Lab Based Teaching

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With thanks to Dr Jenny Slaughter (Chemistry)

Learning Outcomes

- Describe the purpose of a practical session
- Assess the attributes of a good practical session
- Identify relevant health and safety issues
- Review working alongside Graduate Teaching Assistants

Laurentius de Voltolina; (1350); “Henry of Germany delivers a lecture to university students in Bologna”; *Liber ethicorum des Henricus de Alemannia* (*The Book of Ethics of Henry of Germany*).

What is Practical Teaching

- Practical session – students using equipment
- Generally across all years
  - 1st year to Master's Project
- Variable in length
  - 1 hour to 1 semester (or more)
- Element of a taught module or own module

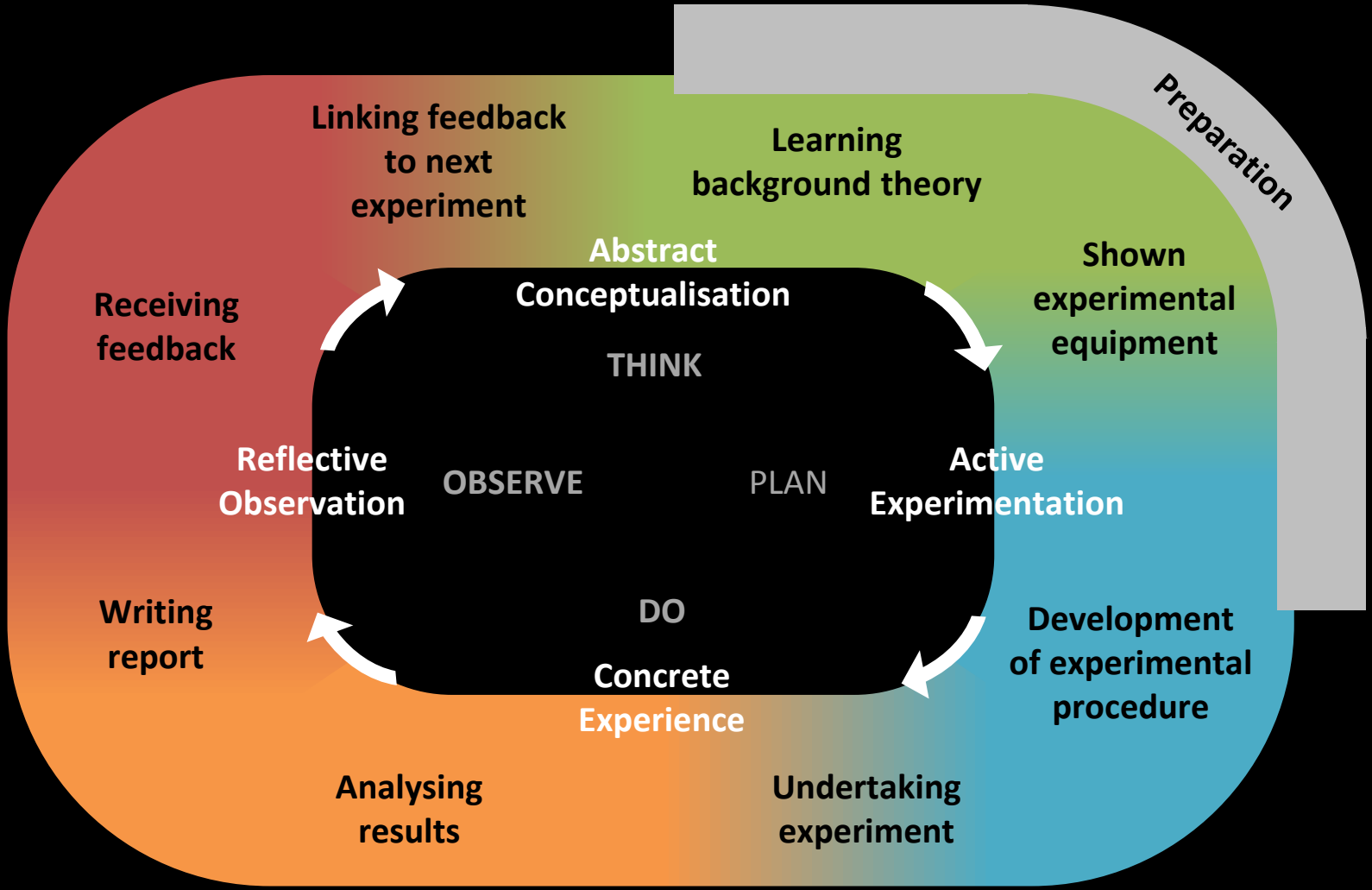
Why Practical Teaching?

