Teaching Effectively in the Lab

January 2019

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Poll for this seminar: http://etc.ch/7jHQ
Welcome!

- Greet them + Meet them
- Invite them in
- Welcome questions and requests for clarification
- Project!
- Get started by setting norms

Vlad the Happy Vampire by ‘blue-eyed-soul’ on Deviant art

Active learning strategies:
Norms

• This is an inclusive learning environment
• BE RESPECTFUL
• Ask if you need me to repeat
• Ask questions
• Participate
• Learn
• Have fun
• **This workshop (like labs) has a learner-centric focus.**

You can have the class set their own norms.
The Plan:

- ‘Peopley’ topics (your students & how to work them)
- Labs (types and structure)
- Instruction and discussion (active learning and participation)
- Break?
- More ‘peopley’ topics (assumptions and obstacles)

Learning objectives:

- Discuss student learning and motivators
- Discuss strategies for presenting in labs
- Discuss how to increase student participation
Who are you?

http://etc.ch/7jH

Active learning strategies: Polling (direct poll), learning goals

https://directpoll.com/r?XDbzPBdEt8j1rJm0k14KVkpZITMoetHwMvb1CqJsQ
Who you are impacts why & how you learn

<table>
<thead>
<tr>
<th>Pedagogy, Andragogy, Heutagogy compared.</th>
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<table>
<thead>
<tr>
<th>Dependence</th>
<th>Pedagogy Children’s learning</th>
<th>Andragogy Adults learning</th>
<th>Heutagogy Self-directed learning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The learner is a dependent personality. Teacher determines what, how and when anything is learned.</td>
<td>Adults are independent. They strive for autonomy and self-direction in learning.</td>
<td>Learners are interdependent. They identify the potential to learn from novel experiences as a matter of course. They are able to manage their own learning.</td>
</tr>
<tr>
<td>Resources for learning</td>
<td>The learner has few resources – the teacher devises transmission techniques to store knowledge in the learner’s head.</td>
<td>Adults use their own and other’s experience.</td>
<td>Teacher provides some resources but the learner decides the path by negotiating the learning.</td>
</tr>
<tr>
<td>Reasons for learning</td>
<td>Learn in order to advance to the next stage.</td>
<td>Adults learn when they experience a need to know or to perform more effectively.</td>
<td>Learning is not necessarily planned or linear. Learning is not necessarily based on need but on the identification of the potential to learn in novel situations.</td>
</tr>
<tr>
<td>Focus of learning</td>
<td>Learning is subject centred, focussed on prescribed curriculum and planned sequences according to the logic of the subject matter.</td>
<td>Adult learning is task or problem centred.</td>
<td>Learners can go beyond problem solving by enabling pro-activity. Learners use their own and others’ experiences and internal processes such as reflection, environmental scanning, experience, interaction with others, and pro-active as well as problem-solving behaviours.</td>
</tr>
<tr>
<td>Motivation</td>
<td>Motivation comes from external sources – usually parents, teachers and a sense of competition.</td>
<td>Motivation stems from internal sources – the increased self-esteem, confidence and recognition that come from successful performance.</td>
<td>Self-efficacy, knowing how to learn, creativity, ability to use these qualities in novel as well as familiar situations and working with others.</td>
</tr>
</tbody>
</table>
| Role of the teacher | Designs the learning process, imposes material, is assumed to know best. | Enabler or facilitator, climate of collaboration, respect and openness. | Develop the learner’s capability:
  * Know how to learn
  * Are creative
  * Have a high degree of self-efficacy
  * Apply competencies in novel as well as familiar situations
  * Can work well with others. |

How did you get to be this awesome?

Talk to the person beside you about how you developed your learning strategies.

Active learning strategies: Think-pair-share, prompt for ‘noise’, poll, discussion

https://directpoll.com/r?XDbzPBd3ixYqg8KxoT4qBCNmvUApLW4aNpTg5l5m
Transitioning up to heutagogy:

Teach them how to be learners
Teach them metacognition

How?
- Scaffolding
- Connections (up and down)
- Teach how to self-assess

Active learning strategies:
Clarification pause
**Motivation**

Active learning strategies:
*Identify mistakes (a couple of the items in this list are suspect. Can you identify them?)*


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**How Children and Adults Learn**

