How to Teach to Emphasize Skill Development

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Consider your experience as an UG student…

What were the characteristics of the best TAs that taught you?
Guiding Educational Principles:
*Attention Span and Seven Principles*

**Student Attention Span**

- Numerous studies have found that in traditional lectures students’ attentiveness drastically reduces after 10 to 15 minutes
- It is important to “reset” the students’ attention every 15 – 20 minutes
  - Active exercise, 2-minute review with peers, Think-Pair-Share, Clicker question, etc.

**Seven Principles of Good Practice in Undergraduate Education**

1. Encourages Student-Faculty Contact
2. Encourages Cooperation Among Students
3. Encourages Active Learning
4. Gives Prompt Feedback
5. Emphasizes Time on Task
6. Communicates High Expectations
7. Respects Diverse Talents and Ways of Learning
Guiding Educational Principles:
Student-Centered Learning Environments

- Centrality of Learner in Defining Their Own Meaning
- Scaffolded Participation in Authentic Tasks
- Importance of Prior and Everyday Experiences
- Need for Multiple Perspectives and Representations

Consider the following set of teaching or learning approaches. Which one do you think is most effective for student learning and retention?

- Lecturing
- Reading
- Videos
- Demonstrations
- Lecturing
- Practice by Doing
- Discussion Groups
- Teaching Others
Guiding Educational Principles

*How the Brain Learns*

- We learn most **effectively** through **active learning**
  
  ![Diagram showing retention rates](image)

  **Figure 3.9** The diagram shows the average percentage of retention of material after 24 hours for each of the instructional methods.

- We can learn best through a variety of activities

- **Retention** is improved through **interaction** and **practice**

- Interestingly, one of the best ways to learn is by **teaching** someone else

**Source:** David A. Sousa, *How the Brain Learns*, 3rd Ed., 2006, pg. 95
Skill Development Tutorials (or Labs!):

- Activities in these sessions might include opportunities to practice various skills such as use of computer programs, problem sets, etc.

- TA’s help to facilitate the activities during these sessions and provide **formative feedback** to students on progress.

**Formative Feedback**: Provide supportive guidance to improve future performance.
Teaching in this type of tutorial requires

- Planning lessons/activities;
- Facilitating hands-on activities, integrating and applying active and collaborative learning strategies;
- Managing classroom interaction;
- Presenting problem solutions (debriefing).

And how to scale learning activities appropriately for the number of students.
Expectations for the Tutorial

• Students will have the opportunity
  – To practice applying course material
  – To receive assistance when they have difficulty

• Teaching Assistant will
  – Be well prepared to assist students
  – Be supportive, patient, attentive and helpful

• Teaching Assistant should not
  – Re-lecture course material
  – Be condescending, sarcastic or apathetic
1. Plan Activities
   - Select problems
   - Match learning outcomes

2. Put students in groups

3. Facilitate
   - Assist students
     - Encourage model problem solving activities
     - Support solving process using formative feedback

4. Debrief
   - Collect, post or present solutions
     - Ideally presentation or posting can be done by students
1. Planning lessons/activities

• Select activities:
  – These are typically problems related to the course material
  – May be chosen by the instructor or you
  – Select problems that match expected learning outcomes.
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• Why?
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3. Facilitating hands-on activities, integrating and applying active and collaborative learning strategies

• Walk around, listen actively
• Answer questions, but do not solve problem for them
• Guide, coach
• Offer strategies
• Keep them moving forward
• Check up:
  “have you tried…..”
  “what if you were to…..”
3. Facilitating hands-on activities, integrating and applying active and collaborative learning strategies

- Encourage use of expert problem solving methods.
Novice vs. Expert Problem Solvers

• Small pieces vs. “chunks” or patterns
• Try once vs. can do attitude
• Dwell on superficial details vs. fundamentals
• Difficulty re-describing vs. define using multi-techniques
• ...
• Trial and error vs. strategy
• ...
• Do NOT analyze into parts vs. do analyze
• Try to calculate first vs. define, draw, explore
• Sketch is often not done vs. done

From “Teaching Engineering” by Wankat & Oreovicz
Basic Problem Solving Approach

Setup
1) Focus the Problem
   • Determine the Goal (Unknown)
   • Visualize the problem (sketch, diagram, or other visual representation of the problem)

2) Set the Foundation for a Solution
   • Identify Knowns
   • Identify Appropriate Principles and/or Fundamental Equations
   • Make and Justify Necessary Assumptions

Strategy
3) Construct a Solution Plan
   • Explore and Ponder (What Needs to be Done?)
   • How do we Connect our Knowns to Unknowns?

Solution
4) Do
   • Execute the Solution Plan
   • Monitor Solution Progress
   • Refine Plan as Needed

Evaluation
5) Check
   • Is the Answer Reasonable? Is the Answer Properly Stated?
   • Is the Answer Complete? Have we Solved the Problem?
6) Generalize
Novice vs. Expert Problem Solvers

• Steps typically missed by novices:
  2. Setting the Foundation
  3. Create a Solution Plan
  5. Check
  6. Evaluate/Generalize

• Novices jump to from “can do” to “do” then stop
Set up the problem

• Define:
  – Re-state problem
  – **Sketch !!!!**
  – State assumptions
  – State knowns and unknowns

• Explore

• Plan
  – Break up problem into parts
Solve: “do” step

• In equation form first !!!

• Check at way points
• Put in numbers last.
Evaluate

• Check
  – Units, sign, other common sense items
  – for “reality”
  – for limits
  – for accuracy

• **Reflect on solution process !!!**

• Evaluate solution method

• Generalize
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4. Debrief: Collect, post or present solutions

• If they present (preferred)
  – Wait to assign a solution to a group until near the end
  – Ask them to write the solution up on the board
  – Suggestions:
    • Use a showcase method

• If you present:
  – Do not cover every step (students have had time to work the problem)
  – Cover most difficult steps; ones that were hurdles for students
  – Be clear: speak clearly, learn to write clearly
Managing the classroom interaction

• Do:
  – Set expectations for tutorial activities
  – **Address misbehaviour if it arises**
  – Learn your student’s names (if possible)
  – Be clear and direct about what you want
  – Be consistent and stick to your expectations (but be flexible when called for)
  – Follow up if problem behaviour is repeated
  – Maintain your sense of humor and optimism
  – Use an incident of problem behaviour as a teaching moment to re-assert expectations

• Don’t:
  – Condone misbehaviour
  – Be sarcastic, hostile, rude, condescending
  – Respond emotionally: angry, etc.
  – Attribute the behaviour to the whole class
  – Escalate the situation
Given your experience this afternoon...

What is the most important thing you learned or realized?

What is one thing you will now do differently with your students?