

Technology for Peer Instruction

Martin and Eric Mazur

Harvard University

AAPT Summer Meeting

Salt Lake City, UT, 9 August 2005

ILT: <http://www.deas.harvard.edu/galileo>

BQ: <http://www.erskine.edu/bq>

Register to the ILT

Interactive Learning Toolkit

SIGN IN

E-Mail ([register](#))

Password ([forgot?](#))

Go

☐ Remember me ([security](#))

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To register for the Interactive Learning Toolkit, please complete **all** the information on this page. None of the information you supply will be made available to third parties.

E-mail:

Name: First Last

Institution:

Type: Please select:

Department:

Position: Please select:

Register

Login

Interactive Learning Toolkit

SIGN IN

E-Mail ([register](#))

Password ([forgot?](#))

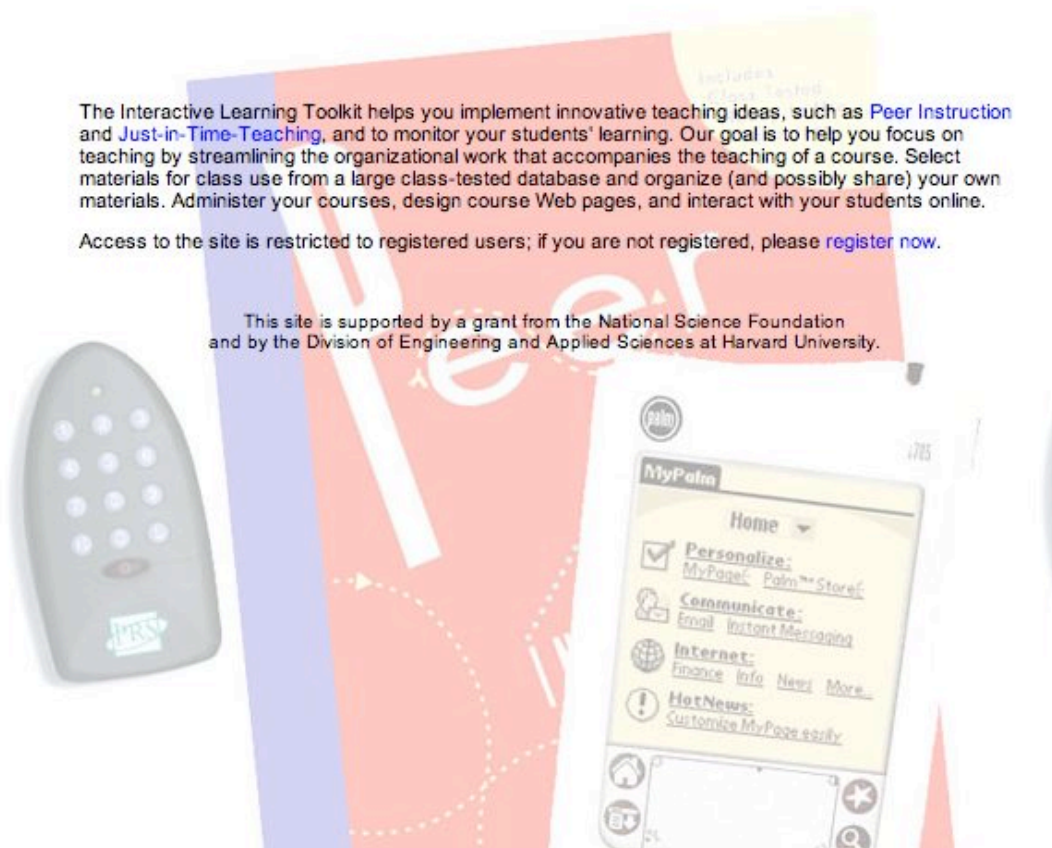
☐ Remember me ([security](#))

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The Interactive Learning Toolkit helps you implement innovative teaching ideas, such as [Peer Instruction](#) and [Just-in-Time-Teaching](#), and to monitor your students' learning. Our goal is to help you focus on teaching by streamlining the organizational work that accompanies the teaching of a course. Select materials for class use from a large class-tested database and organize (and possibly share) your own materials. Administer your courses, design course Web pages, and interact with your students online.

Access to the site is restricted to registered users; if you are not registered, please [register now](#).

This site is supported by a grant from the National Science Foundation and by the Division of Engineering and Applied Sciences at Harvard University.



