Practical Approaches to Developing Problem-Solving Skills

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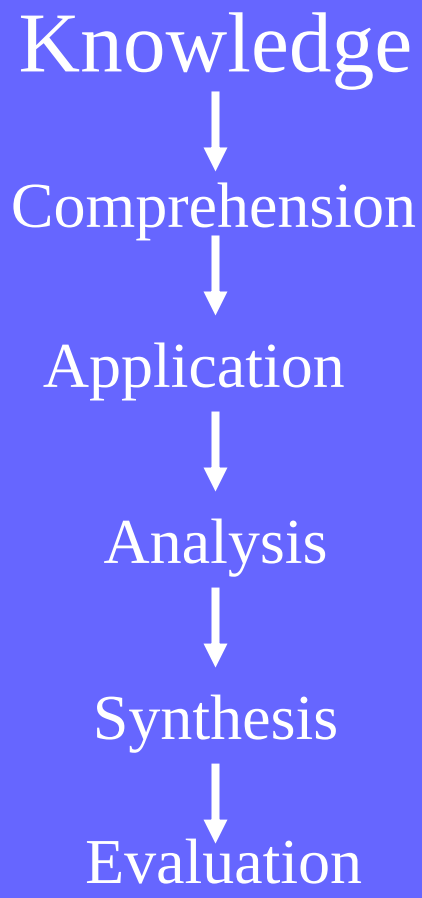
What do we mean by problem-solving skills?

- Generic skill
- able to recognise and define a problem
- able to analyse the problem into components
- able to devise and refine strategies for tackling the components
- critical thinking, creativity, insight, decision-making

Bloom's Taxonomy



Bloom, B. S. (1956). *Taxonomy of educational objectives, handbook 1: Cognitive domain*. New York: Longmans Green.

Scientific Method

- Observe
- suggest hypothesis
- devise methods for testing hypothesis
- experiment to test hypothesis
- observe
- evaluate and refine the hypothesis

Constraints

- Reduction in amount of time devoted to practical work
  - consumables, equipment, timetable constraints
- Perceived need for student to be exposed to particular techniques
- Developing problem-solving skills through practicals can take more time

Role(s) of practical work

- develop technical and scientific skills
- complement and supplement factual knowledge
- develop generic skills eg team-work, problem-solving
- **but** scientific methods are, by definition, problem-solving

Strategies for developing problem-solving skills I

- Emphasis on scientific method
- start off simply-qualitative observation eg mussel practical
- build up to quantitative observation: measurements, sources of error; simple summary statistics;
- set a problem : eg height and gender

Strategies (continued)

- set practicals which don’t give ‘perfect’ results eg ELISA practical
- brainstorm to devise ways of improving results
- [try it out if time]

Open-ended pracs

- Take place over 2-4 weeks
- Gives opportunity for some development and/or refinement
- eg ‘biofilms’ practical (Joanna Verran)

Group work

- Evidence that working in small group enhances critical thinking

see Anuradha A. Gokhale (1995) *Journal of Technology Education* **7** (1)

Johnson, R. T., & Johnson, D. W. (1986). Action research: Cooperative learning in the science classroom. *Science and Children*, 24, 31-32.

Group work (continued)

- students working in pairs or larger groups can develop skills from each other
- mini-projects
- Group Vocational Activities (GVA)

Mini-projects

- Groups of 5 or 6 students
- Set problem in week 1; discuss with supervisor
- group work in laboratory (weeks 1 and 2)
- Analysis and presentation of results in week 3

Mini-projects

- Screen a range of tropical fruits for the presence of proteolytic enzymes.
- Protein content of eggs : is size important?
- Sugar content of breakfast cereals

Group vocational activity

- undertaken in Stage 2 (alternative to industrial placement)
- students work in groups of 3-5
- full-time for 10 weeks (300 hours)
- students apply for GVA, interviews
- topics reflect staff interests

GVAs

- Lab-based research
  - eg Microbiological cross-infection in dental technology laboratories
  - development of an ELISA to detect antibodies to TSST-1
- sponsored lab research
  - eg cross-infection potential of works of art in hospital settings
  - Cultivation and maintenance of *Gallionella*

GVAs

- Education

  eg production of teaching package for schools on cosmetics microbiology and chemistry

  - production of a video ‘Introduction to Practical Microbiology’ for use in school

- Non-university based work

  - eg volunteer work in Uganda, fund-raising on return

see Verran, J (1998) SGM 25(3) 96-97

In addition

- Tutorials can be used for data handling/interpretation and problem solving in relation to practical eg NK tutorial
- Need to keep the students thinking: questions, questions, questions

Projects

- Final year projects are extremely valuable for developing problem-solving skills
- Needs ‘investigative element’
- Can be individual or group-based

Summary

- Problem-solving skills are essential for scientists.
- Such skills are highly valued by employers
- Practical work lends itself well to development of these skills
- We need to provide the time in practicals to develop them