Multiple Technologies to Address Multiple Instructional Needs

Robert Beichner
Overview

What are the problems?
What is the best way to respond?
How did we get into this situation?
An “outside the (black) box” solution
What is the problem?

Students don’t learn as much as we’d like.
What is the problem?

Sorry, video not available

Search YouTube for “Five Minute University”

“The 5-Minute University”
Don Novello as Father Guido Sarducci

from Gilda Live (1980)

Students don’t learn as much as we’d like.
What is the problem?

Education is one of the few things a person is willing to pay for and not get.

William Lowe Bryan

Students don’t enjoy it as much as we’d like.
Students are more diverse than we’d like.

New demographics

1972: 47% of all high school graduates immediately enrolled in college.

2007: 67% (2 M of 3 M) ...and it is still rising.

What do we do with these folks?
What is the problem?

STEM Pipeline — Leaking Badly

In 2001, there were a bit more than 4 million 9th graders. Four years later, 2.8 million of them graduated and 1.9 million went on to two- or four-year college; only 1.3 million were actually ready for college work. Fewer than 300,000 are majoring in STEM fields and only about 167,000 are expected to be STEM college graduates by 2011.

Source: NCES Digest of Education Statistics; Science & Engineering Indicators 2008

...and they don’t make it through the system.
What is the problem?

Kids these days...

75% (4 and under) use computers
27% (6 and under) use computers daily
26% (ages 8-18) use more than 2 media sources simultaneously


Students are digital natives. We aren’t.
What is the problem?

Today’s College Grads

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Television</td>
<td>&gt;20,000 hrs</td>
</tr>
<tr>
<td>Video Games</td>
<td>&gt;10,000 hrs</td>
</tr>
<tr>
<td>Reading</td>
<td>&lt; 5,000 hrs</td>
</tr>
</tbody>
</table>

Mark Prensky, (2001). *Digital natives, digital immigrants*

Students are digital natives. We aren’t.
What is the problem?

In June, Amazon’s e-books outsold paper by nearly a factor of two.

Students are digital natives. We aren’t.
What is the problem?

They’ve been using Google since they first learned to read.

Students are digital natives. We aren’t.
What is the problem?

They think differently about technology.

Students are digital natives. We aren’t.
Do you do most of your electronic communication through e-mail...

...or via texting, IM and FaceBook?

Students are digital natives. We aren’t.
What is the problem?

The brain is plastic!

Hebb’s Rule: Neurons that fire together, wire together.

Students are digital natives. We aren’t.
What is the problem?

Information scarcity to abundance
What is the problem?

Information scarcity to abundance
A student voice: “...we have the world at our fingertips — and the world has been at our fingertips for our entire lives. I think this access to information seriously undermines this generation’s view of authority, especially traditional scholastic authority.”

What is the problem?

400,000 Students
Accredited
$1B Venture Capital

Students have options.
What is the problem?

More than 20% of all current students are taking an online course right now.

Students have options...
What is the problem?

Students have options. And this isn’t the best one.
How can we respond?

When was the last time you watched a lecture on TV?

Given a choice...
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What should we NOT do?
What should we NOT do?
Recognize that information ≠ knowledge

How can we respond?
But how often do we explicitly teach critical thinking (and not assume students would pick it up automatically by osmosis?)

Actually teach critical thinking
How can we respond?

Quality of RELATIONSHIPS (faculty to student and student to student) is

Play our trump card

The Journal of Higher Education has called Alexander Astin’s book *Four Critical Years* the most frequently cited work in the higher education literature.

In *What Matters in College?* Astin presents a completely new and expanded study of how students change and develop in college — and reveals how colleges can enhance that development. Based on a study of more than 20,000 students, 25,000 faculty members, and 200 institutions, the book shows how academic programs, faculty, student peers, groups, and other variables affect students’ college experiences, and how these factors can shape students’ personalities and behavior; values and beliefs; and academic, social, and career development.

This paperback edition includes a new introduction that revisits the findings of the original work in light of the author’s most recent investigations on college students.

The Author
Alexander W. Astin is professor of higher education and director of the Higher Education Research Institute at the University of California, Los Angeles. He is also founding director of the Cooperative Institutional Research Program and author of more than one hundred articles and seventeen books, including *Assessment for Excellence* (1991) and *Achieving Educational Excellence* (Jossey-Bass, 1992). In 1992 he received the American Association for Counseling and Development’s Extended Research Award.
How can we respond?

What do students prefer?

Play our trump card
How can we respond?

Don’t waste peoples’ talents
How can we respond?

If you *can* be replaced by an iPod, you *will* be!

Don’t waste peoples’ talents
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What happened?

Greeks invented viewing/listening places
What happened?

Auditoriums weren’t designed for education
What happened?

"What Matters" is Social Interaction?

Greeks did education differently.
How did we get here?

Auditorium turned into Lecture Hall

Monasteries had auditorium spaces

Monks were great at copying

Decree from Pope Gregory VII in 1079

Gutenberg's Bible not until 1455
How did we get here?
How did we get here?

Various Projectors
How did we get here?

Broadcast and recorded television
How did we get here?

Microcomputers
How did we get here?

Student Response Systems “Clickers”
How did we get here?

MIT OpenCourseWare, Intro to Bioengineering, BE.010J
Prof. Douglas Lauffenburger, Head of Biological Engineering
How did we get here?

Teachers have been concerned about student use of technology in the classroom for a long time.

...if one sees written treatises...these are not...the things of most worth...

Plato, Seventh Letter, 353 BCE
Adapting to new technology is difficult
Sorry, video not available

Search YouTube for “Monastery Helpdesk”
Overview

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Technology (tek'näləjē) noun - the application of scientific knowledge for practical purposes...a designed solution to a particular problem
Classroom environment was intentionally re-designed to facilitate interactions between students and with the instructor.
Round Tables
3 Teams of 3 per Table
White Boards on Walls
Group White Boards
No one is anonymous
Homework lottery
Pass and Reflect

While the students work, the instructor walks around the room, listening and asking questions.

SCALE-UP
5 hours/week* (MW 2 hrs, F 1 hr)

10 minute lecture (Organization & Motivation)

Activities (Tangibles, Ponderables, Visibles)

Followup discussion

5 minute lecture summary

"Typical" Class time

* for NC State Physics
How thick is one page from your textbook?

Figure out how to read Universal Product Codes

How many extra electrons are on a piece of tape?

Why does the definition of flux include a dot product?

Tangibles

Simple (or complex) observations
How far does a bowling ball skid?

What fraction of a candy bar is used in the store?

How many electrons fit on a foil-covered ball?

How many steps is it from NYC to LA?
Visibles

Student-generated models of reality
Stretch wires, measure speed of sound, predict thermal properties

Semester-Long Linkages
Problem solving skills developed
Conceptual learning increased
Retention much higher
Top students benefit most
Performance in later classes enhanced
Student attitudes better
Did It Work?

Retention Rates

NCSU
$t = 5$ years
$N = 16,000+$
Where Are We Now?

Wisconsin-Platteville

Florida Gulf Coast

Virginia Med School

Minnesota

UT Dallas
Where Are We Now?

[Images of a classroom setting and charts and graphs]
beichner@ncsu.edu

SCALE-UP website (http://scaleup.ncsu.edu) is now a wiki.