

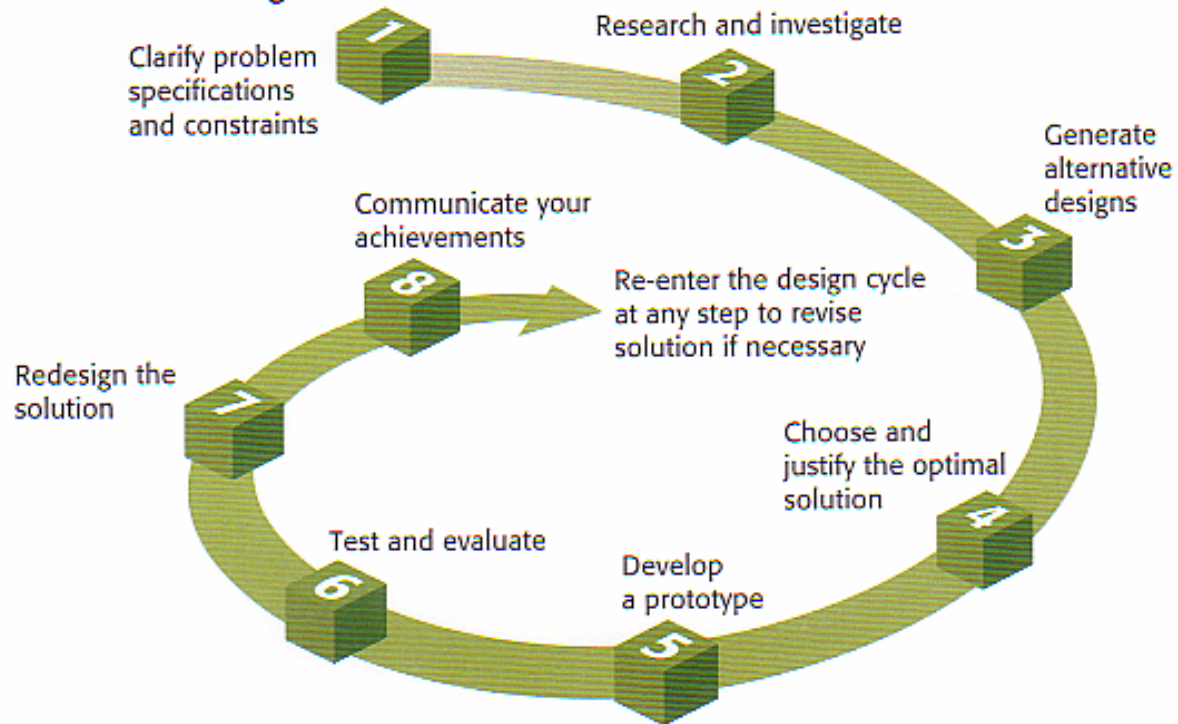
WiP--Math Infusion in a Middle School Engineering/Technology Education Classroom

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Informed Design

The Informed Design Process



Math Infusion – Knowledge and Skill Builders

KNOWLEDGE AND SKILL BUILDERS

A key idea in the informed design process is to have scaffolding math, science and technology activities that “inform” student knowledge before the design is attempted.

**These activities are called
Knowledge and Skill Builders (KSBs).**

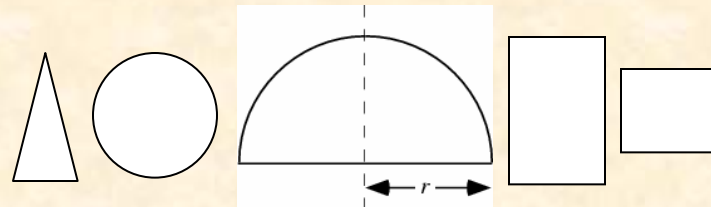
The process is very consistent with the “backwards design” process advocated by Wiggins and McTighe.

Examples of Middle School Math KSBs

- **BEDROOM DESIGN**

Scale. Scale models help in visualizing what a finished room will look like. Make three scale drawings of a room that measures 12 feet by 15 feet. Make one drawing for each ratio: $\frac{1}{2}$ inch = 1 foot, 1 inch = 1 foot, and 2 inches = 1 foot

Ratio and proportion. Window Area must be 20% of the floor area. Design a window using a geometric shape of your choice.



What about the M in STEM??