New Course

TOOLS

[Student view](#)

QUICK LINKS

[Students](#)

[Sections](#)

Select Section ▾

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[Courses](#) > [New faculty course](#)

This page displays the main settings for your course. You can also edit these settings from this page. The sections marked yellow identify settings with no default value. You should set them to your required values. You can view what the students see by clicking the "Student view" tool. The quick links on the left also give you quick access to students and sections in your course (once you've added them). You must complete the yellow regions before you can move on



Edit settings for: [Modules](#) [General](#) [Student](#) [Enrollment](#)

MODULES

[top](#)

- ☒ Lectures
- ☒ Reading
- ☒ Assignments

- ☐ E-mail
- ☐ PRS
- ☒ Forums

- ☒ Handouts
- ☒ Staff
- ☒ Sections

Each module introduces different functionality to your course. When you remove a module in the middle of a course, you will delete all data associated with that module.

[Set modules](#)

GENERAL

[top](#)

Course name: [New faculty course \(edit\)](#)
Course type: [Non-Harvard class, password login \(edit\)](#)
Topic: [No topic set \(edit\)](#)
Protection: [Course unlocked \(lock\)](#)
Final grades: [Hidden \(display\)](#)

Brief explanation of these settings and their meaning

STUDENT SITE [\(student instructions\)](#)

[top](#)

URL: [http://www.deas.harvard.edu/galileo/students/?courseID=268](#)
Home page text: [none \(edit\)](#)
External URL: [none \(edit\)](#)
External Email: [none \(edit\)](#)

Brief explanation of these settings and their meaning

ENROLLMENT

[top](#)

0 students enrolled. Enrollment open
Dates: [not set \(edit\)](#)
Enroll from login page: [disallowed \(allow\)](#)

Brief explanation of these settings and their meaning

Create calendar-based lecture schedule

[Courses](#) > [Physics 1b](#) > [Lectures](#) > [Create Schedule](#)

Set the start and end dates for your lecture. Select the days of week of your lecture. Add a header that will show up in the student view of the lecture. You can also set when the students can access the lecture content. Select the time, whether it is to be available before or after the start of the lecture. You can also change the enrollment dates for the students.



Start date: Sep 10 2003

End date: Jan 31 2004

Lectures on: ☐ Mon ☐ Tues ☒ Wed ☐ Thurs ☒ Fri ☐ Sat ☐ Sun

Lecture start: 9 : 00 am Eastern Standard Time

Lecture duration: 1 Hrs : 30 Mins

Student Access: 1 hours after start of lecture

Lecture header:

Enrollment dates: Sep 1 2003 - Sep 7 2003

Create

Select ConcepTest Q's from database

[HOME](#) [READING](#) [LECTURES](#) [ASSIGNMENTS](#) [FORUMS](#) [NEWS](#) [HANDOUTS](#)

E-MAIL

COMING UP
2/4 Lecture 0
2/9 Reading 0
2/12 Assignment 0

TO DO
[Complete profile](#)

TOOLS
[Create new CT](#)
[Generate slides](#)
[Add to lecture...](#)
[Start new search](#)
[Search within results...](#)
[Expand all](#)
[Collapse all](#)

QUICK LINKS
[Students](#)

[Sections](#)

Select Section ▾

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[Report a problem](#)

[Courses > VU Course > Introduction > Add CT](#)

Please select the CTs you want to add to your lecture and click "Add to lecture". You can also click "Generate slides" to produce slides of question selected. You can modify your search or perform a new search using the search tools on the left. You can change the view of the CTs using the "Expand all" or "Collapse all" links on the left. X

1 - 10 of 156 CTs > >| Sort by: Question text ▾ Sort

☐

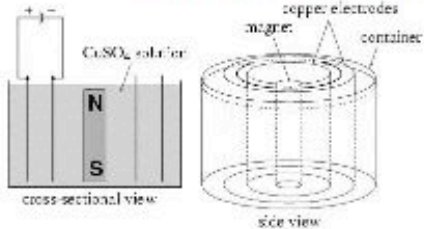
Physics > [Introductory Electromagnetism](#) > [DC Circuits](#) > CT: 3874
October 17, 2001 02:03:23 pm

1. Consider two identical resistors wired in series. If there is an electric current through the combination, the power dissipated in each resistor is:
1. equal to
2. half
3. smaller than, but not necessarily half

☐

Physics > [Introductory Electromagnetism](#) > [Magnetism](#) > CT: 3983
October 1, 2001 00:00:00 am


2. A CuSO_4 solution is placed in a container housing coaxial cylindrical copper electrodes....
1. positive.
2. negative.
3. both positive and negative.
...