Positive

- Vocational
- Variation in teaching delivery
- Kinaesthetic learning
- Theory into practice (or practice into theory)
  (Holt *et al*., 1969)
- Misconceptions & black boxes
  (Helm & Novak, 1983; Novak, 1987)
- Scientific process
- Dealing with failure!
  (Uno & Bybee, 1993; Uno & Bybee, 1994)
- Enjoyable

Negative

- Expensive
- Risky
- Health & safety
- Expectations - dealing with failure!
- Time consuming
- Highly demanding
- Ability disadvantages
- Pressured situations - stressful



Kolb's Learning Cycle for a laboratory experiment. - Rodgers (2018). *ChemEngDayUK18*

What Type of Practical?

Types of Practical

- Traditional / “cook-book”
- Investigative
  (Thornton, 1972)
- Open-ended exercise
  (Morgan & Carter, 1993)
- Inquiry
  (Uno, 1989)
- Open-inductive
- Cooperative & peer-team
  (Cooper, 2012)

Effective Use

- Proving theory/new technique
- Testing theory/skills
- Choosing techniques/skills
- Generating & testing hypothesis
- Observation to build hypothesis
- Team-working skills

What Makes a “Good” Practical?

Students

- Enjoyable + easy + sense of achievement
- Good instructions and objectives
- Good GTAs
- Relevant to surrounding subjects
- Flexible timing
- Minimal reporting
- Marking that reflects the effort
- Good + plentiful equipment
- Treated as adults/equals

GTAs

- Access to all students (well designed room)
- All equipment works
- Have experience of practical
- Get paid for preparation (not just contact time)
- Not have too many students
- Students to have prior knowledge of the subject area
- Well planned practical
- Students who respect the rules
- Outdoor issues/weather (if relevant)

What Makes a “Good” Practical?

Technicians

- Consumables are clean afterwards and won’t break easily
- Knowledge is recognised
- Runs according to schedule and finishes on time
- Students have basic knowledge
- People with clear roles assigned
- Academic staff are appropriately involved and knowledgeable
- Enjoyable for them

Academics

- Theoretical/experimental competence of students
- Emphasize practical link to theory
- Provide strong basis at the start of the session (H&S, experimental)
- Design and preparation
- Outcomes, highlight key steps, expectations
- Experimental time management
- Budget management (materials, consumables)
- Keep it short/simple/trouble free
- Clear effective mark scheme

A Balanced Approach

- Educational outcomes vs logistics
- Student engagement vs managing expectations
- Information vs independence
- Assessment & feedback vs time & resource

Educational Outcomes vs Logistics

- Wow or wonder?
- Well-described or investigative?
- Progression & course links
- Resource:
  - Timetable
  - Space
  - Kit
  - Staff
  - Safety