<table>
<thead>
<tr>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Rely on others to decide what is important to be learned.</td>
<td>• Decide for themselves what is important to be learned.</td>
</tr>
<tr>
<td>• Accept the information being presented at face value.</td>
<td>• Need to validate the information based on experiences</td>
</tr>
<tr>
<td>• Expect what they are learning to be useful in the future</td>
<td>• Expect what they are learning to be immediately useful</td>
</tr>
<tr>
<td>• Have little or no experience upon which to draw</td>
<td>• Have much past experience upon which to draw</td>
</tr>
<tr>
<td>• Little ability to serve as a knowledgeable resource</td>
<td>• Significant ability to serve as a knowledgeable resource</td>
</tr>
<tr>
<td>• Encourages convergent thinking</td>
<td>• Encourages divergent thinking</td>
</tr>
<tr>
<td>• Use specific concrete thought</td>
<td>• Use generalized abstract thought</td>
</tr>
<tr>
<td>• Rote learning</td>
<td>• Active learning</td>
</tr>
<tr>
<td>• Subject centered</td>
<td>• Task or problem centered</td>
</tr>
<tr>
<td>• Motivated by external</td>
<td>• Motivated by internal</td>
</tr>
<tr>
<td>• rewards/punishment</td>
<td>• incentives/curiosity</td>
</tr>
</tbody>
</table>
Motivation: Students need...

1. ...to believe that the goal is attainable. (Give feedback.)
2. ...to believe that their work will pay off. (Talk about learning.)
3. ....personal interest in tasks and topic. (Enthusiasm.)
4. ...to know the value. (Relevance.)
5. ...motivators. (Goals—social and academic.)

### Motivation for attending university (% important or very important)

<table>
<thead>
<tr>
<th>Motivation</th>
<th>2016</th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am more likely to get a job with a degree</td>
<td>91%</td>
<td>75%</td>
</tr>
<tr>
<td>To get a more fulfilling job</td>
<td>90%</td>
<td>84%</td>
</tr>
<tr>
<td>To prepare for a specific job or career</td>
<td>90%</td>
<td>74%</td>
</tr>
<tr>
<td>To satisfy my intellectual curiosity</td>
<td>80%</td>
<td>5%</td>
</tr>
<tr>
<td>Learning new things is exciting</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td><strong>To apply what I will learn to make a positive difference in society or my community</strong></td>
<td>78%</td>
<td>2%</td>
</tr>
<tr>
<td>To get a broad education</td>
<td>78%</td>
<td>67%</td>
</tr>
<tr>
<td>To earn more money than if I didn't go</td>
<td>73%</td>
<td>52%</td>
</tr>
<tr>
<td>To explore whether university is right for me</td>
<td>41%</td>
<td></td>
</tr>
<tr>
<td>To meet my family's expectations</td>
<td>58%</td>
<td>18%</td>
</tr>
<tr>
<td>The satisfaction of doing challenging academic work</td>
<td>57%</td>
<td></td>
</tr>
<tr>
<td>To meet new people</td>
<td>53%</td>
<td>22%</td>
</tr>
<tr>
<td>Most of my friends are going</td>
<td>24%</td>
<td></td>
</tr>
<tr>
<td>The chance to participate in varsity athletics</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>I didn't have anything better to do</td>
<td>12%</td>
<td></td>
</tr>
</tbody>
</table>

Source: Canadian University Survey Consortium 2016 & 1998 results, first-year students
Motivators to learn in this seminar:

• Teaching dossiers/profiles/styles
• Think back to ‘what you want to do?’ survey results:
  – Academic/teach/research/tech company
  – Consult/med school/law school
  – Employed
• Resources?

How do you feel about that?
What are your questions?
What is SOTL?

 Discipline-based pedagogy:

- Life Sciences Education [https://www.lifescied.org/](https://www.lifescied.org/)

- Journal of Chemical Education [https://pubs.acs.org/journal/jceda8](https://pubs.acs.org/journal/jceda8)


Active learning strategies: Pause, Content hole, Recap and relate to LO
Structure and function of labs

http://www.normanjackson.co.uk/creativehe/what-metaphors-can-we-apply-to-our-own-pedagogy
Structure of labs

- Pre-lab talk (keep it short!)
- Demonstration
- **Explain safety**
- Experiment/activity
- Wrap-up

Worst lab ever

• Get into groups of about 10.
• Everyone states their worst lab experience (in ~30 seconds)
• Pick the worst experience from the group.
• Reporter will share on behalf of the group.

Active learning strategies: Whip, Reporter

Teaching strategies: Repeat student comments
Prepare

• Know:
  – the learning objectives (explicit/implicit)
  – the background info
  – relevance and motivators
  – techniques (try it yourself)
  – pitfalls?
  – assessments?
• Send a reminder email to the students
  – Summarize the lab activities (this week we will...)
  – Assessment/quiz reminder
  – Safety
  – See you next week
  – Personal message or link to care
Prepare Prepare Prepare Prepare

• Prepare your presentation method
  – notes
  – lesson plan
    • Hook/activity/reflection
    • 5E (Bybee and Landes 1990)
  – presentation (watch level of detail!)
• Enthusiasm*
• Plan for participation
**Strategies to use when teaching**

