Interactive Self-Study Modules for Chemical Engineering

Flipped classrooms require content delivery outside the classroom so that active learning can be used in the classroom. In an effort to make content delivery more interactive, we have prepared more than 50 interactive self-study modules for chemical engineering courses (http://www.learncheme.com/quiz-yourself/interactive-modules). The current modules are mostly for thermodynamics, material and energy balances, fluid mechanics, and kinetics. The modules utilize self-testing since that has been shown to be the most effective way to study and learn.[1] The modules are designed for students to use on their own and should take about an hour to complete. Most modules contain the following sections:

Overview: A 1-2 sentence description of the module and a list of the contents.

Motivation: Why the topic is important and which ChE course(s) could use the module.

Before studying this module, you need to: A list of what the user should be able to do before using the module (i.e. pre-requisites) and links to pre-requisite modules.

After studying this module, you should be able to: A list of what the user should be able to do after completing the module.

ConcepTests/Example problems: Either two ConcepTests (multiple choice questions) or one ConcepTest and one example problem statement are posed before any content is presented. Students are encouraged to answer the question(s) and/or solve the problem since studies have shown that when students try to answer questions and solve problems, *even before reading material on the topic or being shown an example problem*, they retain more when they subsequently read the material.[2]

Interactive screencasts: Short screencasts (typically 4 - 6 minutes) that introduce the topic; each screencast pauses once or twice and presents a multiple-choice question that students can answer online. They are then given the answer and an explanation.

Important equations: The important equations are listed along with definitions of each variable so students can refer to them while watching the screencasts.

Interactive simulations: Most modules contain 1 or 2 interactive simulations that allow the user to change parameter values and observe the system response. Students are prompted to answer 1 - 3 questions (predict simulation behavior) before using each simulation.

Quiz-yourself simulations: Some modules contain interactive simulations that lead the user through a step-by-step procedure and provide feedback.[3]

Example problem screencasts: For most modules, two example problem statements are presented and screencast solutions are embedded on the page. Students are encouraged to try to solve the problems before watching the solutions.

ConcepTests: Students are prompted to answer two multiple-choice ConcepTests.

Summary: This section contains answers to the ConcepTests and a list of key points.

REFERENCES

1. Brown PC, Roediger III HL and McDaniel MA (2014) *Make it Stick: The Science of Successful Learning*. Harvard University Press/Belknap, Cambridge, MA.
2. Kornell N, Hays JJ and Bjork RA (2009) Unsuccessful retrieval attempts enhance subsequent learning. *J. Exp. Psychol. Learn. Mem. Cogn.* 35(4): 989–998.
3. Falconer JL (2019) Interactive quiz-yourself simulations. *Chem. Eng. Ed.* 53(4): 220-222. ❒

— JOHN L. FALCONER, KIMBERLY R. BOURLAND, JANET DEGRAZIA, MICHELLE L. MEDLIN
UNIVERSITY OF COLORADO BOULDER • BOULDER, CO 80309