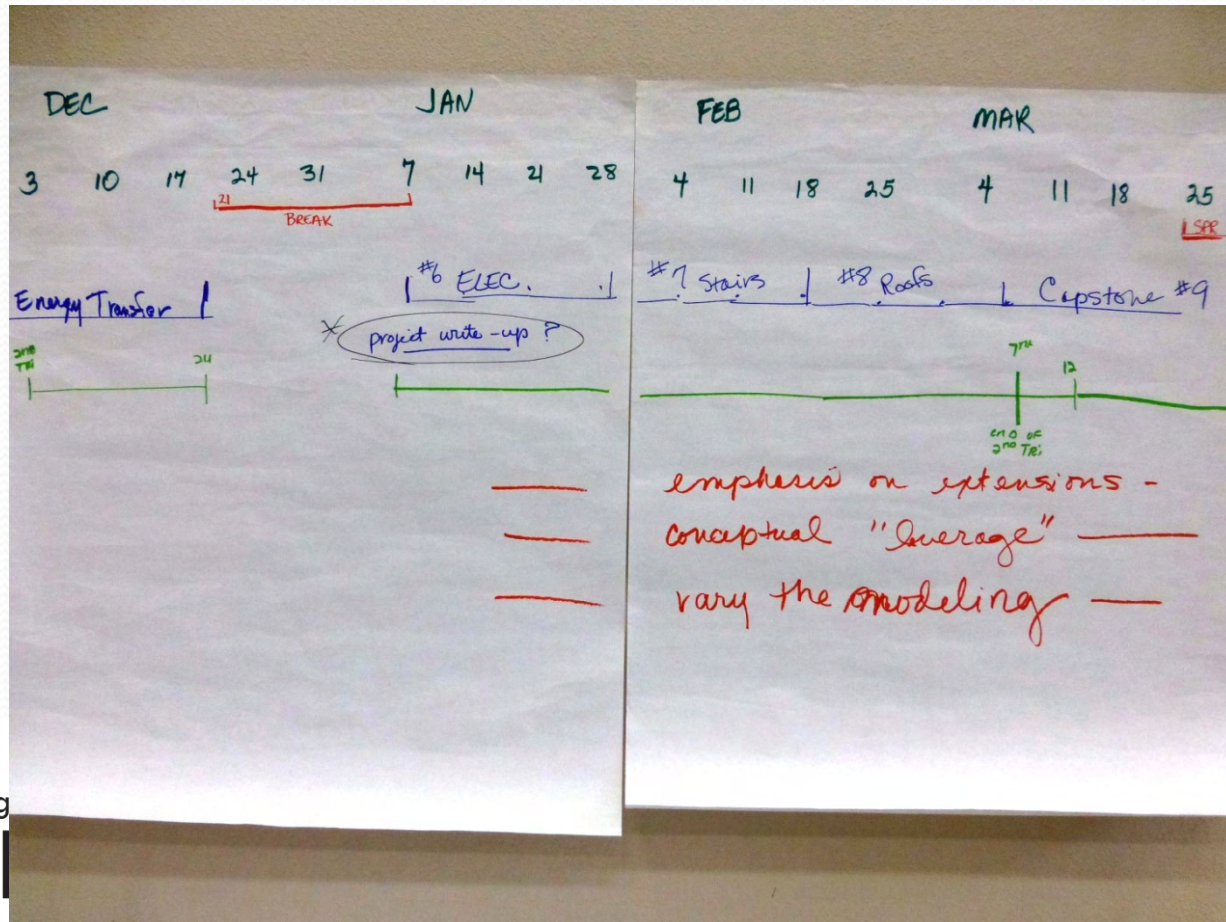
Peer teaching of the units



Investigating resources



Developing a unit calendar for the year



Developing Technical Math Curriculum

The Research

Project Purpose

Create a collaborative model for developing a technical math course that meets graduation requirements and improves student performance



Joint Effort

- Oregon Department of Education (ODE)
- National Research Center for Career and Technical Education (NRCCTE)
- Lane County Education Service District (ESD)



Three Year R&D

Phase 1: Year 1

Development teams design instructional units for trial implementation in Year 2.

Phase 2: Year 2

Development teams implement the course and refine the units for a Year 3 test.

Phase 3: Year 3

Technical math course is implemented and tested at pilot schools.



