Computing and Games in the ChemE Curriculum A Development Workshop

Marcel Liauw, Margot Vigeant DMs

AIChE Annual Meeting, November 2013
San Francisco
Edited to include workshop developments & participants

Schedule

- Greetings and Goals (15 min)
- A Vision (15 min)
- Show and Tell (30 min)
- Worktime (30 min)
- Report out and next steps (15 min)

Greetings & Goals

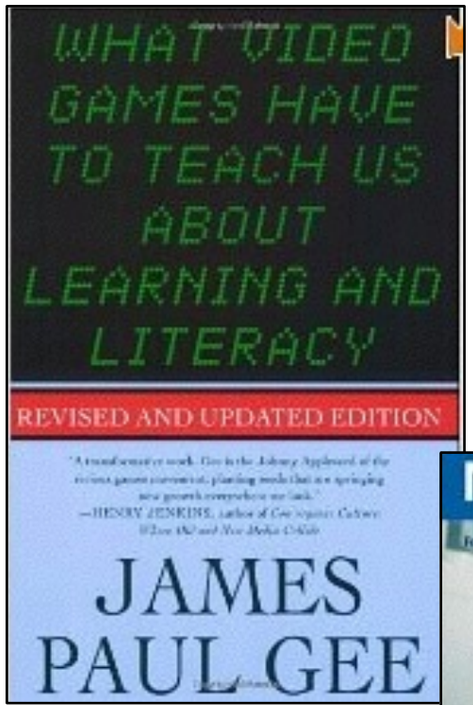
- What games exist in ChemE?
- Meet potential collaborators for current ideas
- Encourage professors to implement games
- What are the effective features of games?
- What is the game trying to *do*?

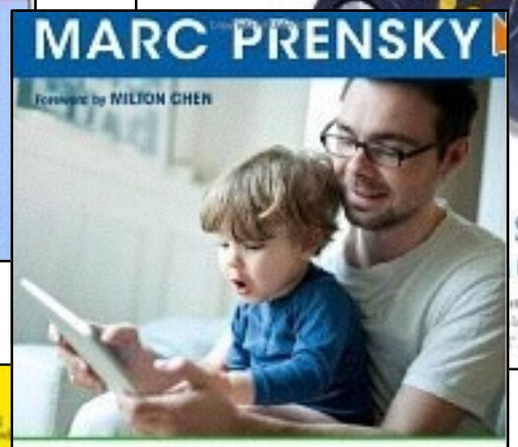
Workshop

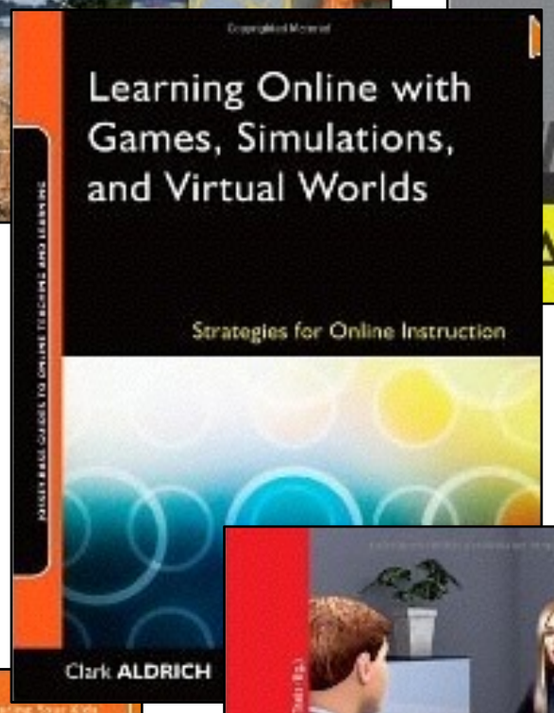
Computing and interactive games in the curriculum

