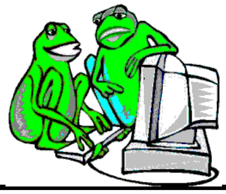
TENNESSEE TECHNOLOGY ENGINEERING EDUCATION



Straight from the Frog's Mouth!

The Southern Edition

December 2009
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ADDRESSING MATHEMATICS LITERACY THROUGH TECHNOLOGY ENGINEERING

Inside this issue:

As a subject area, we are often not given the credit that we rightfully deserve for helping to deliver basic skills in the classroom as we prepare our students for careers in STEM.

Once upon a time math teachers taught math, and technology teachers taught technology (and of course, technology engineering teachers also taught math, not to mention science, often a bit of history, usually some economics, language arts, creative writing, and elements of other subject as well). Those of us who teach technology engineering education have always know this. Perhaps because technological content is so inextricably linked to other subjects, we take the notion of interdisciplinary instruction for granted as a routine part of our teaching. But do other teachers realize this? Do most school administrators recognize this? Does the general public recognize this?

In an era when so much emphasis is being placed on the high-stakes standardized testing of fundamental subjects such as reading, writing, and math, it makes sense to demonstrate the role technology engineering educators play in developing such fundamental knowledge and sills in our youth.

Does technology engineering education really make a contribution to mathematical literacy? In order to answer this question, a basic review of the mathematical standards that define math literacy may be a logical place to start. In 2000 the National Council of Teacher of Mathematics (NCTM) published its most recent version of Principles and Standards for School mathematics (PSSM) (NCTM, 2000). Like our own Standards for Technological Literacy:Content for the Study of Technology (STL) (ITEA, 2000, 2002, 2007), the authors articulate what students should know and be able to do with mathematics at various grade levels including pre– K-1, 3-5, 6-8, and 9-12.

The mathematics standards are ramped, meaning that the same standards exist at almost all grade levels, but the difficulty level and the expectations grow more challenging as the grade levels increase. What follows is a brief explanation of each content standard along with examples from technology engineering education laboratories like your won, where you may be helping students to achieve competence toward a mathematics literacy standard that perhaps you never even know about.

NCTM Standard 1: Number and Operations

- Understanding numbers, ways of representing numbers, relationships among numbers, and number systems.
- Understand meaning of operations and how they relate to one another
- Compute fluently and make reasonable estimates.

Sample Activities:

- Students in an electronic module construct a digital clock out of light-emitting diodes. The clock reads in binary coded decimal as follows: OXXOX : OOOXXX. What time is the clock reading?
- Students in a communications are storing pictures of school activities throughout the year to save to a CD for the graduating seniors. Each picture consumes approximately 35 to 40kb or memory. If the student wish to burn a CD that has about 680mb of useable space, then how many pictures can be saved to one CD?

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QUALITY PROGRAM INDICATORS

Each month we will provide some focus on two of the Quality Program Indicators (QPI) as outlined by the Department of Education. These QPIs must be met before any federal Perkins Funds can be used to support the program. In the October issue, all ten QPIs were listed. This month we will focus on **QPI #1 and QPI #2.**

QPI #1 - Programs of such size that offer a sequence of three or more earned credits.

Research has shown that students having three (3) or more CTE credits in a sequence have a higher graduation rate (89.5%) as compared to students taking less then three (3) CTE credits (78%). CTE programs offering three (3) or more courses affords the student opportunities to have a higher level of knowledge and skill attainment, more dual credit/dual enrollment opportunities, increased industry certification opportunities and increased post-secondary scholarships prospects.

Career and Technical Education programs must be of size and scope to offer a sequence of courses that allows a student to become concentrators. If a program does not offer at least three (3) credits, it is difficult for the student to develop the skills and knowledge to become concentrators and transition to post-secondary education. Furthermore, it would be difficult for the student to meet the State Board of Education's graduation requirements as outlined in the Tennessee Diploma Project of having three (3) earn credits in a focused program of study. A list of the graduation requirements can be found on http://tennessee.gov/education/gradreq.shtml.

QPI #2 - Programs of such scope that are aligned with state approved programs of study within career clusters.

Tennessee State Board of Education has implemented rigorous graduation requirements for all students. All students will pursue a focused program of study preparing them for postsecondary study. While all students may not enter postsecondary training immediately following high school, they must be prepared for lifelong learning.

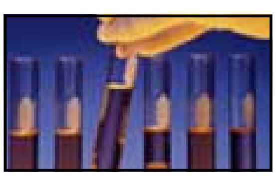
Students will complete an elective focus of no less than three credits. The elective focus may be CTE, science and math, humanities, fine arts, AP/IB, or other areas approved by the local board of education. Students completing a CTE elective focus within a single career cluster must complete three units in the same CTE program area or state-approved program of study.