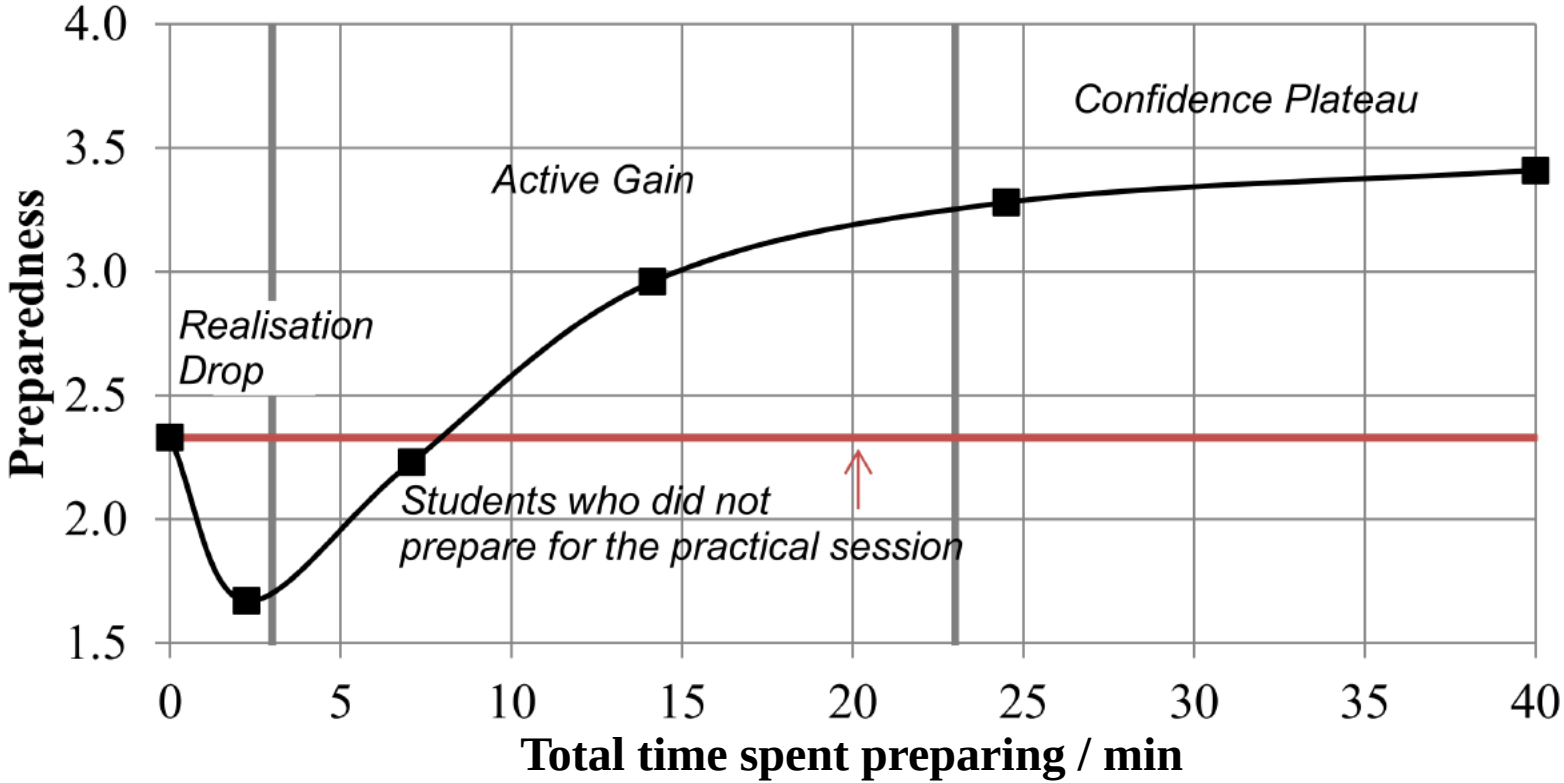
Student Engagement vs Managing Expectations

- Previous experience & knowledge = expectations
- Support for learning?
  - Preparative
  - People
- Cognitive load

Information vs Independence

- Lab manual
- Lab notebook
- VLE
- Assessment
  - Online
  - Submission
- Marks & Feedback

Information vs Independence



Rodgers *et al*. (2019). *European Journal of Engineering Education,* DOI: 10.1080/03043797.2019.1593322

Assessment & Feedback vs Time & Resource

- Achievable: Clarity, Transparency & Timing
- Feedback: Timely & Actionable
- Feedforward: Progression focussed
  - Pre-lab
  - During lab
  - Post-lab
- Opportunities to fail – formative vs summative