☐

Physics > [Introductory Electromagnetism](#) > [Magnetism](#) > CT: 3980
October 1, 2001 00:00:00 am

3. A battery establishes a steady current around the circuit below. A compass needle is placed successively at points P, Q, and R.
1. P, Q, R.
2. Q, R, P.
3. R, Q, P.
...



Create your own ConcepTest Q's

[READING](#) [LECTURES](#) [ASSIGNMENTS](#) [FORUMS](#) [NEWS](#) [HANDOUTS](#)

[Courses](#) > [VU Course](#) > [Introduction 2/4](#) > **Create ConcepTest**

Add a new ConcepTest X

Introductory text of your question.

Upload image ...

Text to appear after image.

1

Multiple choice no. 1

2

Multiple choice no. 2

1

More choices

Add choices in bulk

Text to appear after answer choices.

Explanation of answer.

Upload explanatory image...

Correct?

☐

Correct?

☐

Lecture page

Introductory Mechanics

Logged in as Veronica McCauley
Sign out

[HOME](#) [READING](#) [LECTURES](#) [ASSIGNMENTS](#) [FORUMS](#) [NEWS](#) [HANDOUTS](#)

COMING UP
10/29 Lecture 3

TO DO
[Complete profile](#)
[Reading assignments](#)
[Create assignments](#)

TOOLS
[Add from database](#)
[Add new CT](#)
[Remove selected](#)
[Move selected](#)
[Copy selected](#)
[Reorder questions](#)
[Edit header](#)
[Generate slide set](#)
[Upload PRS data](#)
[Interactive classroom](#)
[Expand all](#)
[Collapse all](#)
[Export data](#)
[Student view](#)

QUICK LINKS
[Standardized tests](#)
[Students](#)

[Courses](#) > [Introductory Mechanics](#) > [Lectures](#) > [Lecture 1 10/29](#) > >|

This page lists the ConceptTests in your lecture. You can generate slides for this lecture using the "Generate slides" link on the left. You can also add CTs from database or create a new CT for yourself. You can move, delete, copy CTs from this lecture to another. Click "Edit header" to add more information for this lecture. Use the "Upload PRS data" to review the student responses in class to the CTs.

[edit](#) [clone](#) [↑↓](#) [🔍](#) [✉](#)

[Physics](#) > [Introductory Mechanics](#) > [Inertial Mass & Momentum](#) >
CT: 3940
October 17, 2001 02:03:37 pm

1. An astronaut floating weightlessly in orbit shakes a large iron anvil rapidly back and forth. She r...
1. the shaking costs her no effort because the anvil has no inertial mass in space.
2. the shaking costs her some effort but considerably less than on Earth.
3. although weightless, the inertial mass of the anvil is the same as on Earth.

[edit](#) [clone](#) [↑↓](#) [🔍](#) [✉](#)

[Physics](#) > [Introductory Mechanics](#) > [Forces & Interactions](#) > CT:
4080
October 17, 2001 02:04:02 pm

2. Consider a weight suspended from a stretched spring. On being released, it travels up to to a certa...
1. $F_{\text{net}} = 0$.
2. $K_{\text{total}} = 0$.
3. $F_{\text{net}} = 0$ and $K_{\text{total}} = 0$.
...

[edit](#) [clone](#) [↑↓](#) [🔍](#) [✉](#)

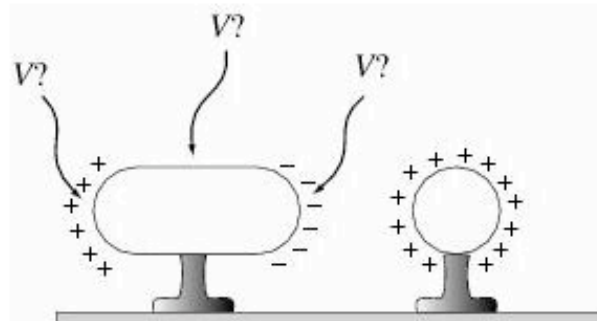
[Unfiled](#) > CT: 4936
October 28, 2003 03:45:00 pm

3. You're on a boat in the center of a lake, and you drop a rock into the water. The rock sinks to the...
1. It goes up
2. It goes down
3. It stays the same

Private ConceptTest, not shared. [Share](#)

Create student view of question

1. A charged object is brought near an uncharged metal object. Negative charges accumulate on the side of the uncharged object nearest to the charged sphere, positive charges on the opposite side. On the uncharged metal object, the potential is



1. largest on the positive side
2. largest on the negative side
3. largest in the middle
4. the same everywhere

Answer

2. A cylindrical piece of insulating material is placed in an external electric field, as shown. The net electric flux passing through the surface of the cylinder is