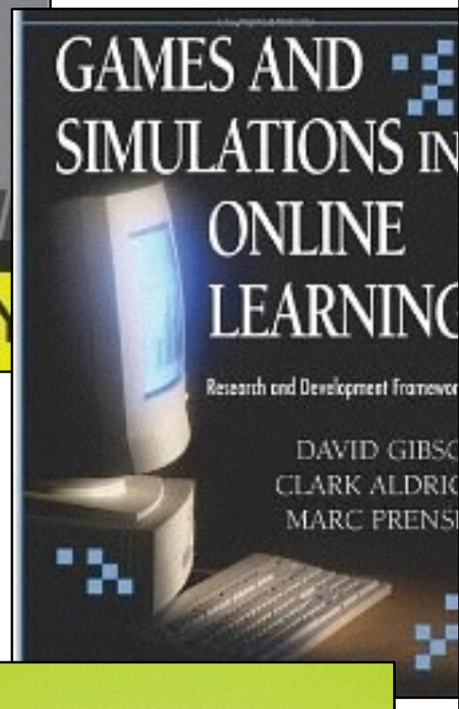
http://www.kinderzeugs.de/20101112/computer-auf-dem-wunschzettel/, on 19.11.2010

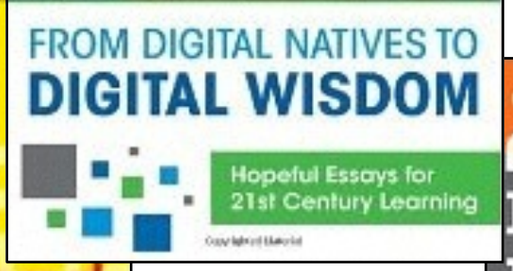
GBL references

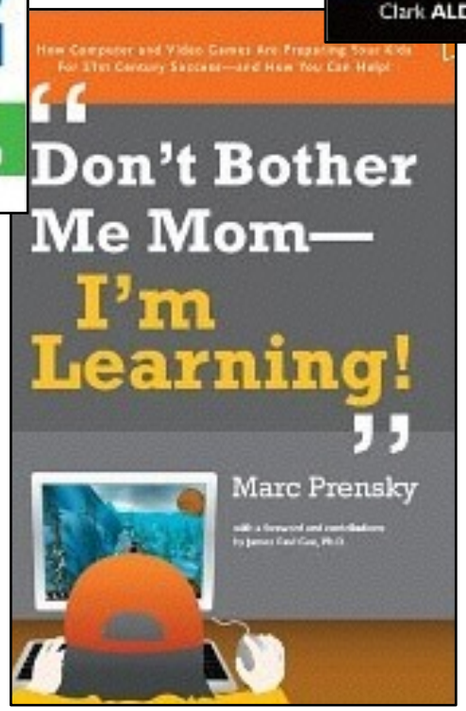


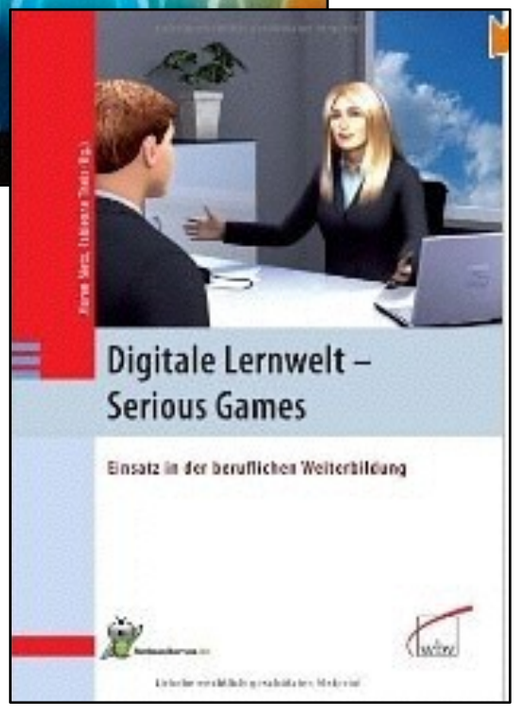


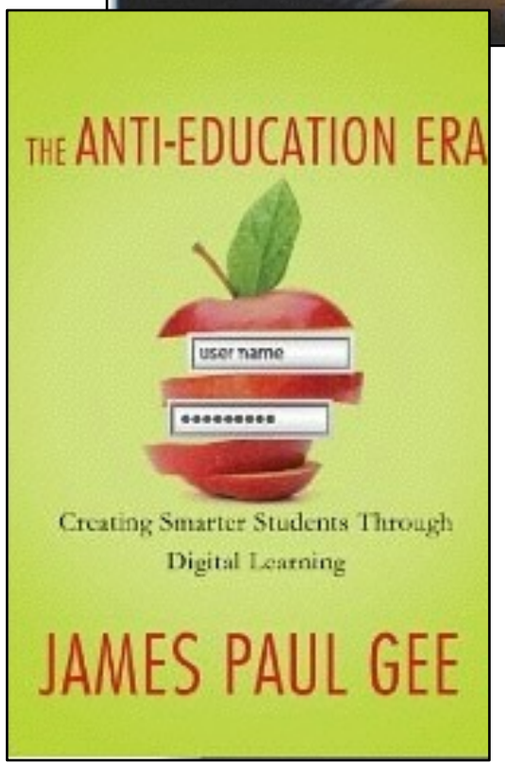












Die Rettung der Zink & Co.

i.e. „Saving Zinc Inc.“

by Volker Deringer, Steffen Heddrich, Marcel Liauw

What?

- **Game**
- *Designed environments with rules where players make choices that move them towards a goal state.*

- **Gameification**
- *The process of applying game-thinking and game-dynamics, which make a game run, to the non-game context in order to engage people and solve problems**

*Bohyun Kim, Keeping up with….Gamification Association of College & Research Libraries http://www.ala.org/acrl/publications/keeping_up_with/gamification

Why?

Creativity Contentment Awe&Wonder Excitement
Curiosity Pride Surprise Love Relief Joy

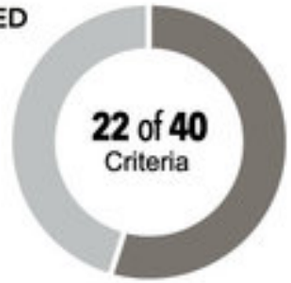
*Jane McGonigal EDUCAUSE 2013 & “Reality is Broken”

Competency Based Education

The New York Times — November 3, 2013

BUS3020:
Fundamentals of EBusiness - Spring 2013
Instructor: John Smith

YOU HAVE COMPLETED
19 CRITERIA, *towards*
32 TOTAL CRITERIA



YOU HAVE COMPLETED
5 ASSIGNMENTS, *out of*
10 TOTAL ASSIGNMENTS

YOU HAVE **6** COMPETENCIES in this course

NON-PERFORMANCE BASIC PROFICIENT DISTINGUISHED

COMPETENCY – 1
Examine the basic business models for e-business. MORE >>
BASIC

COMPETENCY – 2
Relate the importance of e-business infrastructure to the economic impact of a business. MORE >>
BASIC

COMPETENCY – 3
Examine the relationship of basic e-business strategies to business success. MORE >>
PROFICIENT

COMPETENCY – 4
Apply effective e-business planning and implementation. MORE >>
DISTINGUISHED

COMPETENCY – 5
Develop a technology and management e-business plan. MORE >>
DISTINGUISHED

COMPETENCY – 6
Evaluate the management implications of e-business. MORE >>
NON-PERFORMANCE

Students in Capella University's FlexPath program can see how many criteria they must complete to achieve each competency. Colors indicate how well the student is doing.

