Online Resources for Education

IUCEE Leadership Summit
July 2017, Goa, India
Outline

- Introduction
- Clickers and Embedded Questions
- Online Interactive Experiments
- Online interactive electronic Texts
- Flipped Classroom
- Remote Laboratories
- Faculty development
- Conclusion
- Questions and Answers
Harnessing the Power of Technology in Education

- Traditional – Teacher lecturing students in a classroom
- 19th century – “Cyclostyle”
- 1920s on-air “classes”
- 1930s Overhead projector
- 1940s Video tapes
- 1960s Photocopiers
- 1970s Calculators, computers
- 1980s Portable computers
- 1990s Internet – world wide web, smartphones
- 2000s Writable tablets, Internet resources, and hardware
- 2010– explosion of Internet resources and hardware
- Future?

Ref: http://online.purdue.edu/ldt/learning-design-technology/resources/evolution-technology-classroom
Traditional Delivery of an Engineering Course

I talk and you listen and take notes.
“iGen” Students and Online Technology

- Born mid 1990s and later: iGen
- Born late 70’s to mid 90’s: Millennials
- Born early sixties to late 70’s: Gen X
- Born before early sixties: Baby Boomers or Traditionalists or Silent Generation or simply, Dinosaurs!
Comparison of attitudes of Gen Boomers and “iGen” Students
About the Millennials

This slide is used with permission from Dr. Twenge
Are you above average?

This slide is used with permission from Dr. Twenge

Twenge, Campbell, & Gentile, 2012, *Self & Identity; Generation Me, iGen*
Changes in grades and study time

Nationally representative sample of 12\textsuperscript{th} graders

Twenge, Campbell, & Gentile, 2012, \textit{Self & Identity; Generation Me; iGen}
Expectations

Nationally representative sample of 12th graders

Grad school expect
Grad school actual
Professional expect
Professional actual

Reynolds et al., 2006; Generation Me; iGen

This slide is used with permission from Dr. Twenge
Commonly used technology resources in today’s classrooms

- Learning Management Systems (LMS’s)
- Emails, Posting syllabi, calendars, assignments, information, grades, etc.
- Collecting assignments
- Internet surfing for information, searches, current status (“Google Scholar”)
- Lecture capture and delivery
Commonly used technology resources in today’s classrooms....continued

- Lecture capture and delivery
  - Live class recording, equipment, iClickers, and other strategies
  - Live broadcast via internet (synchronous)
  - Asynchronous or on demand delivery and data collection (timing, feedback to questions)
- MOOCs
General Tips
for using online resources

- Hardware/Software/Internet
- Use
- Applicability
- Most important: adapting and adopting
- We need to use students’ “language”
- “talk the talk” and “walk the walk”
Outline

- Introduction
- Commonly used technology resources in today’s classrooms
- Clickers and Embedded Questions
Question 2

- How well the members of audience in our class are familiar with “clicker technology”, so let’s find out
Example Question

How well are the members in audience familiar with "clicker technology?"

Clicker is a device which:

A. makes clicking sound
B. is an electronic device used to record a student’s response
C. is an electronic device that vibrates to awake sleeping students
D. is used to keep evil elements away
E. is something I have no idea about
Example question:

In the current context, a clicker is a device which:

A. makes clicking sound
B. is an electronic device which is used to record a student’s response
C. is an electronic device which vibrates to awake sleeping students
D. is used to keep evil elements away
E. is something I have no idea about
What are “clickers”

- A technology to engage all students in class
- Handheld wireless devices to transmit student responses to a receiver
- One pre-registered clicker per student
- Typically, student respond by selecting one out of several choices
- Instant cumulative feedback is available to the presenter
Challenges Addressed

For students:
- Keep them engaged – a major challenge with current students who can access the world with their mobile phones!
- Make them feel actively involved

For instructors:
- Assess their background
- Check if most of them understand the lecture topic (Do I need to explain in some other way?)
- Review the topics at the end of lecture
If the response is....
Employing clicker-like technique in online lectures – we call it “embedded” questions

- Embedded Questions: Inserted in Video Lectures to track and record student interactions; questions pop up without warning
- Data collected online
- Identified by the student’s email address to track and record the interactions
Cost

- iClicker technology can be expensive
- However, good alternatives are available
Four Good Alternatives to Clicker Systems

One of the benefits of allowing students to bring their cell phones into your classroom is that they can use them to give you anonymous feedback on sensitive questions and questions for which a name isn't necessary. For example, you might just want to take a survey of the average length of time your students spent studying for a quiz or how long it took them to complete an assignment. Here are four alternatives to purchasing clicker systems for your school while still gathering valuable information.
A “free” version of this technique...