Key Features of the Model

- Be replicable
- Meet HS math levels, standards, or both
- Offer a systematic, intentional approach (not episodic)
- Involve partnerships with career and technical education (CTE)



Foci of Units

A combination of Algebra and Geometry was situated in CTE-oriented units:

- Manufacturing
- Bridge
- Staircase
- Trusses
- Electrical
- Energy Transfer
- Architecture
- Animal House
- Marketing



Student Measures

- Pre- and post-testing of mathematics ability in tech math and comparison classrooms (Accuplacer)
- Math Attitude Inventory (ATMI)
- Demographic student surveys
- Artifacts of student activities and accomplishments



Year 3 Findings

- Significantly improved math attitudes over peers in comparison classrooms
- Comparable math achievement to peers in comparison classrooms
- Students with high pre-test scores improved over their peers in geometry classes



Teacher Measures

- Pre- and post-PD teacher surveys
- Online pre-unit reports from CTE partners
- Lesson-by-lesson reports from the mathematics teachers
- End-of year focus groups



The Teacher Experience...

... problem-based or project-based learning, I find... very exciting.

It's easy for me in a ...traditional math direct lesson... to get as bored as the kids do occasionally. And so I found [PBL] stimulating.



The Teacher Experience...

“Am I in a math class or am I in a CTE class?” And so I found several times when it came time to ... some of the rigor of math, [I said] “Okay, it’s a math day.”



The Teacher Experience...

I was excited for this set of lessons because the students that I work with ...traditionally don't do well in school and need a hands-on component to make math relevant...

I was hoping this would do it for them, and from what I see it works...



The Teacher Experience...

The electrical unit ...was just mind-boggling for me. When I first looked at it, I said, “Ah. How are we really going to do this?” It was something I knew absolutely nothing about whatsoever, and that was a challenge.




The Teacher Experience...

[Some students] were used to doing a problem on a piece of paper, and if the result didn't work out, they could move along... and never have to deal with it again....

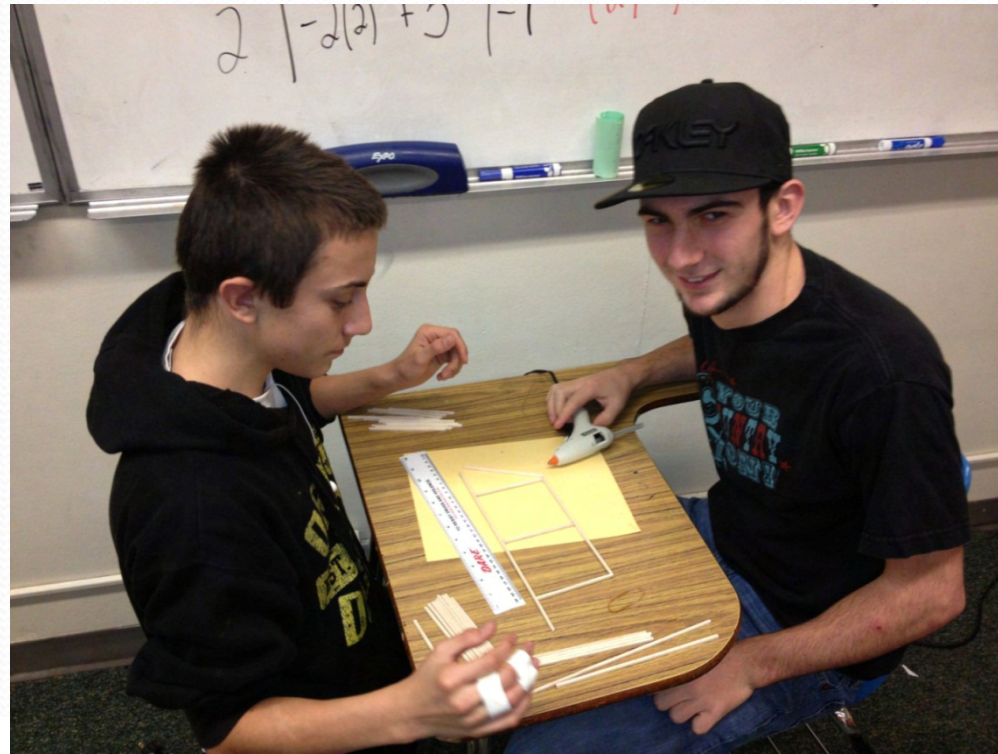
when you're doing the math that we're trying to do, they had to get it right before they could go do the [CTE] activity, and that is a unique



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The Student Experience...

Students liked working in teams





Students
enjoyed
building their
projects

Student Feedback

“I learned a lot now I will be able to help my dad build a house this summer”

“ Math is starting to make sense to me”

“Working in teams is a lot of fun someone always knows what to do.”



Emergent Principles

- Fostering partnerships between math and CTE teachers.
- Emerging communities of practice.
- Math as a central feature of situated problems and questions
- Adapting instruction within the units
- “We are teaching mathematics in context: we are not CTE teachers.”



For more information...

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