NY Times, November 3 2013

Show & Tell

Demos
Descriptions
Play-Testing

Summary of Show and Tell

- **Kevin Hadley** from SDSM&T - Pandemic for team building
- **Dan Anastasio & Daniel Burkey** from UConn - Seniors vs. Zombie gamification
- **Ulrich Schacht** from Strathclyde University - Game of design for teamwork and project management
- **Milo Koretsky** from University of Oregon - Multiple simulations of industrial process - “game” of internship
- **Cheryl Bodnar** from University of Pittsburgh - Games and Gamification of courses; ChemE application of D. Schaffer’s epistemic games.
- **Marcel Liauw** from RWTH Aachen University - Development and use of a laboratory and experimental simulation game.
- **Margot Vigeant** from Bucknell University- Lab simulation experiment as game

What is this Good For?

- **GOOD**
- Motivation
- Concepts
- Better memory, connection to images
- Accesses what students do already (converge!)
- Affirmation
- Improves memory of the class itself (if not the material)
- Opportunity to situate learning in <u>real</u> contexts
- Simulate things they can't really do
- Learning over the course of the semester (not cramming)
- Rewarded for learning things that might not jump out of the text
- Students get more ownership
- Promotes teamwork
- Instant feedback, Adaptive feedback
- Addressing students differently

Not so good

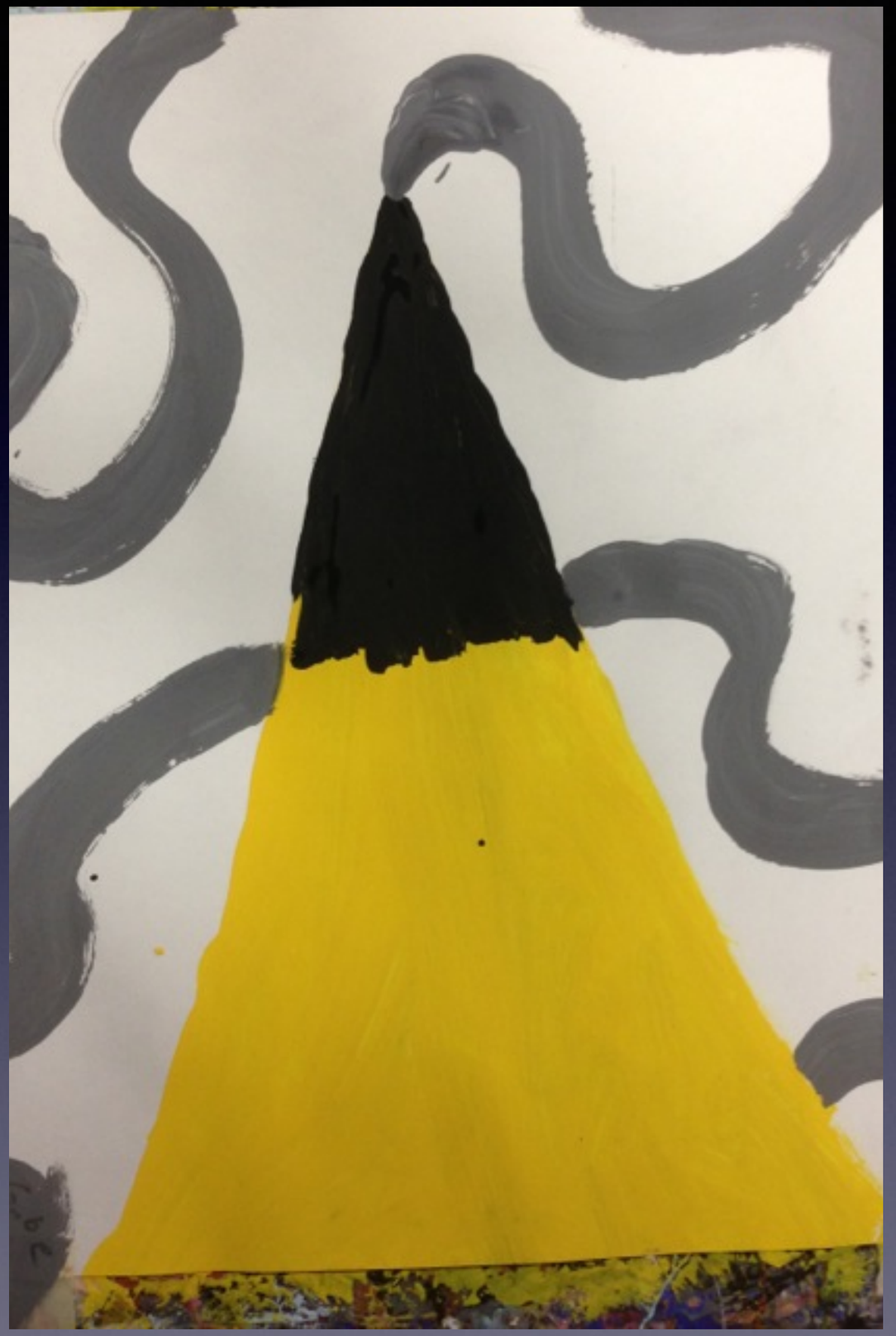
- Students who will game the game (exploit)
- A competitive classroom can be negative
- Need good assessments to prove this is actually working
- What level of Bloom’s are we at
- Games should have an optional element
- Difficult to get it accepted by the non-gamified world (this may be getting better with time)

