SERVICE LEARNING IN ANALYTICAL CHEMISTRY - THE NEIGHBORHOOD AS A LABORATORY

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How do we train Analytical Chemists?

- Scientists or Lab Technicians?
- What do students need to know?

Textbook Answer

- Typical Analytical texts describe Analytical Process in detail

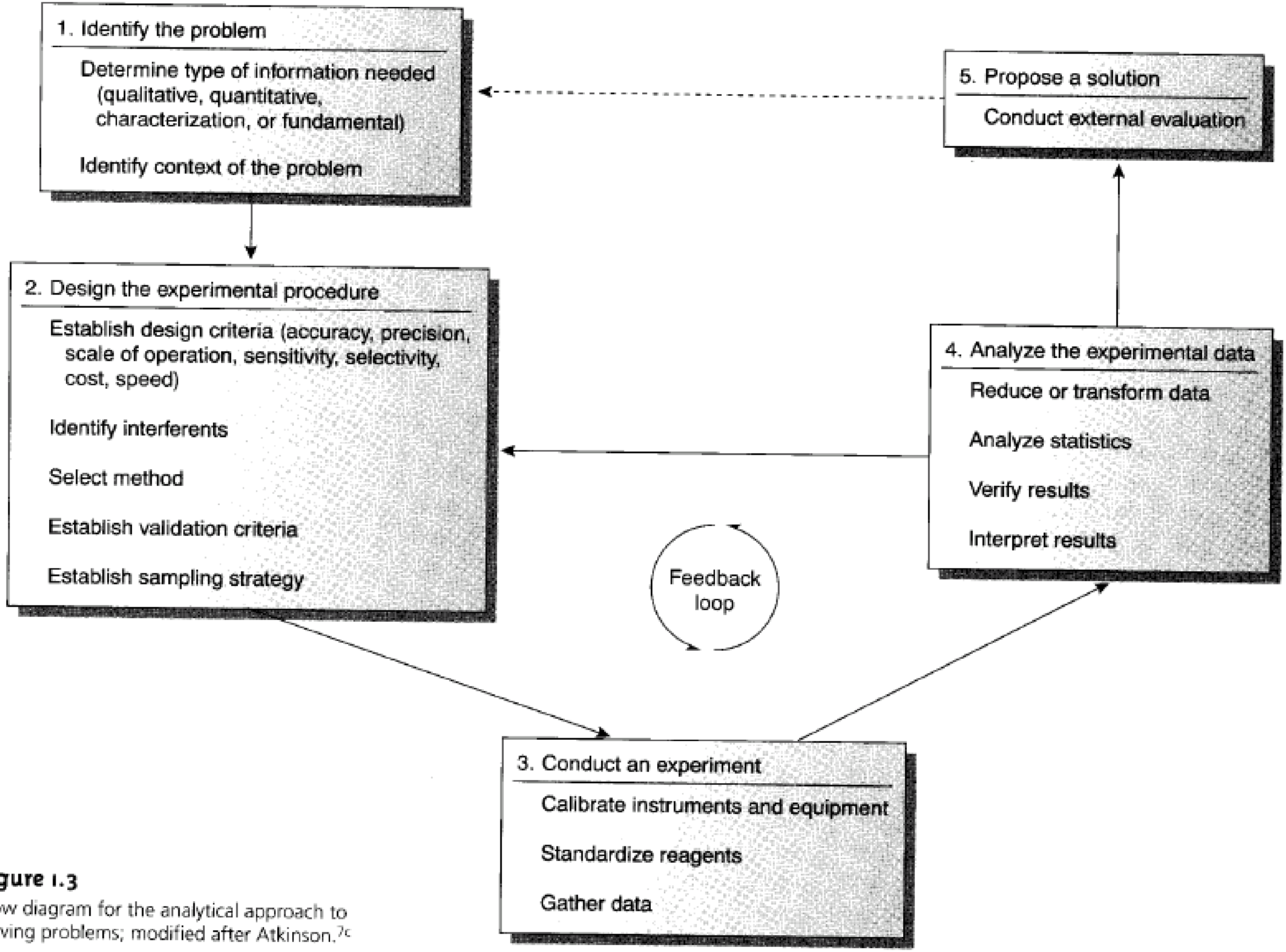

Figure 1.3
Flow diagram for the analytical approach to solving problems; modified after Atkinson.[7c]

What do most courses do?

- 3. Conduct an experiment
  - Standardize
  - Calibrate
  - Gather data
- 4. Analyze Experimental Data
  - Transform Data
  - Analyze Statistics
  - Verify ??
  - Interpret results??

What we DON'T do

- Identify a problem
  - Determine the context
  - Determine what type of information is needed
    - Quantitative
    - Qualitative

What we DON'T do

- Design the Experimental Procedure
  - Establish criteria
    - Accuracy
    - Precision
    - Cost
    - Selectivity
    - Speed
  - Identify Interferences
  - Select a Method
  - QA/QC criteria
  - Sampling Strategy

What we DON'T do

- Interpret Results
  - Propose a Solution to the initial Problem

Larger Context of Science Education

- Too much time on what we know
- Not enough time on how we know it

- Train technicians rather than scientists

Solutions to the Problem

- Need “Real” Problems for Students
- Need strategies for Student Success

Where to Find Real problems?