- Is available as “polleverywhere” app and at least three other similar apps
- [https://www.polleverywhere.com/](https://www.polleverywhere.com/)
- Works on mobile smart phones
- Needs some initial learning – like any other technique
- Great for simple questions
To summarize: *Clickers in Live Class and Embedded Questions in Video Lectures*

- Keeps students engaged
- Makes them feel participated
- Can be used to check attendance
- We highly recommend this practice to engineering educators
Outline

- Introduction
- Commonly used technology resources in today’s classrooms
- Clickers and Embedded Questions
- Online Interactive Experiments
Challenges Addressed

For students:
- Understanding fundamental concepts through a practical example

For instructors:
- Bringing the experiments to the lectures – can’t afford labs for so many students, and there is no time for a separate lab course!
Examples

- Example: Concept of conservation of mass applied to flow of water in a pipe
  
  *Ref: https://phet.colorado.edu/

- Ohm’s Law
  

- Wave on a string
  
  https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_en.html
Poll question 3:
Have you used such interactive experiment in your lecture before?
A. Yes
B. No, because I was not aware of such techniques.
C. No, because we do not have adequate equipment (such as Internet access or computer graphics, etc.)
D. No, because I do not think it is useful
E. No, because I did not think of it/Other
To summarize:

There is a wealth of open, online experimental demos that can do a wonderful job of supplementing our lectures.
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Electronic Textbooks

- Not just a pdf copy posted online
- Encourages reading
- Highly interactive
- Great assessment tool
In a steady-flow process, the change of total energy of the control volume must:

Click the answer you think is right.

- decrease
- increase
- remain zero

Do you know the answer?

I know it  Think so  Unsure  No idea
where the subscripts 1 and 2 denote the inlet and the exit states, respectively, \( \rho \) is density, \( V \) is the average flow velocity in the flow direction, and \( A \) is the cross-sectional area normal to flow direction.

During a steady-flow process, the total energy content of a control volume remains constant (\( E_{CV} = \) constant), and thus the change in the total energy of the control volume is zero (\( \Delta E_{CV} = 0 \)). Therefore, the amount of energy entering a control volume in all forms (by heat, work, and mass) must be equal to the amount of energy leaving it. Then the rate form of the general energy balance reduces for a steady-flow process to

\[
\dot{E}_{in} - \dot{E}_{out} = \frac{dE_{system}}{dt} = 0 \quad (5-33)
\]

or

\[
\frac{\dot{E}_{in}}{kW} = \frac{\dot{E}_{out}}{kW} \quad (5-34)
\]

Energy balance: \( \dot{E}_{in} = \dot{E}_{out} \)

Noting that energy can be transferred by heat, work, and mass only, the energy balance in Eq. 5–34 for a general steady-flow system can also be written more explicitly as

\[
\dot{Q}_{in} + \dot{W}_{in} + \sum m \dot{\theta} = \dot{Q}_{out} + \dot{W}_{out} + \sum m \dot{\theta} \quad (5-33)
\]

or

\[
\sum \left( \dot{Q}_{in} - \dot{Q}_{out} \right) = \sum \left( \dot{W}_{in} - \dot{W}_{out} \right) + \sum m \dot{\theta} \quad (5-33)
\]
Other resources with interactive electronic text

- Making quizzes with question banks and algorithmic questions
- Homework assignments
- Student performance reports
- Setting up time windows
- ....
In Summary

- Interactive electronic text is relatively a new and very powerful resource
- Available in not many topics
- Expensive
- In my course, it costs $100 per student (as opposed to $250 for a hardbound copy)
- Trend for the future
- Anyone uses this technology?
Outline

- Introduction
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- Flipped Classroom
What is “flipping a classroom”?
(from our Reading Assignment 5 by Velegol, et al.)

- A flipped, or inverted, classroom is where, first, the technical content is delivered via online videos before class. Students then come to class prepared to actively apply this knowledge to solve problems or do other activities.
Example from my class:

Topic: *Conditions for boiling water and phases of water*

- Water boils at 100 deg C – always? Or, does it depend on other quantities, like pressure, density, etc.?
- Where do you begin to look it up in the hundreds of pages of property data tables?
Poll question 4 coming up

- First I would start with asking a teaser question before explain the theory based on an observation........
Poll question 4:

Water boils on Mount Everest at a temperature____

A. greater than 100 deg C because it is too cold up there
B. of 100 deg C, because it is the boiling point
C. less than 100 deg C because pressure is too low there
D. that depends on what device you use to boil it
E. .... I have no idea
Poll question 4:

Water boils on Mount Everest at a temperature____

A. greater than 100 deg C because it is too cold up there
B. of 100 deg C, because it is the boiling point
C. less than 100 deg C because pressure is too low there
D. that depends on what device you use to boil it
E. …. I have no idea
### Thermodynamic Property Data Tables

#### Table A-4

**Saturated Water—Temperature Table**

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<th>Specific volume, $v_s$, m³/kg</th>
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</table>
My experience in flipping the classroom

- Lecture on video
- In-class session with teaching assistants
- Example
Can I make water boil in this classroom, at 25 °C?