What do we want to tackle?

- Fugacity: the game
- How to do *basic research*
- Design of an active pharmaceutical compound and its reaction and purification train
- Turning a simulation (ASPEN, ChemCAD) into a game
- A game of ChemE (4-year long)
- Methods to assess outcomes from games

Work Time

Grouping
Working
Report



Design Elements

- **Game**
  - Story
  - Environment
  - Goal state
  - Rules
- **Gameify**
  - Setting
  - Level requirements
  - Badges
  - Monitoring
  -

Report Goals

- Educational Outcome
- Setting
- Approach (game or gameify or ….)
- Game elements
- Needed tools/tech/resources
- Evaluation approach

fugacity

GAMEify → Level 1: Ideal Gas
State IGL

Txy Data → Fit w/ Raoults Law (1)
score ∝ r^2
Fit w/ 1-Marqules
2-Marqules ...

Unlock Models
— Assume

Stuff	Model	
Simple Stuff	IGL	
	Raoults Law	
	Ideal Sln	
Complex Stuff	Mod Raoults Law	Excess Properties
IONS Polymers etc.		

If you assume, ideal solution, turn to Page 15

You fool! 20 bar!! Run!

Choose Your own Thermodynamic Model Adventure

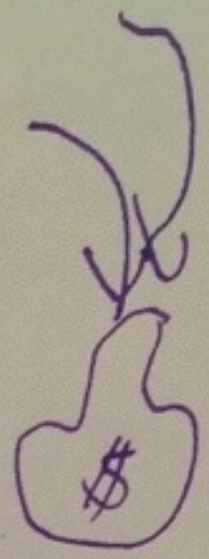
SIMULATION

- OIL TYCOON
- SIM CITY + ASPEN

REAL TIME OPTIMIZATION { COST, MAINTENANCE, MANAGEMENT

EX. DIST. COL.

FUNDAMENTALS + CASHFLOW



[4-year game] → Competencies

↓

Concept Inventories

→ "Talent Trees"

"Specializations / Minors"