Below is an outline of how QP #1 and #2 may be implemented.

Cluster – Science, Technology, Engineering and Mathematics (STEM)

Planning, managing, and providing scientific research and professional and technical services (e.g., physical science, social science, engineering) including laboratory and testing services, and research and development services.

Program of Study (POS)/Course Sequence – Science and Mathematics



Those who choose careers in the Science and Mathematics program of study apply essential mathematics and science content and skills in a real world context. Science and mathematics occupations include those in physical, environmental and human endeavors. Career possibilities range from teachers of science and mathematics to lab technicians to NASA astronauts. Preparation for such occupations require the following:

1. Understanding the process and applying the skills necessary to engage in discovery.
2. Recognizing the need to obtain a broad education in science and mathematics and share (communicate) this knowledge with the world.
3. Understanding the role of gathering, creating, processing and sharing data in science and mathematics.

QUALITY PROGRAM INDICATORS

Program of Study (POS)/Course Sequence – Engineering and Technology

For a future in the Engineering and Technology program of study, students should study and apply principles from advanced mathematics, life sciences, physical science, earth and space science, and technology. In addition, future engineers and technologists should learn certain processes in mathematics, science and technology. In Grades 9-12, all future engineers and technologists should study mathematics each year, learning important mathematical concepts and processes defined by the National Council of Teachers of Mathematics in Principles and Standards for School Mathematics. With such knowledge and skills, students will be able to demonstrate the following competencies: Apply mathematics, science and technology concepts to solve problems quantitatively in engineering projects involving design, develop Association for the Advancement of Science in Benchmarks for Science Literacy. Additionally, learners should become proficient in the areas of technology defined by the Standards for Technological Literacy.

Grade Level	POS - Science and Mathematics	POS - Engineering and Technology
9th	Foundations of Technology	Foundations of Technology
10th	Technological Systems	Technological Systems
11th	Advanced Technological Applications	Advanced Design Applications
12th	Problems and Solutions in Technology	Engineering Design

Implementation of the career cluster and programs of study is a vital component to attain Quality Program Indicators #1 and #2.

A listing of all career clusters and associated Programs of Studies can be found on http://pathways.tbr.edu/programs.php.

Additional questions or assistance should be directed to Thomas D'Apolito, DTE, Ph.D., Technology Engineering Education Program Consultant at tom.dapolito@tn.gov or call 615-532-2844.

New TSA Conference Registration Procedure

CHAPTER ADISORS: When register for Regional and State Conference, you go to the Tennessee Online Registration site @ http://www.registermychapter.com/tsa/tn/.

IMPORTANT: You will not enter the State issued username and password. To Log in to the Tennessee site you will need to enter the username and password that National TSA has sent you once you have affiliated for 2009 - 2010 school year.

If you have not affiliated with National TSA, you will not be able to register your chapter for Tennessee Conferences. The new procedure will only allow you to register students for Regional or State Conferences who have been registered on your National affiliation form. National TSA and Tennessee TSA are now using the same database.

Any advisor who Affiliated for 2009 - 2010 and has forgotten their username and password sent by National TSA need to call Ms Heather Henderlight at 865-594-6044 or email her at heather.henderlight@tn.gov and she can assist you with this. She will only have the username and passwords for the chapters who have already affiliated.

ADDRESSING MATHEMATICS LITERACY THROUGH TECHNOLOGY ENGINEERING EDUCATION

(Continued from Page 1)

NCTM Standard 2: Algebra

- Understand patterns, relations, and functions
- Represent and analyze mathematical situations and structures using algebraic symbols
- Use mathematical models to represent and understand quantitative relationships
- Analyze change in various contexts

Example of Activity:

- Students in transportation are challenge to calculate the cubic inch displacement of a six-cylinder engine with three-inch cylinder bores and four inches of displacement per stroke for each cylinder. What is the total CID for the engine?

NCTM Standard 3: Geometry

- Analyze characteristics and properties of two and three dimensional geometrical shapes and develop mathematical arguments about geometric relationships.
- Specify locations and describe spatial relationships using coordinate geometry and other representational systems.
- Apply transformations and use symmetry to analyze mathematical situations.
- Use visualization, spatial reasoning and geometric modeling to solve problems.

Example of Activity:

- Construct a tower structure by rolling single 8.5” x 11” sheets of printer paper into columns, using up to 10 sheets maximum. Students will use formulae to calculate volume of a cylinder, determine how much concrete each team’s structure would consist of if the paper columns served as forms for concrete. A cost analysis will also be submitted.

