Some strategies 策略 – to encourage active learning

Chuxiong Normal University, December 2007

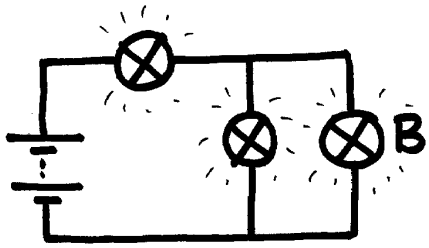
Active Learning in Physics
主动学习物理

Research suggests that ***interaction*** is vital to learning.
研究表明相互交流对学习至关重要
These strategies can assist with active learning.

1. Predict, Observe and Explain

预测－观察－解释
This strategy involves setting up a situation and then giving each student time to make a prediction.
这一策略涉及设定情景，然后给学生时间预测
Sometimes overnight would be appropriate.
思考的时间最好是上课前一天晚上
Do not rush this activity.
不要匆忙
Allow time to discuss and consider any issues that come up.
留出时间讨论，以及考虑出现的问题
Students are forced to commit to an answer. If it is only quickly given by a lecturer before a student commits, learning is less.

The Blown Bulb - 熔断的灯泡



Given this circuit, what would you expect to observe if bulb B blows?
如上所示的电路图中，如果灯泡B熔断，将会出现什么情况？

Justify your answer.
论证你的答案

2. Collaborative Small Groups

小组合作学习
Research suggests that interaction is vital to learning.
研究表明相互交流对学习至关重要

1. Small groups can assist in this process.
   在相互交流过程中学习小组可以起作用
2. Small groups do not work automatically, they need to be
   学习小组不会自然而然起作用，需要

- carefully structured
- facilitated.

认真组织
积极推动

3. This is true even in physics –
   在物理中也一样

"Traditional classroom methodologies have proved to be ineffective when following a methodology where students are passive and mere receptors of ideas"[1]
传统课堂教学中学生被动学习，只是知识的接受体，这些教学方法都已经证明效果不佳。
Roles can help.

Small groups can often do problems that are harder than they could do on their own.
There are benefits and challenges from group work.[2]

PAUSE: are there any questions you have about groupwork?

[1] Heller
[2] See http://akowiki.canterbury.ac.nz and the site at http://www.physics.umn.edu/groups/physed/projects.html

3. Think – Pair – Share

独立思考－结对合作－相互交流

Good for lectures, large groups.

1. Students are given a problem.
2. They think. (Say, one minute)
3. They pair up with a neighbour and discuss.

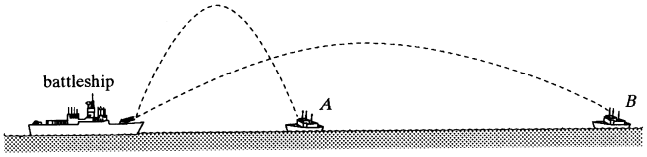
Note: Eric Mazur has done a lot of work on this and has published a lot of what he calls ConcepTests[3].

A Typical ConcepTest

Battleships

A battleship simultaneously fires two shells at enemy ships with the same initial speed, but different angles of projection.

If the shells follow the path shown, which ship gets hit first?



1. A
2. Both at the same time.
3. B
4. Need more information

ACTIVITY: 1. Answer this problem. 2. Pair up with someone. 3. Share your answer.

Extra: Suggest how long you would give to your class for this problem . .

ACTIVITY: Do the problem set.

Discuss: What are the things you did to solve the problem? How did you approach the problem?

4. A problem solving strategy

一种解决问题的策略

Experts think different to novices.

Experts	Novices

Have a strategy you teach and model to your students!!

One simple strategy

1. **Set problem in words-** 解决
2. **Show in a picture -** 看图
3. **Physical Representation (eg Free Body Diagram** 隔离体受力分析图**, circuits, graph) -** 物理表示法
4. **Math Representation -** 数学表示法

Students will often try to go straight from problem to the algebra (the maths).

Algebra is not enough - 代数还不够

ACTIVITY: Do a problem sheet together in a group.

What are the benefits of this way of working?

[3] from Eric Mazur's book, "Peer Instruction" available off the Web http://mazur.www.harvard.edu/education/

5. A special kind of problem

Context Rich problems[4]

The Building Jump

The Chuxiong Police Department has hired you as a consultant in a robbery investigation. A thief allegedly robbed a bank. To escape the security guards, the thief took the elevator to the roof of the Bank. Then, in order to not be caught with the evidence, she allegedly threw the money bag to a waiting accomplice on the roof of Dickos, on the other side of the road. The defence attorney says that to reach the roof of McDonalds, the defendant would have had to throw the money bag with a minimum horizontal velocity of 10 m/s. But in a test, she could throw the bag with a maximum velocity of no more than 5 m/s.
How will you advise the prosecuting attorney? You determine that the Bank is 250 m high and the Road is 20 m wide.