- Look in your Neighborhood
  - Water Analysis
  - Soil Analysis
  - Air Analysis
  - Consumer Product analysis

- We avoid human tissue and human subjects to keep design and regulatory aspects simple
  - No Human Subjects Committee
  - No Biowaste

Acid Rain Study

- General Chemistry Students
- 1991- 2002
  - Collect rain samples daily
  - Measure pH and total acidity
    - Ross pH electrode
    - HACH digital titrators
  - PIC HPLC of Nitrate and Sulfate
    - (poor man's IC)
  - Students interpret results and propose solutions
    - Letters to Editor
    - Letters to Governor

Park River Study

- Chemical study of river near campus
- Each Spring for 6 years
- Work with
  - Americorp Volunteers
  - RiverWatch Project
  - ConnPIRG

Park River Study

- pH and Alkalinity
- Nitrate and phosphate
- Dissolved Oxygen
- Chloride and sulfate
- Temperature and depth

Park River Study

- Taking samples

Alcohol in Inner City

- Client – Trinity Center for Neighborhoods
- Question – What is alcohol content of common beverages sold in the inner city and how does it compare with those sold in the suburbs?

Alcohol in Inner City

Wines

- Night Train “Express” (Gallo)
- Thunderbird (Gallo)
- Richard’s Wild Irish Rose (Canadaigau)
- MD 20/20 (Mogen David)

- For comparison, the alcohol content of a “typical” brand of “regular” wine.

Alcohol in Inner City

Malt Liquor

- Old English 800
- Colt 45
- St. Ides

- Comparison to typical brand of beer

Alcohol in Inner City

- Method
  - GC with FID
  - Internal standard method using n-propanol
  - Packed column
- Fortified wines contain the amount of alcohol specified on the label

CCA Lumber and Playgrounds

- Client – local elementary school
- Research Question – Does the use of CCA lumber to construct play scapes constitute a health hazard for children who use them?
  - Does risk diminish with age of the material?

CCA Lumber and Playgrounds

- Risks
  - Chromium {total, not just Cr(VI)}
  - Arsenic
- Method
  - ICP-AES of soils under the play scapes
    - EPA Method 3050B and 6020B
  - ICP-AES of wipe tests of surfaces
    - Acid, water, and dry wipes

CCA Lumber and Playgrounds

Arsenic data - Soils

EPA limit

10 ppm

blank	0.05
Control	12.7
Hole <10yr	57.5
<10 yr	9.7
2-5 yr	13.7
>10 yr	8.5
>10 yr	9.1

CCA Lumber and Playgrounds

Arsenic data – Wipe tests

FDA limit 49 ug/day for 22.7 kg child

Site		Conc in swab (pp	Consumption (ug/day)
blank		0	0
<10 yr	Acid	0.149	7.35
<10 yr	Water	0.179	8.95
<10 yr	Acid	0.0787	3.94
<10 yr	Water	0.238	11.9
<10 yr	Dry	0.197	9.85
2-5 yr	Acid	0.156	7.8
2-5 yr	Water	0.39	19.5
2-5 yr	Dry	0.376	18.8
>10 yr	Acid	0.167	8.35
>10 yr	Water	1.12	56
>10 yr	Dry	0.288	14.4
>10 yr	Acid	0.356	17.8
>10 yr	Water	0.683	34.2
>10 yr	Dry	0.212	10.6

CCA Lumber and Playgrounds

Chromium data- Soils

EPA limit

10 ppm

blank	0.0314
Control	7.61
< 10 yr	59.1
< 10 yr	9.33
2-5 yr	5.57
>10 yr	3.24
>10 yr	3.6

CCA Lumber and Playgrounds

Chromium data- Wipe tests

FDA limit 76 ug/day for 22.7 kg child

		Conc in swab (ppm)	Consumption (ug/day)
blank		0.0041	0.205
< 10 yr	Acid	0.412	20.6
< 10 yr	Water	0.399	20
< 10 yr	Acid	0.164	8.2
< 10 yr	Water	0.59	29.5
< 10 yr	Dry	0.571	28.6
2-5 yr	Acid	0.111	5.55
2-5 yr	Water	0.356	17.8
2-5 yr	Dry	0.296	14.8
>10 yr	Acid	0.189	9.45
>10 yr	Water	1.44	72
>10 yr	Dry	0.319	16
>10 yr	Acid	0.448	22.4
>10 yr	Water	0.748	37.4
>10 yr	Dry	0.241	12.1

Strategies for Student Success

- Break Projects Down
  - Background Research Define Question
  - Annotated Bibliography
  - Draft Protocol
    - Includes safety and QA/QC
  - Final Protocol
  - Final Report
  - Poster Presentations

Strategies for Student Success

- Organize the groups
  - Rotating leadership
    - Easier for faculty to keep track of progress
    - Each student gets to be in charge of part
    - Minimizes coasting by weaker students

Strategies for Student Success

- Failure is Allowed
  - Broccoli lady
- Success is not necessary for a reasonable grade
  - Do a good job but the method doesn’t work as expected
  - Not always time to iterate
    - Some projects don’t need it

Strategies for Student Success

- Spread project our over entire semester
- Do projects only after students have learned some basic techniques

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