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<th>Temp., $T$ °C</th>
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Does “flipping a classroom” work?

- Widespread support, but some question it
- Other implications: Is there heavier workload for instructor? For students? Do we need balance?
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- Remote Laboratories
Remote Laboratories

- Current technology
- Labs are setup at a location by a provider
- Students access it remotely and conduct experiments
- Software available with cloud computing
- Can be scheduled 24/7 by students in different parts of the world
- Multiple lab stations in multiple locations/countries
Remote Laboratories
Photos used with permission from Electorno of Bangalore, India; Mr. Kalyan, CEO

- Single point or centralized maintenance.
- Track utilization parameters
- Facilitate online students to perform hands-on experiments which otherwise was just not possible
Remote Laboratories

Photos used with permission from Electorno of Bangalore, India; Mr. Kalyan, CEO

- Provide simultaneous access to multiple resources that are available in a given Laboratory as shown below
- Provide student and proctor usage data
- This setup contains Motor-Generator coupled systems with different types of Electrical machines
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- Faculty development
Number of Elements in Course Models

Resident Course

1. Lectures
2. Homework
3. Paper based exams
4. Campus email
Number of Elements in Course Models

1. Resident lectures (live streamed)
2. On-demand lectures (recorded)
3. Online textbooks and readings
4. Online homework and exams
5. Student email, chat, and Skype
6. Course web site in LMS
7. Online gradebook in LMS
8. Improved content organization
9. Live video chat exam reviews
10. Interactive visuals during lectures
11. Annotated visuals during lectures
12. Video demonstration vignettes
13. Online lab activities
14. Virtual instruments for labs
15. Remote access to engineering labs
16. Lecture recording for travel away
Number of Elements in Course Models

Resident Course

Blended Course

Faculty Development
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- Conclusion
In Conclusion….

We looked at several aspects and techniques regarding online resources for education:

1. Clickers and Embedded Questions
2. Online Interactive Experiments
3. Online interactive electronic Texts
4. Flipped Classroom
5. Remote Laboratories
6. Faculty development
Online Resources provide us, the teachers and students, great means for making the modern teaching-learning process more efficient,

And yet, many of us are reluctant to use those for various reasons..

So, my recommendation is
My recommendation:

- Try it yourself with selective few topics
- Tweak your technique to include other versions
- Initially there may be heavier workload, but push through
- Then judge yourself!
Advice for the educators and students

“Believe not because some old manuscripts are produced, believe not because it is your national belief, because you have been made to believe it from your childhood; but reason it all out, and after you have analysed it, then, if you find that it will do good to one and all, believe it, live up to it, and help others to live up to it.”

— Swami Vivekananda
Corollary..

- Don’t reject the wealth of online resources in engineering education just because it is not supported in old texts, or because your teachers did not use it, or others around you don’t endorse it; but rather, learn it, try it out, and after you have checked it out, then, if you find that it will do good to your students, believe in it, live up to it, and help others to live up to it!
Thank you!
“iGen” Students and Online Technology

- iGen or Gen Z or Centennials: Born 1996 and later
- Millennials or Gen Y: 1977 - 1995
- Generation X: 1965 - 1976
- Baby Boomers: 1946 - 1964
- Traditionalists or Silent Generation: Born 1945 and before
Cost

- iClicker technology can be expensive
- However, good alternatives are available
Cost

- Single point or centralized maintenance.
- Track utilization parameters
- Facilitate online students to perform hands-on experiments which otherwise was just not possible
• Provide simultaneous access to multiple resources that are available in a given Laboratory as shown below
• Provide student and proctor usage data
• This setup contains Motor-Generator coupled systems with different types of Electrical machines
Cloud Software Library

Cloud Physical Laboratory

- Kodak invented the digital camera in 1975, but didn’t invest heavily in the new technology, instead sticking with what had always worked: traditional cameras and film. In 1996, Kodak had a $28 billion market capitalization with 95,000 employees.

- After a downward spiral, Kodak went bankrupt in 2012. That same year, Facebook acquired Instagram, a digital photo sharing app, which at the time was a startup with 13 employees. The acquisition’s price tag? $1 billion. And Instagram had been founded only 18 months earlier.
- The most ironic piece of this story is that Kodak invented the digital camera; they took the first step toward overhauling the
Are you above average?

- $N = 9$ million
- Everyone is the same age, but different points in historical time. Any differences due to generation, NOT age.
- “Rate yourself on each of the following traits as compared with the average person your age.”
  - Highest 10%
  - Above Average
  - Average
  - Below Average
  - Lowest 10%

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Twenge, Campbell, & Gentile, 2012, *Self & Identity; Generation Me; iGen*
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