



Enhanced interaction and learning in discussion-based physics courses

Kristin M. Poduska

Department of Physics and Physical Oceanography
Memorial University of Newfoundland

Canadian Association of Physicists Congress, 15 June 2011

Current trends in physics education

Physics
Education



kris@mun.ca
Kris Poduska

- Student-centred learning
- Interactive class formats
- Peer evaluation
- Think-pair-share
- Just In Time Teaching
- Reflection in learning
- Teaching with technology

Motivation

LTD

It works!

The big picture

Current trends in physics education

Physics
Education



kris@mun.ca
Kris Poduska

- Student-centred learning
- Interactive class formats
- Peer evaluation
- Think-pair-share
- Just In Time Teaching
- Reflection in learning
- Teaching with technology

Don't overlook discussion-based learning...
it's not just for literature classes anymore!

Motivation

LTD

It works!

The big picture

A practical approach to discussion classes

Physics
Education



kris@mun.ca
Kris Poduska

Motivation

LTD

It works!

The big picture

As an instructor,

- 1 Explain the goals of the discussion format
- 2 Outline the rules of engagement
- 3 Introduce a firm class structure
- 4 Reward discipline

Follow these four steps and be prepared for pleasant surprises!

Learning Through Discussion (LTD)

Physics
Education



kris@mun.ca
Kris Poduska

a structured framework for interactive, discussion-based learning

based on Learning Thru Discussion by W.F. Hill, Sage Pub. (1977).

- Used by instructors in a range of disciplines
- Lends itself to use with both textbooks and primary literature

For each class meeting,

- 1 Each student brings a preparation sheet.
- 2 Students take turns with discussion leader responsibilities.
- 3 The entire group evaluates the discussion and its effectiveness.

Motivation

LTD

Overview

Format

Prep sheet

Keys to success

It works!

The big picture

Discussion group format

Physics
Education



kris@mun.ca
Kris Poduska

Motivation

LTD

Overview

Format

Prep sheet

Keys to success

It works!

The big picture

- 1 Identify subtopics.

Display before class begins.

- 2 Allocate remaining time.

*Gauge how much time to spend on the remaining sections
and write the times next to the appropriate headings.*

- 3 Questions concerned with the discussion of subtopics.

- 4 General summary statement and overview of the important material.

- 5 Integrate and apply the material to other areas of physics and to other fields of science.

If there is a discussion problem, talk about it here.

- 6 Evaluate the group.

based on Learning Thru Discussion by W.F. Hill, Sage Publications (1977).

Outline for daily preparation sheet

Physics
Education



kris@mun.ca
Kris Poduska

Motivation

LTD

Overview

Format

Prep sheet

Keys to success

It works!

The big picture

- 1 Identify subtopics in the reading assignment.
- 2 Write out a brief statement on the subject matter for each subtopic.
- 3 List under each subtopic all questions that you have on that material. Try to include a minimum of one question for each subtopic. Write out the questions in full so that it is easy for you to state them in class.
- 4 Write out your version of a general statement of the material covered; your statement should emphasize what you consider to be the important points.
- 5 Come up with several examples that integrate and/or apply the material to other areas of physics or to other areas of science. If there are discussion problems, include your calculations with the prep sheet.

based on Learning Thru Discussion by W.F. Hill, Sage Publications (1977).

Keys to successful discussions

Physics
Education



kris@mun.ca
Kris Poduska

Motivation

LTD

Overview

Format

Prep sheet

Keys to success

It works!

The big picture

Criteria for a good discussion group

- Climate: warm, accepting, nonthreatening
- Learning: accepted as the main reason for the meetings, everyone participates and interacts, cooperative, material is adequately and efficiently covered
- Leadership: responsibilities are distributed, members attend regularly and come prepared
- Evaluation: accepted as an integral part of the group's operation

Group roles and member skills

- Initiating, encouraging, relieving tension, confronting, evaluating, diagnosing
- Giving and asking for information, reactions
- Setting standards, clarifying, summarizing, reality testing, restating, giving examples, timekeeping

based on Learning Thru Discussion by W.F. Hill, Sage Publications (1977).

LTD example: statistical mechanics

Physics
Education



kris@mun.ca
Kris Poduska

PHYS 4400: Statistical Mechanics

1 Boltzmann Statistics (Chapter 6) ~ 3 weeks

- Probability, entropy, Boltzmann factor, partition functions, Maxwell speed distributions, free energy

2 Quantum Statistics (Chapter 7) ~ 5 weeks

- Gibbs factor, grand partition functions, bosons & fermions, degenerate Fermi gas, density of states, Blackbody radiation, Debye theory of solids, Bose-Einstein condensation

3 Systems of Interacting Particles (Chapter 8) ~ 4 weeks

- Weakly interacting gases, ferromagnetism, Ising model, mean field approximations, theory of phase transitions

Offered: Winter 2011

Enrolment: 4

Motivation

LTD

It works!

Example
Reactions

The big picture

LTD example: Evaluation scheme

Physics
Education



kris@mun.ca
Kris Poduska

Motivation

LTD

It works!

