Some of the capabilities expected from chemical engineers that we graduate:

- to react flexibly to shorter production cycles and strict quality requirements
- to assimilate new and emerging technologies as required
- to improve product quality, reduce costs, and limit environmental impact

Our “products” should meet these challenges, instructed by an appropriate curriculum, that is also mindful of the limited time available.
**Building Competence in Simulation**

Following Bellman (1957), design sequence to ensure seniors attain competence "just in time":

- Typical senior activities involve:
  - Large scale flowsheet simulation
  - Optimization
- Implies that juniors should have mastered advance flowsheet simulation topics, e.g.
  - Simulation (convergence) of multicomponent separation systems
  - Simulation of multiphase heat transfer equipment
- Implies that sophomores should have mastered basic flowsheet simulation topics, e.g.
  - Simulation (convergence) of recycle systems
  - Appropriate selection of property prediction methods

**Technion Experience (to 2003)**

Until the 2003-4 academic year, the "just-in-time" approach to training in simulator use was implemented:

- Basic instruction in 2nd semester (M- & E balances):
  - Simulation (convergence) of recycle systems
  - "Economics-slanted" project
- Units-ops instruction in 4th semester:
  - Heat transfer equipment design (evaporator)
  - Appropriate selection of property prediction methods
- Multi-stage separation design in 6th semester:
  - Simulation (convergence) of recycle systems
- Advanced simulation in 8th semester:
  - Large scale flowsheet simulation (heat integration)
  - Optimization
Technion Experience (from 2003)

In the 2003-4 academic year, all of these activities were combined into one course, given in the 6th semester:

1. Getting started in HYSYS.Plant
2. Material and energy balances (with recycle)
3. (Selecting) property prediction methods
4. Heat exchangers
5. HDA Process (Step 1 - reactor section)
6. Modeling reactors (PFR and CSTR)
7. Separators - flash to distillation
8. HDA Process (Step 2 - Separator section)
9. Optimization
10. HDA Process (Step 3 - Engineering)

See "Simulation Laboratory 054330.pdf" for details

ASEE Summer School Materials

An 111-page document including:

- Instruction sequences using multimedia support, suitable for support of the usage of simulators (HYSYS/ASPEN PLUS) in ChemE core courses
- Problem statements and solutions suitable for the following courses:
  - Material and Energy Balances
  - Thermodynamics
  - Heat Transfer
  - Separation Principles
  - Reactor Design Principles

See "Workshop 12.pdf" for details
Technion Experience (from 2003)

Opportunity of integration of materials over three courses:

- Simulations Laboratory [6th Semester]
  - Students are taught critical and efficient usage of a process simulators (HYSYS.Plant at the Technion)
  - Complete a simulation of a complete process (HDA in 2003)

- Design and Analysis [7th Semester]
  - Students are taught systematic methods for process design, including algorithmic methods (e.g., separation train synthesis, HEN synthesis...)
  - Are expected to optimize the same flowsheet they simulated in the previous course

- Plant Design [8th Semester]
  - Students are taught detailed plant design, as well as development of management and leadership skills
  - Large teams (c. 20/team planned) will each take on the detailed design of the complete process developed in the previous two semesters

Conventional Instruction Approach

Teaching the use of any software by demonstration is not effective:
- The pace is too slow for “expert” students
- The pace can never be slow enough for “beginners”

This calls for a self-paced approach.
Multimedia instruction means that students:
- progress at their own pace
- ask smarter questions

Summary

* Simulation enriches and enhances synthesis instruction.
* Using simulation techniques, one can challenge students with open-ended problems, and thus expand and enrich on the theoretical knowledge they acquire.
* To be effective, these skills need to be acquired in advance of the design project.
* Multimedia modules enable effective, self-paced instruction.