NCTM Standard 4: Measurement

- Understand measurable attributes of objects and units, systems, and processes of measurement.
- Apply appropriate techniques, tools, and formulas to determine measurements.

Examples of Activity:

- High School - Check an engine valve stem for wear with a micrometer. The repair manual provides a specification that the valve should be discarded if it is worn to less than .249. They are to determine the status of the valve stem.

NCTM Standard 5: Data Analysis and Probability

- Analyze Formulate questions that can be addressed with data and collect, organize and display relevant data to answer them.
- Select and use appropriate statistical methods to analyze data.
- Develop and evaluate inferences and predications that are based on data
- Understand and apply basic concepts of probability.

Example of Activity:

- Calculate the cost of insulation that is rated at R13 costing $ .30/square foot versus insulation that is rated at R23 costing $ .50 per/square foot for use on the exterior walls of a propane-heated work shed. The wall area is 440 square foot. The average temperature between inside the shed and outside is 30 degrees F over a 210 day heating season and the she is heated all winter long. If the cost of propane is $1.75/gallon, is spending the money on the better insulation justified.

As technology engineering educators we have always been required to teach some aspects of mathematics, but we have not done a particularly good job of articulating our contributions to mathematic literacy to the public at large. **IT IS TIME - SPREAD THE WORD.** Technology Engineering does help all student become technologically literate and helps them applies STEM.

May you and your families be blessed during the Holiday Season. Heather and I look forward to seeing many of you at our TSA Regional Conferences in January and February.

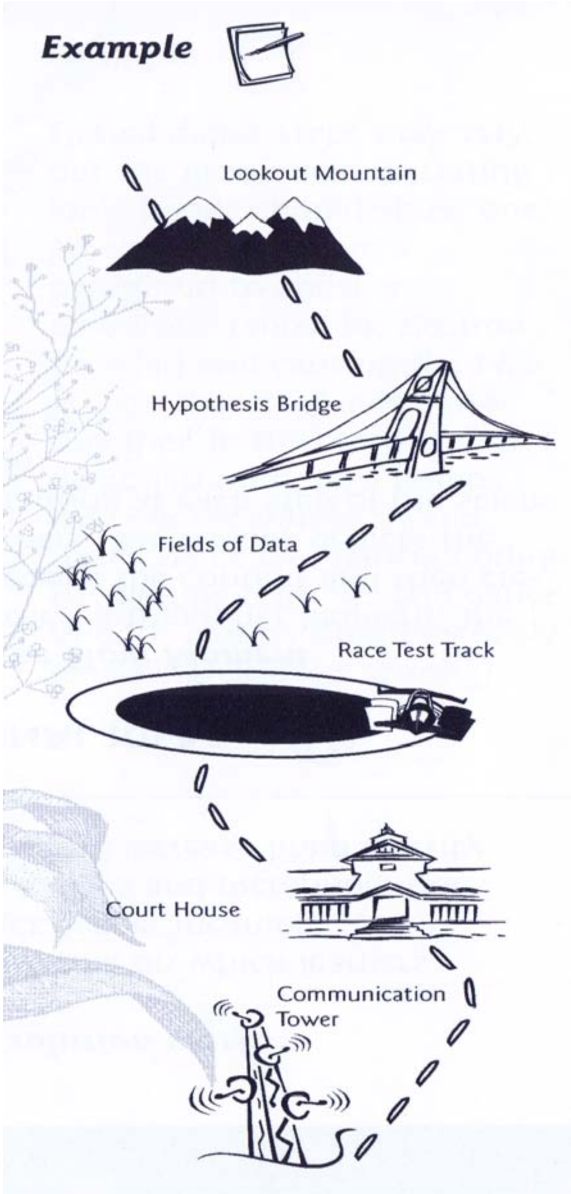
Dr. Dap

STEPS OF THE SCIENTIFIC METHOD

Strategy to Remember Process and Procedures

Every CTE area has a multitude of processes and processes that students must understand completely before entering a lab or research activity. The Personal Mapping example below can help you engage every student to understand even the most difficult process or procedure. This process can help you to either validate or non-validate a teaching strategy or instructional procedure in any program area.

Steps of the Scientific Method



Objective:
Students recite from memory the six steps of the scientific method.

Problem Area:
Although students are taught the scientific method multiple times during their years of education, they often have difficulty remembering the steps and order of the process.

Solution:
Cartographer Moment
Students create a map reviewing the steps in the Scientific Method.

1. **Present the steps in the scientific method.**
   a. Ask a Question
   b. Research/Observe
   c. Hypothesis
   d. Test by Experiment /Collect Data
   e. Conclusion
   f. Communicate Your Results

2. **Brainstorm map features.**
3. **Map the process**
4. **Review maps.**

Cartographer Moment
Students create a map reviewing the steps in the scientific method.