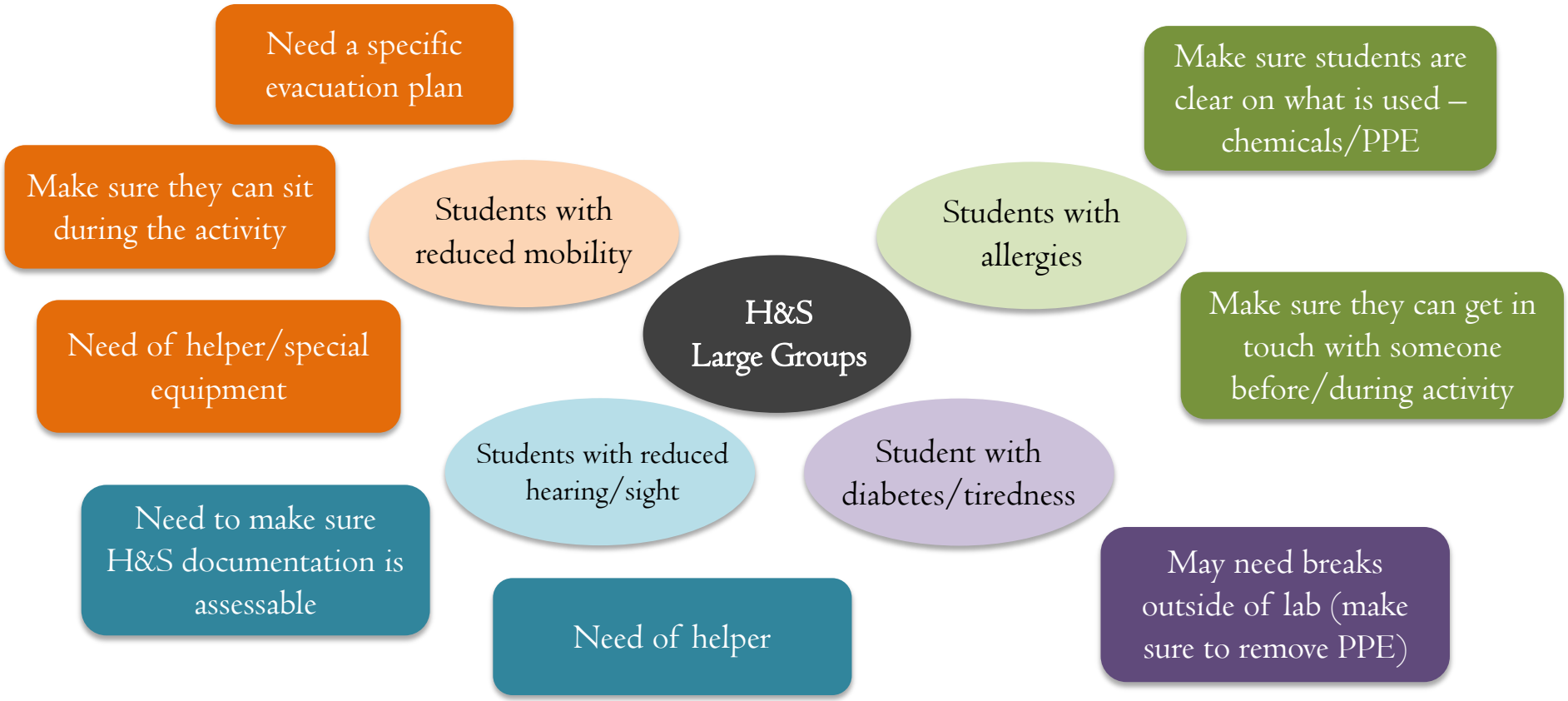
Health and Safety

- Lab is ideal for introducing H&S issues
- Good housekeeping
- Chemical hazard awareness (CoSHH)
  - Electrical
  - Radiation (nuclear and em)
  - VDUs and computing
  - Lifting
  - Working at height
- Risk assessment (RAs)
- Documentation

Health and Safety

- Make sure all H&S implications are considered
- Consider issues associated with a large/diverse group of students
- Consult safety officer in your school
- Reconsider the activity if some part appears too risky
- Make sure H&D is clearly available to all involved
- Students must read it

Health and Safety – Large Groups



Working with GTAs

- Service (Wood, 1990)
- Academic (O'Toole, 2012)
- Personal
- Professional (Rice, 2009)

- Spend more time with students than academic staff
  (Rushin et al., 1997)

- Set tone for learning – inquiry based / facilitator
  (Dotger, 2010)

- Interaction directly related to student engagement & retention
  (Turner et al., 2003)

A “Good” Practical

Learning support resources:

- Clear ILOs & links to progression
- Lab manual
- Lab note books
- Pre-lab resources
- Assessment type matched to ILOs
- Transparent & consistent rubrics
- Templates & examples for assessment

Technical support resources:

- Health & safety – RA, CoSHH, CRA etc.
- Kit & chemical requirements
- Budget

GTA support resources:

- Training time – consistent message
- Theory & practice notes
- Clear assessment rubrics
- Examples for assessment
- Access to student content

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