Using Concept Mapping Strategies in Teaching Engineering

A picture is worth a thousand words

www.biotopics.co.uk/as/insulinhexamer.gif

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Concept Maps

Why use concept maps?
What are concept maps?
How to create a concept map?
Why Use Concept Maps?

“Help students establish connections between the various topics covered in a course and to help students organize concepts in their minds. “

--Cornwall, “Concept Maps in the Mechanical Engineering Curriculum”

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What are concept maps?

A graphical map that consists of nodes, concepts and interrelationships with connecting text.
Let’s do it!

Activity 1:
Individually brainstorm concepts related to “Energy”

Activity 2: Energy – main idea
In groups build a map with concepts, add nodes, connecting lines and interrelationships. Use colored markers and poster paper
Process of construction

1. Identify important concepts
2. Arrange concepts spatially
3. Identify and label the relationship between concepts.
Energy

- created
- destroyed cannot be
- cannot be
- remains constant in
- can
- change form

Isolated system
How will this help your students learn?

Knowledge base framework
Visualization
Recall and recognition of concepts
Help students “see” what they know
Training and construction are easy
Promote discussion when shared in class
Make connections with prior knowledge
Instructor will “know” what the students are actually learning.

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How can I use this in my class?
How can I use this in my class?

Lecture presentation
Syllabus map – structure of course
Build along with students in class
Student activity or group activity
Pre-test, review, quiz
Assessment

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Considerations

What is needed?

Training
Paper and pencil
Software (Inspiration or Free Ware)

Advantages – just-in-time learning (paper)
Disadvantages – cost and access

Access for students in the public labs
Cost of software
Sharing and submission
Scoring

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Resources


Application Cards

On your application card write one idea on how you might use concept maps in a course.
Resources


For further information

Resource and supplemental material handout on Leonhard Center Website and TatTLeer blog
www.personal.psu.edu/ryt/blogs/totos_tidbits

Contact the Leonhard Center for consultation on designing concepts maps for use in teaching and learning
www.engr.psu.edu/leonhardcenter

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Questions?

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Course level Assessment

Gauge prior knowledge at the beginning of a course

Just-in-time learning – are the students understanding the current lecture material

Monitor progress throughout the course

Readiness assessment for the next lecture, chapter, class material
In Problem Solving

Understanding any idea depends on how it is related to memory.

Developing a conceptual, qualitative representation of a problem is a necessary prerequisite to representing problems quantitatively.

---Jonassen, Learning to Solve Problems, 2004
In Problem Solving

Help learners to organize what they know by integrating information into a progressively more complex conceptual framework.

Increase the total quantity of formal content knowledge because they facilitate the skill of searching for patterns and relationships among problem components

--Jonassen, Learning to Solve Problems, 2004
In Problem Solving

Building the qualitative concept map before solving the problem helps the student to “see” components of the problem before they begin to solve it.
Meaningful learning: empowering students

Concept maps are a good way to help a teacher organize knowledge for instruction, and for helping students to find key concepts and principles in lectures, readings or other instructional materials...

Empowering the students as learners.

Empowering the teacher...a useful tool to negotiate meanings about knowledge with students and to design better instruction.

--Novak, Learning, Creating and Using Knowledge, 1998
Clarification

Students recognize how to group ideas and how they are connected

Allow the student to study in a constructive way

In class project, student groups can compare maps with other student’s maps
Reinforce Understanding

Students use their own words to recreate what they have learned.

Self-reflection of what was learned.

Helps absorb and internalize new information.

Students have ownership of their ideas.
Helps Identify Misconceptions

A map can show a student what they know or don’t know

A self-assessment and readiness assessment tool
Use of concept maps in groups

Informal group in class to teach concepts and group process

Students individually brainstorm concepts

Group creates a concept map from the individual students

Come to consensus and submit

Peer learning
Graphically

Concepts - Illustrate relationships between ideas
Brainstorming – concepts and ideas
Nodes – organize and encourage understanding
Relationships – linking words that describe the interconnection
Examples of use in engineering

Mechanical engineering — Cromwell, Rose-Hulman Institute of Technology, “Concept Maps in the Mechanical Engineering Curriculum”

Helps student understand purpose and goals for a course
Helps student to understand the technical content of a course.
To help students identify the principles to apply when solving problems
Present material in a single chapter or several chapters.
Technical content of dynamics

Group into two broad categories – kinematics and kinetics

Use two maps to illustrate the categories

One map illustrates the use of concept maps for material in a single chapter

Second map illustrates and relates the material in several chapters

Help students identify principles when facing a new problem
Kinematics example: group work

Use a concept map to help students learn that the key to identifying what principle to apply when facing a new problem is found within the problem statement.

Presented as group work in class.

Each group was given five problems where they were to identify the principle to apply when solving the problem. To simply map out the solution.

One student from each group was selected to explain how the group approached one of the problems.