1. Present the steps in the scientific method.
Through interactive lecture, experiment, demonstration or other teaching method, ensure that all of the students have a solid understanding of the steps in the scientific method.

STEPS OF THE SCIENTIFIC METHOD

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2. Brainstorm Map Features. Ask students: If you were to describe this process just like you would give directions to a location on a map, what kind of landmarks would come to mind? Discuss their examples and provide your own such as: The landmark for the first step, "Make an Observation," might be Lookout Mountain. The landmark for step six, "Conclusions and Recommendations," might be a courthouse.

3. Map the Process: Students use the ideas generated in step two and additional ideas to create a map of the scientific method process. Thinking of this process in our own way helps us connect it in our brain. Building from our prior examples of landmarks for each step in the Scientific Method process, create your own map using the style of your choice. Take 5 minutes to create your map on the paper provided. (We suggest 11x17 sized paper.)

4. Remind them to include details like road names and drawing of features like islands, lakes, and mountains.

5. **Review Maps.** When the maps are complete, have the students tape them to the wall. Instruct the students to walk quietly around the rooms noticing how others represented the steps in the process. Lead a discussion highlighting various landmarks for each step in the scientific method.

Why this solution works

- Builds schema on which learners construct deeper meaning
- Creates images and metaphors that stimulate and increase brain activity

ADDITIONAL IDEAS

Go With the Flow Moment

Similar to the Cartographer Moment, the students receive the content and then create a flowchart that visually depicts the activity occurring at each step of the scientific method.

Source: Creative teaching "moments" for challenging topics

Date	Event
December 1, 2009	Regional Conference Registration Opens
January 15, 2010	Regional Conference Registration Closes
January 19, 2010	Middle TN TSA Regional Conference - Fairview, TN
January 22, 2010	South-East TN TSA Regional Conference - Chattanooga, TN
January 26, 2010	West TN TSA Regional Conference - Jackson, TN
February 15, 2010	East TN TSA Regional Conference - Knoxville, TN

COOPERATIVE LIVING HABITAT LESSON PLAN

Grade Level: 7, 8, 9, 10, 11, 12

Subject (s):
Technology Engineering Education, Science/Environmental Education

Description: Students are engaged in a process of creating a model **Cooperative Living Habitat** in the local community.

Goals: As a result of their direct involvement in a school year-long service project, students will be able to:

1. explain the concept **Cooperative Living Habitat**,
2. identify the characteristics of a **Cooperative Living Habitat**, and
3. design and implement a detailed site management plan. a **Cooperative Living Habitat**.

Objectives: Students will:

1. interact with community resource people
2. interact with a selected natural environment site
3. read about conservation/stewardship/management practices and programs
4. map the natural environment site
5. collect (on film and video tape) data
6. analyze data
7. evaluate alternative strategies re: site management
8. select a preferred site management strategy
9. design/implement a detailed site management plan
10. test soil samples
11. analyze rock samples, write science lab reports

Materials:

- Community resource people
- a natural environment site
- sketch pads/pencils
- compasses
- reference materials (print/non-print and software)
- still/motion picture cameras and video tape equipment (for data collection purposes)
- water testing kits
- soil testing kits

COOPERATIVE LIVING HABITAT LESSON PLAN

Procedure:

Working with their social studies and science teachers, students are introduced to the concept: Cooperative Living Habitat . A 'CLH' is a given area in which MAN and NATURE coexist and mutually prosper -- as a result of human efforts to:

1. create a quality life space
2. protect natural phenomena/processes
3. protect the health and well-being of humans
4. balance the interests of MAN and NATURE

Students are introduced to a selected natural environment site in the local community/region.

The site is 'adopted' by the student -- becoming their community service project for the school year.

Working with community resource people, e.g., soil conservation/wildlife management/forestry department/water management personnel, students learn about site management strategies.

A management plan is designed and implemented, by the students, to:

1. improve/eliminate environmentally-destructive conditions
2. remove natural debris
3. remove human-caused litter
4. conduct an environmental impact study,
5. design a nature trail system -- to be used by K-12 students as a field-based learning laboratory
6. create/maintain a Cooperative Living Habitat at the selected natural environment site

Assessment: Students will demonstrate the ability to:

1. explain the concept: Cooperative Living Habitat
2. discuss concepts, e.g., conservation, stewardship, resource management
3. draw maps
4. use compasses
5. collect data at field-based sites
6. analyze data
7. make decisions
8. create audiovisual presentations
9. participate in the creation/maintenance of a Cooperative Living Habitat at a selected natural environment site
10. write essays about field-based experiences