The LT3 package

- ▶ **Integration of Interactive Learning Toolkit (ILT) and BQ creates new software package:**
- ▶ **Learning and Teaching Through Technology (LT3)**

Test

- ▶ **Prof. Mazur's Physics 1b class at Harvard (165 registered students)**
- ▶ **Peer Instruction used extensively (ca. 6-7 ConcepTests per class, most with pre- and post discussion polling)**

Result: Two LT3 components

- ▶ **Two parts:**
- ▶ **Server-based content and course management system (ILT)(runs 24/7)**
- ▶ **Server- or PC/Laptop-based Interactive Classroom**

New features of the LT3

- ▶ **Upload ConcepTests prepared within the LT3 server component (ILT) to the Interactive Classroom (BQ)**
- ▶ **Use a wide variety of communication devices to poll class (Details in next talk)**
- ▶ **Upload student responses back to the server**

CT responses in LT3 facebook



Lisa Simpson

F11112222

lsimpson@fas.harvard.edu

Laboratory 8 Tue 1:00:pm

Section 5 Wed 4:00:pm

Class: 2004
Major: economics
Registered on: 2/2/2003
PRS Unit ID: 0248
Final grade: B

Forums: 4 posts
Email: 36
No. of self-tests: 1 self-tests
Reading FAQs: 1

RA	CT	PT	L	PS	HE	OT	FE
6/6	1/1	2/2	9/10	40/40	20/35	5/5	39/60
4/6	5/6	2/2	9/10	28/35	14/35	15/15	
5/6 *	5/6	0/2		35/35	25/35	18/18	
5/6 *	2/3	2/2	9/10	35/35*			
5/6 *	6/9	2/2	10/10	35/35			
5/6 *	7/8	0/2		35/35			
6/6	3/4	2/2		35/35			
6/6	5/9	2/2		35/35			
5/6 *	9/9	2/2					
6/6	8/11						
6/6							
5/6 *	5/5						
6/6	10/10						
6/6	8/9						
6/6	10/10						
6/6	7/7						
6/6							
6/6							
6/6	11/11						
6/6	9/9						
6/6	8/8						
6/6	13/13						
119/126	132/148	14/18	37/40	278/285	59/105	38/38	39/60
94%	89%	78%	93%	98%	56%	100%	65%

RA: Reading assignments; CT: ConceptTests; PT: Pretest; L: Laboratory; PS: Problem Set; HE: Hour Exam; OT: Online Test; FE: Final Exam;

CT responses in LT3 statistics module

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Physics > Further Introductory Physics > Physical Optics > CT: 3821

October 17, 2001 02:03:16 pm

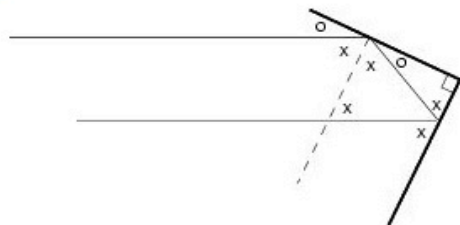
3. Light enters horizontally into the combination of two perpendicular mirrors as shown below.



After reflecting off of both mirrors the direction of the incident light

1. bounces back and forth many times, until it hits the corner.
2. depends on the mirror angle θ .
3. is reflected back and upwards.
4. is turned around by 180° .
5. is reflected back and downwards.

Answer: 4. Because the angles marked θ and x add up to 90° , the back reflected beam is the incident one. See figure.



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Physics > Further Introductory Ph

4. To look at a tattoo on the back of her shaved head, a woman stands 4 ft. in front of a wall mirror. She holds a hand mirror one foot behind her. How far back from the wall mirror is the image of the tattoo?

1. 3 ft
2. 4 ft
3. 5 ft
4. 6 ft

Answer: 4. The "object" for the image of the tattoo in the wall mirror is actually the image of the tattoo in the hand mirror, which is 6 ft away.

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Physics > Further Introductory Ph

5. You are standing a long distance away from a concave mirror (a mirror with a surface that curves slightly away from you). The image that you see is



ILT: Course Statistics

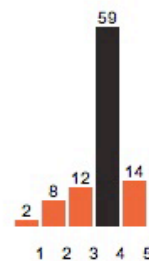
3821. Light enters horizontally into the combination of two perpendicular mirrors as shown below.

After reflecting off of both mirrors the direction of the incident light

1. bounces back and forth many times, until it hits the corner.
2. depends on the mirror angle θ .
3. is reflected back and upwards.
4. is turned around by 180° .
5. is reflected back and downwards.