Example

Reactions

The big picture

- **Discussions (20%)** Classes will follow a discussion format, with each student to lead the discussion (~ 6 classes each). Structured discussions will be based on specific topics from the textbook. For every class, each student will need to hand in a preparation sheet. The format for the preparation sheets and the discussions will be outlined during the first class.
- **Assignments (20%)** There will be three graded assignments with the following tentative due dates:
 - 1 Boltzmann Statistics (01 Feb 2011)
 - 2 Quantum Statistics (01 Mar 2011)
 - 3 Systems of Interacting Particles (22 Mar 2011)

Each assignment is due at the beginning of class (15:30) on the specified date. Late assignments will not be accepted after solutions are posted.

- **Midterm test (30%)** An in-class, closed-book midterm test will be given on Thursday, 17 Feb 2011.
- **Final exam (30%)** The final exam will be a 2 hr hour comprehensive, closed-book written exam.

LTD: examples of student comments

Physics
Education



kris@mun.ca
Kris Poduska

Motivation

LTD

It works!

Example

Reactions

The big picture

Winter 2011 – PHYS 4400: Statistical Mechanics

- articles are a welcome change of pace from text chapters
- much more time spent preparing for class, but less time needed for studying for tests
- learn more from the textbook than from articles
- articles were more interesting, but not good for prep for midterms/finals

LTD: examples of student comments

Physics
Education



kris@mun.ca
Kris Poduska

Motivation

LTD

It works!

Example

Reactions

The big picture

Winter 2011 – PHYS 4400: Statistical Mechanics

- articles are a welcome change of pace from text chapters
- much more time spent preparing for class, but less time needed for studying for tests
- learn more from the textbook than from articles
- articles were more interesting, but not good for prep for midterms/finals

Winter 1994 – P231: Classical Mechanics

Carleton College, MN, USA (Instructor: Prof. Bill Titus)

What LTD won't do

Physics
Education



kris@mun.ca
Kris Poduska

- May not improve student exam scores.
- Will not increase the amount of material you cover.

Motivation

LTD

It works!

The big picture

Pros/Cons

E-learning

Summary

What LTD will do

Physics
Education



kris@mun.ca
Kris Poduska

Motivation

LTD

It works!

The big picture

Pros/Cons

E-learning

Summary

- Dramatically increase student preparation prior to class.
- Can decrease instructor preparation time prior to class.
- Increase student comfort levels with course material.
- Increase student comfort levels with asking questions.
- Enable integration of scientific literature into classes.
- Allow incorporation of different areas of student interest.

The next stage: LTD and iPads

Physics
Education



kris@mun.ca
Kris Poduska

<http://thecommons.mun.ca/ipad/>



Motivation

LTD

It works!

The big picture

Pros/Cons

E-learning

Summary

MUN's iPad project: blogs, videos, apps

Physics
Education



kris@mun.ca
Kris Poduska

Motivation

LTD

It works!

The big picture

Pros/Cons

E-learning

Summary



Subscribe to RSS



the iPad project

[Close to the End](#)

Category: [Students](#)

Class is about to start so this will be short, but it's been a while since I last blogged so I figured I should...

[Read More »](#)

[March!? Already?](#)

Category: [Students](#)

As the title implies this semester has been flying by and in the multitude of assignments that have pushed me blindly forward towards summer...

[Read More »](#)

[A Short Update](#)

Category: [Students](#)

It has been a while since I blogged about the iPad so I shall do a quick one now. I'm using the iPad more...

[Read More »](#)

[A Similar Project From The Business School POV](#)

Category: [Aaron Goulding](#)

Really great article about using ipads in a business classroom. They touch on a lot of the same strengths and weaknesses that are becoming...

Why mix e-tablets with discussion classes?

Physics
Education



kris@mun.ca
Kris Poduska

- More conducive to face-to-face discussions

*"Laptops are a lean-forward device;
iPads are a lean-back device."*

www.theglobeandmail.com/report-on-business

- Allow multi-tasking during discussions
- Bring the web (and all of its caveats) into the discussion
- Streamline the process of sharing and submitting classwork

Motivation

LTD

It works!

The big picture

Pros/Cons

E-learning

Summary

The big picture

Physics
Education



kris@mun.ca
Kris Poduska

- Discussion classes shift class preparation responsibilities away from instructors toward students.
- Student feedback for discussion-based classes is overwhelmingly positive.
- Discussion-based classes do not preclude the use of teaching technologies.

Motivation

LTD

It works!

The big picture

Pros/Cons

E-learning

Summary

Acknowledgments

Physics
Education



kris@mun.ca
Kris Poduska

Aaron Goulding, founder of the iPad project

The Commons, Memorial University

Erin Alcock, library science-specialist

Memorial University Library

Brad de Young, Department Head

Physics & Physical Oceanography

Rob Wells & Jane Costello, iPad loans and assistance

Distance Education and Learning Technology Services

funds for hardware, software, and data collection personnel

Memorial VP Academic and Instructional Development Office

Motivation

LTD

It works!

The big picture