Lessons Learned from Renovation of NJIT's Chemical Engineering Curriculum through an Infusion of Computation and Multiphysics Modeling

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NJIT/CHE DEPT. BACKGROUND

NJIT

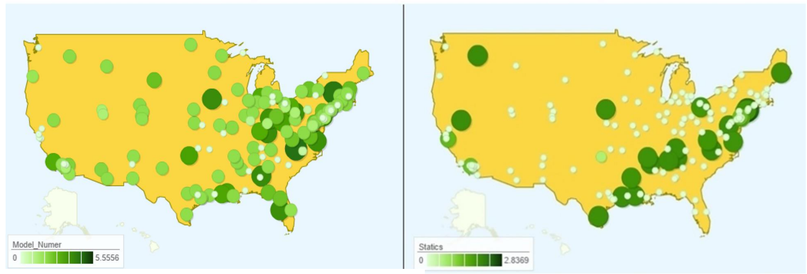
RESEARCH INSTITUTION

TEACHING

- Severely outdated ChE curriculum
- NJ Law: BS ≤ 120 hrs
- Orphaned Course: "Tech Process Simulations" (Aspen)
- Freshman CS (Matlab)

COMPUTATION IN CHEMICAL ENGINEERING CURRICULUM

First U.S. ChE Curricula Survey in 60 years



Numerical Methods & Modeling **Statics & Strength of Materials**

ChE course credits plotted as % of total degree credits

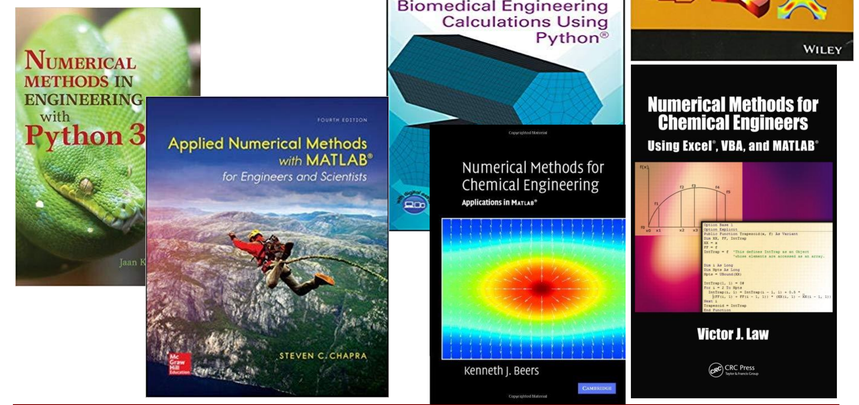
- **114 (77%) of the U.S. depts. → warranted!**
- **Avg. Credits: 3.4 (2.6 across all depts.)**

Tool for guiding / justifying changes:

Voronov, R. S., Basuray, S., Obuskovic, G., Simon, L., Barat, R. B., & Bilgili, E., Education for Chemical Engineers, 2017, 20, 1-10. https://doi.org/10.1016/j.ece.2017.04.002

Numerical Methods Sub-Survey (N = 20)

- **Junior/Senior Numerics Course**
- **Addt'l Fresh/Soph Excel Course**
- **No Process Simulation**
- **Python & VBA**



CHE 365 – CHEMICHAL ENGINEERING COMPUTING

PROBLEMS/CHALLENGES:

- Writing Code From Scratch
- Pre-made Subs (book/profs) / Follow-Along
- Confused by Two Simultaneous Topics
- Cheating is Too Easy
- Randomized Problems
- Individualized Problems
- Coding on Tests Skills (Grading, Cheating)
- Time Management
- Prefer Free Languages (Python & VBA)
- Prefer Simulation Soft.: COMSOL / ASPEN

LESSONS/SOLUTIONS/COMPLICATIONS:

- Freshman MATLAB course → C++
- Lecture → Lab ("Active Learning")
- Math @ Home / Code in Class
- NetOP Software (online HDs, lack of PCs)
- MGH-CONNECT (buggy, $)
- Groups w/ Dedicated TAs
- No Coding on Tests!
- TAs Grades HKWs in Lab, iClickers
- Maybe After Tenure
- COMSOL Tutorials Project

INFUSION IN OTHER COURSES

UNDERGRAD HEAT & MASS:

- Discretize Numerically → Solve by Hand
- Give Solution & Re-solve via All:
  Excel, MATLAB, Mathematica, & COMSOL

GRADUATE TRANSPORT PHENOMENA:

✓Problems from Work
✓Research by Professors
→ Report = Mini Scientific Paper:
Literature review, methods, results, conclusions

LESSONS LEARNED:

- Convenient Tutorials
- Variable Difficulty
- Difficult to Grade
- Course Evaluations