<p>| | |</p>
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<tbody>
<tr>
<td>1.</td>
<td>Wait</td>
</tr>
<tr>
<td>2.</td>
<td>Have them write</td>
</tr>
<tr>
<td>3.</td>
<td>Think pair share</td>
</tr>
<tr>
<td>4.</td>
<td>Don’t do too much</td>
</tr>
<tr>
<td>5.</td>
<td>Hand raising</td>
</tr>
<tr>
<td>6.</td>
<td>Multiple hands, multiple voices</td>
</tr>
<tr>
<td>7.</td>
<td>Random calling</td>
</tr>
<tr>
<td>8.</td>
<td>Reporters</td>
</tr>
<tr>
<td>9.</td>
<td>Whip around</td>
</tr>
<tr>
<td>10.</td>
<td>Monitor participation</td>
</tr>
<tr>
<td>11.</td>
<td>Know their names</td>
</tr>
<tr>
<td>12.</td>
<td>Use diverse examples</td>
</tr>
<tr>
<td>13.</td>
<td>Small group work</td>
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<tr>
<td>14.</td>
<td>Vary your strategies</td>
</tr>
<tr>
<td>15.</td>
<td>Access and equity for all</td>
</tr>
<tr>
<td>16.</td>
<td>Ask open-ended questions</td>
</tr>
<tr>
<td>17.</td>
<td>Don’t judge responses</td>
</tr>
<tr>
<td>18.</td>
<td>Praise cautiously</td>
</tr>
<tr>
<td>19.</td>
<td>Establish norms</td>
</tr>
<tr>
<td>20.</td>
<td>Start teaching immediately</td>
</tr>
<tr>
<td>21.</td>
<td>Collect assessment from everyone</td>
</tr>
</tbody>
</table>

**Teaching strategy:**
Fair warning
*Pick a couple to try*
More active learning

• Jigsaw
• Peer teaching
• Design an experiment to test...
• Potential exam question
• Next week I am going to ask you...
• Proximity

Teaching strategy:
Fair warning
*Pick a couple to try*
During the lab:

• Demonstrate
• Observe and Assist
• Engage
  – What is your result?
  – Can you explain your result?
  – How could you test that?
  – Next experiment?
  – Call them over to an excellent example of...
• Facilitate interactions

Teaching trick: Relate back
Types of Student Inquiry

By: @trev_mackenzie

- **Structured Inquiry**: Students follow the lead of the teacher as the entire class engages in one inquiry together.

- **Controlled Inquiry**: Teacher chooses topics and identifies the resources students will use to answer questions.

- **Guided Inquiry**: Teacher chooses topics/questions and students design product or solution.

- **Free Inquiry**: Students choose their topics without reference to any prescribed outcome.

Inspired by: Fitchman, 2011

https://www.kqed.org/mindshift/50620/how-to-ease-students-into-independent-inquiry-projects
What if the experiment fails?

• There are always ‘take-aways’
  – What would you expect? What did you see? What would you expect if...? Was there any part that worked? Can we figure out where it went wrong? What should we do different next time?

• Highlight that science is more than confirming expectations.

• Talk about when your research took an unexpected turn.
I made a mistake.

• Own it.
• Correct it. (give right info/instruction)
• Compensate if you can (you may not be in charge of all aspects).
• Discuss what should have happened, what happened because of the mistake, what parts of the experiment that are still informative.
Obstacles, privilege, and assumptions

Active learning strategies: Poll, Predict the answer
Take-home

• Your students are complex.
• Go easy where you can.
• Don’t take it personally.
• Direct them to help if you can.
Side one: Write something from today that you will apply in your first lab.

Side two: Write something you want to know more about.

Other options: Ticket to leave Muddiest point Agree/disagree/new idea Potential exam question
Keep learning

• Listen to advice and feedback
• Peers
• CTL
• GTLP
• FGSR
• Coursera
• READ (twitter is a good place to start)
• Google
Extra resources:

Kimberly Tanner’s publications: http://www.sfsusepal.org/research/publications/science-education-research-publications/ (look for Twenty-One strategies, 5E, what if students revolt?)

Faculty Focus look for the Teaching Professor Blog (esp. Mary-Ellen Weimer)
Safety

You are responsible for the students’ safety.
Make sure they are following the rules.
Make sure YOU are following the rules.

PPE

Personal Protective Equipment

Biology 107 labs require that you wear:
- Safety glasses
- Lab coat (buttoned)
- Full-length pants
- Full-coverage shoes
- Hair tied back (not loose)

Examples of inappropriate PPE:
- Torn jeans
- Rolled pants or capris
- Exposed ankles
- Exposed feet
- Tights or sheer leggings

Icons source: Freepik via Flaticon.com. Jeans icon was edited to add tears and rips. Bun and man bun icons are original.