

The Evidence About Teaching

Over the past 15 to 20 years, well-controlled studies of teaching practices, as well as advancements in cognitive science, have significantly changed our understanding of how students (and really, all people) learn. Here is a short list of **findings about learning for which the evidence is the strongest**, along with selected references for each, listed below.

1. Students who **work with/use/apply** the information they are learning, especially *during class time*, learn more (1,2,3,16,18,24,25,27). This is the single best-supported piece of knowledge we have about learning.
2. Students who are given **frequent feedback on their understanding**, either through **more frequent exams or quizzes**, or other methods (examples: “clicker” questions, asking conceptual questions in class for students or student teams to answer, the [Minute Paper](#)) can learn more during a semester (9,21,26,35).
3. When students **work together in teams** to answer questions or solve problems given to them in class or outside of class (4,6,10,22,23,28,29,34,36), they learn more. (This seems to be because students have to “try out” their explanations and understanding in a group, allowing them to get valuable feedback about their learning; additionally, our “expert blind spot” often prevents us from giving non-experts the best explanations of concepts we understand well but they do not, and peers can help bridge this gap).
4. Students who are given **specific learning goals**, written in terms what they should “Be Able to Do,” can learn both more and (if goals are complex) more deeply than otherwise. Goals that a) emphasize conceptual understanding over pure memorization and b) include some higher-level skills like application, each increase the length of time students can remember and use concepts (11,12, 13,15,20,30,31, 32). **Student learning of goals is dependent upon the exam being based on them.**
5. When students are **expected to come to class having already learned some basic information** (6,7,16,17,39, 40,41), enforced by a short quiz or homework assignment, they learn more, partly because they are forced to **study earlier and more often**, and partly because class time can now be spent on **more complex and difficult questions or topics**.
6. When students are asked to **explain concepts on exams** (in part), **in writing or orally**, instead of answering *only* multiple choice questions, they study using more big-picture, deep methods, learn more, and retain the information for a longer time (5,14,19).
7. Students perform better on exams if they are **explicitly taught to study more deeply** (8,33,37,38).

To Learn More:

Visit these websites:

Carl Weimann's Science Education Initiative: <http://www.cwsei.ubc.ca>

Richard Felder's Resources in Science Education site:
<http://www4.ncsu.edu/unity/lockers/users/f/felder/public/>

Jim Sibley's Team-Based Learning site: <http://learntbl.ca>

Cognitive Psychologist Stephen Chew's videos that can help students study more deeply: <https://www.youtube.com/watch?v=RH95h36NChI&t=1s>

Read These Books:

What Is the Evidence About Teaching University Science?

Teaching Undergraduate Science by Linda C. Hodges

Teaching and Learning STEM: A Practical Guide by R. Felder and R. Brent

How Learning Works: Seven Research-Based Principles for Teaching by S. Ambrose

Designing Your Class:

Understanding By Design by G. Wiggins and J. McTighe

Creating Significant Learning Experiences by D. Fink

Assessing Student Understanding During Class Time:

Classroom Assessment Techniques by T. Angelo and K.P. Cross

Collaborative Learning Techniques by E. Barkley and C. Major

Student Engagement Techniques by E. Barkley

Motivating Students:

Creating Self-Regulated Learners by L. Nilson

Learner-Centered Teaching by M. Weimer

Watch these videos of teaching workshops:

<https://www.youtube.com/watch?v=1wxRqyoeKuA> (Evidence-Based Teaching)

<https://www.youtube.com/watch?v=1YgvD4iEvqI> (Motivating Students)

<https://www.youtube.com/watch?v=NQIQL-8300U> (But What about the Content?)

<https://www.youtube.com/watch?v=dEvbntzfAoM> (Outcomes-Based Course Design)

<http://www.medicalmedia.eu/cs/Detail/1383> (Assessing your Teaching)

<http://www.medicalmedia.eu/cs/Detail/1275> (Preparing a Good Exam)

<http://www.medicalmedia.eu/en/Detail/1396/1277> (Curriculum Reform in Medical Education)

<http://www.medicalmedia.eu/cs/Detail/1459> (Team-Based Learning)

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