Treating the Content Coverage Syndrome: Preparing Students for Active Learning in Large Classes

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I. Introduction: Content in context

II. Being strategic about content

III. Moving content from the instructor to the student

IV. Impacts on student learning
Content in context

**Analyze:** Can I recognize underlying patterns and structure?

**Synthesize:** Can I put ideas and information together to create something new?

**Evaluate:** Can I make judgments on the relative value of ideas and information?

**Apply:** Can I use these ideas in a new situation?

**Understand:** Can I explain these ideas to someone else?

**Remember:** Can I recall key terms and ideas?

Bloom et al. 1956 *Taxonomy of educational objectives*
Krathwohl 2002 *Theory Into Pract.* 41: 212-218
Facts: Can’t live with ‘em, can’t live without ‘em

• p339 sodium-potassium pump: carrier molecules have two forms, ferry Na\(^+\) and K\(^+\) across in a 1:1 ratio

• p451 sister chromatids are joined only at the centromere (no synaptonemal complex)

• p121 32 ATP per molecule of glucose from ETC (+4 from glycolysis); flow of electrons through ETC generates ATP

• 143 pages of diversity material (17% of total text) ... virtually all incorrect
A general pattern:

Predicted Exam Score (avg. % correct) vs. Weighted Bloom’s Index

Freeman et al. 2011 CBE-LSE 10: 175-186
Content in context

Cognitive load and short-term working memory

• In general, people can keep 7 digits or 5 words in short-term working memory

• Experts can retrieve more information than novices because they chunk it (requires context)

• Cognitive load is a function of the difficulty of material

A personal perspective: learning facts through application

Content in context

Information as a commodity
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Being strategic

Backward course design

• Start with learning goals: articulate what your students will be able to do, at the end of the course

• Write assessments to evaluate student mastery of these goals

• Design course activities that will help students practice and achieve mastery

KEY POINT: the content that you ask your students to learn should serve these goals

Being strategic

Trimming and focusing content

• 40 courses in two years; 4-5 hours of back-to-back classes
• Fighting the “mention trap”

Criteria for trimming: An example

• Introductory biology for majors: 1200 page textbook, 55 chapters, ~2000 glossary terms (not counting organism or lineage names)
• 114 classes: 10.5 pages, 0.5 chapters, 17.5 new vocabulary terms per day
Criteria for trimming

• Will they need to know this for other concepts in the course? (e.g. negative feedback, fitness trade-offs, coevolutionary arms race)

• Will they need to know this as they enter other courses in the curriculum?

• Is this the last time they will see the term or concept? Am I responsible for an introductory, working, or mature/expert level of understanding?

• Will they need to know this for MCATs, DATs, PCATs, GREs?
Criteria for trimming

Please spend a few minutes making a list of criteria you will use in trimming material from your course.

Once your content list is assessed and focused, HOW are you going to cover it?
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Flipping the classroom

Traditional model for STEM courses:

Class period:
Lecturer “goes over” relevant information

Homework after lecture:
Students work high-level problems

Jon Bergman, Aaron Sams
Offloading content

Flipping the classroom

Traditional model for STEM courses:

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Options for offloading content prior to class

1. Reading quizzes ...

... online the night before, or with clickers at the start of class.

Offloading content

2. Preparatory vodcasts: a talking head plus

... and plus a quiz or other graded homework (may be high level)

Offloading content

2. Preparatory vodcasts: software packages for do-it-yourself production
Offloading content

2. Preparatory podcasts: off-the-shelf products
Offloading content

3. Online courses, with face-to-face discussion sections

Coursera

Education for Everyone.

We offer courses from the top universities, for free.
Learn from world-class professors, watch high-quality lectures, achieve mastery via interactive exercises, and collaborate with a global community of students.

Watch Our Video > Sign Up Now

Healthcare, Medicine, and Biology

Our wide range of courses allows students to explore topics from many different fields of study. Sign up for a class today and join our global community of students and scholars!

Basic Behavioral Neurology
Roy Hamilton, MD
This course will survey fundamental principles of cognitive and behavioral neurology. The emphasis of the course will be on the neural mechanisms underlying aspects of cognition and on diseases that affect intellect and behavior. No prior background in neurology, medicine, or neuroscience is required.

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Cardiac Arrest, Hypothermia, and Resuscitation Science
Benjamin Abella, MD MPhil
This course will explore new breakthroughs in the treatment of patients during cardiac arrest and after
Would this work in your course?

Please spend a few minutes making notes on how you could set up and deliver reading quizzes or preparatory podcasts/vodcasts for your students, or convert your course to online delivery with face-to-face, in-class interaction.

What human, financial, and technical resources would you need?
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Data on student learning

**An example: Human-computer interaction course at the Georgia Institute of Technology**

 Controls:
1. Identical instructor
2. No difference in student gender, major, yr, incoming GPA
3. Identical exams, graded blind

Also:
4. Time spent watching vodcasts was deducted from course contact time in experimental treatment
5. Same topics, lecture slides, assigned reading, lecture homework, semester project, required attendance, class size (28,18)

Data on student learning

**HCI @ GIT, continued**

Traditional lecture
vs.
Experimental treatment:
• project-related group presentations
• small breakout group discussions and presentations
• redesign sessions
• design critiques
• design reviews with HCI experts
• role-playing activities
• discussions with local HCI practitioners

Data on student learning

**HCI @ GIT, continued**

**Final grades**

Experimental section: $79.95 \pm 4.69$ (s.d.)

Control section: $88.23 \pm 6.07$ (s.d.)

$p < 0.01$

Data on student learning

Other examples—experiments that include reading quizzes or preparatory vodcasts:

**Biology**
- Freeman et al. 2011 *CBE-LSE* 10: 175-186
- Kitchen et al. 2003 *CBE* 2: 180-194

**Physics**

**Psychology**
- Morling et al. 2008 *Teach. Psychol.* 35: 45-50

**Chemistry**

**Computer Science**
- Lassere 2009 *ITiCSE*

**Engineering**