1. **Visualise the problem**. Draw a diagram. What do you need to find out?

2. **Describe in Physics terms**:
   Put measurements and velocities on diagram.
   Use vectors to show both horizontal and vertical velocities.

3. **Plan a solution**.
   What mathematics is needed.

4. **Carry out the Plan**.
   Answer the question.

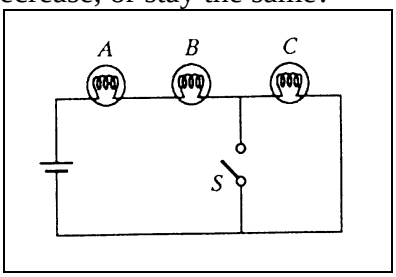
ACTIVITY: Read this **problem** (do not do it!!!). ***What is different about this problem compared to "normal" physics problems?***

6. Concepts First[5]:

先讲概念
[Formulas later on] - 后推公式

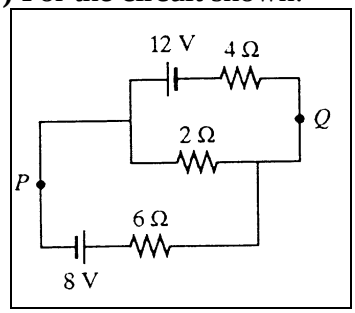
Two questions from Eric Mazur

(Question 1) A series circuit consists of three identical light bulbs connected to a battery as shown here. When the switch *S* is closed, do the following increase, decrease, or stay the same?



a. The intensities of bulbs *A* and *B*
b. The intensity of bulb *C*
c. The current drawn from the battery
d. The voltage drop across each bulb
e. The power dissipated in the circuit

(Question 5) For the circuit shown:



Calculate:(*a*) the current in the 2-Ω resistor and (*b*) the potential difference between points *P* and *Q*.

ACTIVITY: Compare and contrast these two questions above.
Which do you think is harder, Question 1 or Question 5? Why?

Eric Mazur's finding: _____

[4] This is just a brief note, from http://www.physics.umn.edu/groups/physed/projects.html

[5] Ronald Gatreau and Lisa Novemsky "Learning to think like a Physicist"

7. Use multiple representations[6]

使用多种表示法

Examples:

1. Diagrams - 图表
2. Numbers - 数字
3. Before and after pictures - 先后
4. Graphs
5. . .
6. . .

8. Concept Maps -概念地图

Finding connections . . .找出以下概念间的关系

Example: Force and Motion Concept Map 力和运动概念地图

Energy 能量	Work 功	Power 功率
Distance 距离	Motion 运动	Mass 质量
Velocity 速度	Speed 速率	Acceleration 加速度
Joule 焦耳	Momentum 动量	Newton 牛顿
Force 力	Watt 瓦特	m/s

1. Cut out items.
   剪下各个概念条目；
2. Arrange on a page in some sort of grouping. Stick with glue or tape.
   用胶水或胶带分组粘贴在一张纸上；
3. Add in lines to connect related items.
   添加连接相关条目的连线；
4. Label any connections that you can.
   标记能够找出的概念间的关系；
5. Add in any other terms that you like.
   添加其他的概念术语。

It is the NUMBER and QUALITY of the links that counts

ACTIVITY: Choose another topic, and create a concept map exercise for that.

Final word

These (strategies) have been helpful to many people in many classes.
But, you must implement with care.
但是希望大家慎重使用
You have your own special context.
你们的情况不同
You must decide for yourself what you take away and implement.
自己判断获取什么以及该如何用
A Maori proverb from our country:

Kohia te kai rangatira, ruia te taitea:
Gather the best, reject the bad.

I wish you well.
-Derek Chirnside, December 27 2007
Derek.chirnside@canterbury.ac.nz

These are summary notes from Derek Chirnside, University of Canterbury, Christchurch, New Zealand. They are to go with a three hour workshop at Chuxiong University, Deceber 2007.

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- My family (for letting me come here)
  以及支持我来楚雄的家人

There are a huge number of physics education researchers who have uncovered these ideas. See a fuller list at http://akowiki.canterbury.ac.nz

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[6] This is just one of the 11 modes *From: Concept-Based Problem Solving: Combining educational research results and practical experience to create a framework for learning physics and to derive effective classroom practices*
W J. Leonard, W J. Gerace, R J. Dufresne & J P. Mestre - University of Massachusetts [July 15, 1999]