Benefits

- Create engagement early
- Create camaraderie early
- Learn about ChE early

Requires

- Very good mapping

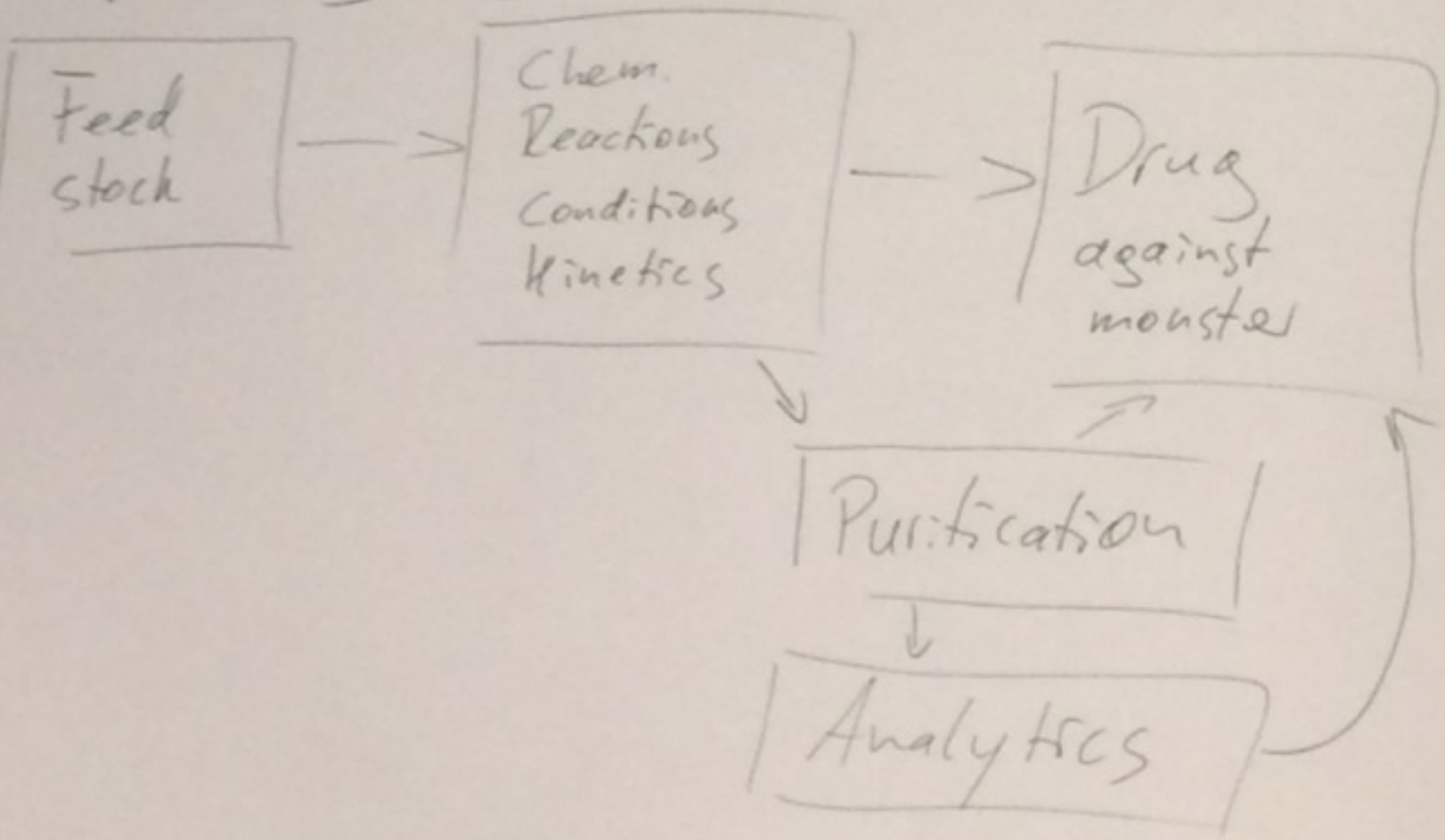
⇒ Adaptive Assignments – progressive competences

Design an API: Reactions to purification

* Howard-Syrum (Böhringer-Ingelheim)

You are a pharma company to develop new drug

* Develop drug against monsters



Next Steps?

“It is not difficult to imagine a school of the future as a ‘laboratory school’ - a school making massive use of educational simulation games, laboratory activities, and creative projects - a school in which almost everything to be learned is manipulated, physically or mentally.”

Clark Abt, Serious Games (1970)