- **What mathematics do students require?**
- **Of the standards-based mathematics, what mathematics can be contextualized?**
- **What about our teachers' mathematics preparation?**

Getting to Know the Math

- **Some mathematics can be embedded into ETE. Some 8th grade examples are:**
 - **Calculate distance using a map scale**
 - **Understand that numerical information can be represented in multiple ways**
 - **Create a graph given a description or an expression for a situation involving a linear relationship**
 - **Use the Pythagorean Theorem to determine the unknown length of a side of a right triangle**

Source: NYSED Core Mathematics Curriculum

Knowing the math means...

- **Knowing math content**
- **Knowing math pedagogy**
- **Knowing what math is in the standards**
- **REALLY knowing the math also means knowing how to teach it.**

MSTP Professional Development Model

These essential elements have been identified by MSTP for professional development:

- 1) Guided collaborative lesson plan design, implementation, feedback and revision**
- 2) Supported academic year implementation**
- 3) Peer review and learning communities.**

Exemplary Lesson Planning

Model Lesson Plan Elements

- **Lesson Objectives**
- **Background Knowledge Required**
- **Preconceptions/Misconceptions that might Impede Understanding**
- **Math and Science Performance and Process Standards to be Addressed**
- **Math that Informs Science/Technology**

Exemplary Lesson Planning

Model Lesson Plan Elements, Continued

- **Assessment Strategies that will be Used**
- **Pedagogical Practices to be Employed**
- **Detailed Instructional Planning**
- **Reflection re: the Day's Lesson**
- **Pre/post Assessment**

Lesson Implementation and Fine Tuning

Lesson Plan Implementation

- **On the first day, teachers come with the beginnings of their lesson plan template filled out.**
 - During after-school meeting, teachers work in grade- and discipline-level teams to refine their plans.
- **Teachers Implement the lesson with their classes.**
 - During implementation, teacher collect high, medium, and low student work examples
- **The teachers return with their lesson plans, student work, assessments of student learning, and their own reflections.**
 - A critique of student work will occur within a peer review format. This is a learning community where teachers critically examine the quality of the work. The lesson plan is revised based on student attainment of instructional goals.

Teacher Reaction to A/B Workshops

STEM Teacher Responses

- **98.2% of all teachers found the A/B workshops to be very useful or useful (n=180)**
- **90% teachers from participating schools stated they were able to use the MSTP lesson template to create a successful lesson that included enhanced math and/or that infused math into science/technology**
- **Over 90% of the teachers stated they would use the MSTP lesson they created in their classrooms again.**
- **90% of teachers believed they spent enough time working with teachers from their own discipline**
- **Only 60% of teachers believed they spent enough time working with teachers from other disciplines.**

Bedroom Design Challenge

You are moving to a new house that is being built for your family and a friend is also moving to a new house being built. The same architect is being used by both families and needs information regarding your living style to determine the best design. Time for some fun—Trading Places. You and your friend have a challenge to design the optimal furnished bedroom for each other. It can be a dream bedroom and you have a budget of \$27,500 to design a rectangular bedroom with minimum dimensions of 130 square feet. However, the budget increases to \$30,000 if you design a non-rectangular bedroom with a minimum area of 130 square feet.

Bedroom Design Challenge

You and your teammates are to design a furnished bedroom. You will build virtual and actual scale models of your bedroom, with furnishings.

Bedroom Design Specifications

- The window area must be equal to at least 20% of the floor area.
- The minimum room size is 130 square feet. The minimum height of all ceilings is 8 feet and the maximum is 12 feet.
- The bedroom will have two outside walls and two interior walls. In the actual scale model one interior wall can be removed for ease of access and seeing the design.
- The budget is \$27,500 for a rectangular bedroom and \$30,000 for a non-rectangular bedroom.
- The cost of basic construction is estimated at \$150 per square foot of floor area.

Some Research Findings

Infusing Math into Bedroom Design

- **n = 128 students**
- **A paired t-test indicated the difference was statistically significant, providing evidence that students were showing gains on their math content knowledge. $t(128) = 2.828, p < .005$**

Math Infusion - Challenges

- **Teacher Pedagogical Content Knowledge**
- **Assessment Questions**
- **Scoring Rubric for open-ended questions**
- **Consistency of unit between teachers**

Current Efforts

- Training of 15 middle school tech ed teachers in summer 2008
- Refined assessment questions
- Continued use of comparison teachers
- Use of combined electronic and hardcopy design portfolio
- Use of Excel in evaluating alternative designs.

For Further Information

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