Attendance: 95/165

Pre correct: 62%



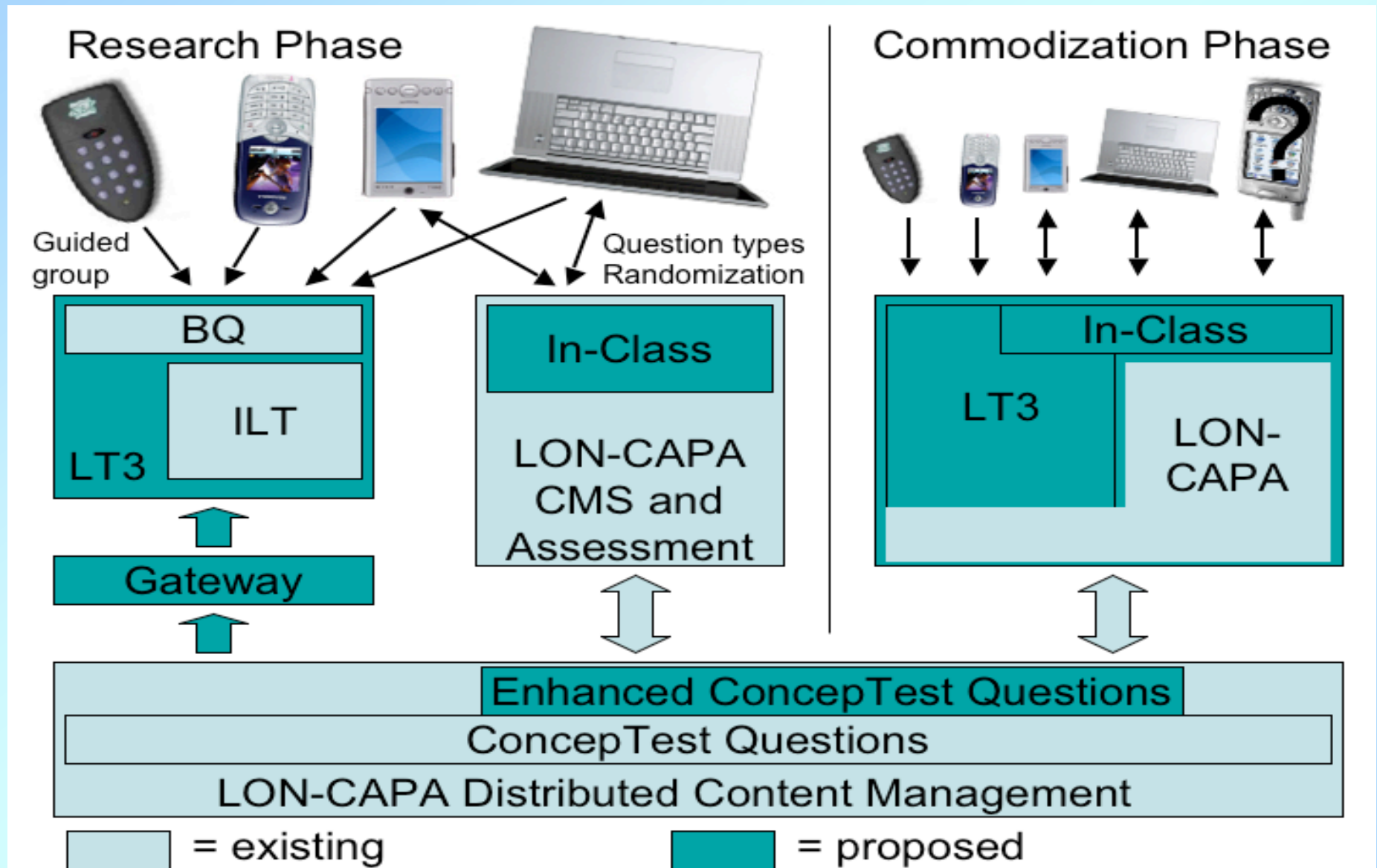
Correct pre (f_{pre}):	62%
Correct post (f_{post}):	79%
Revised answer:	63%
Gain ($(f_{post}-f_{pre}) / (1-f_{pre})$):	0.55
R -> R:	42%
W -> R:	37%
W -> W:	21%
R -> W:	12%
No 2 nd :	0%

Attendance: 110/165

Post correct: 79%



Outlook



Acknowledgments

NSF Distinguished Teaching Scholar Award

DEAS Information Technology Group

ASA Assessment of Student Achievement in
Undergraduate Education

For more information please visit:

<http://mazur-www.harvard.edu/lt3>