LEARNING IN AN OPEN WORLD

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The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring

BENJAMIN S. BLOOM
University of Chicago and Northwestern University

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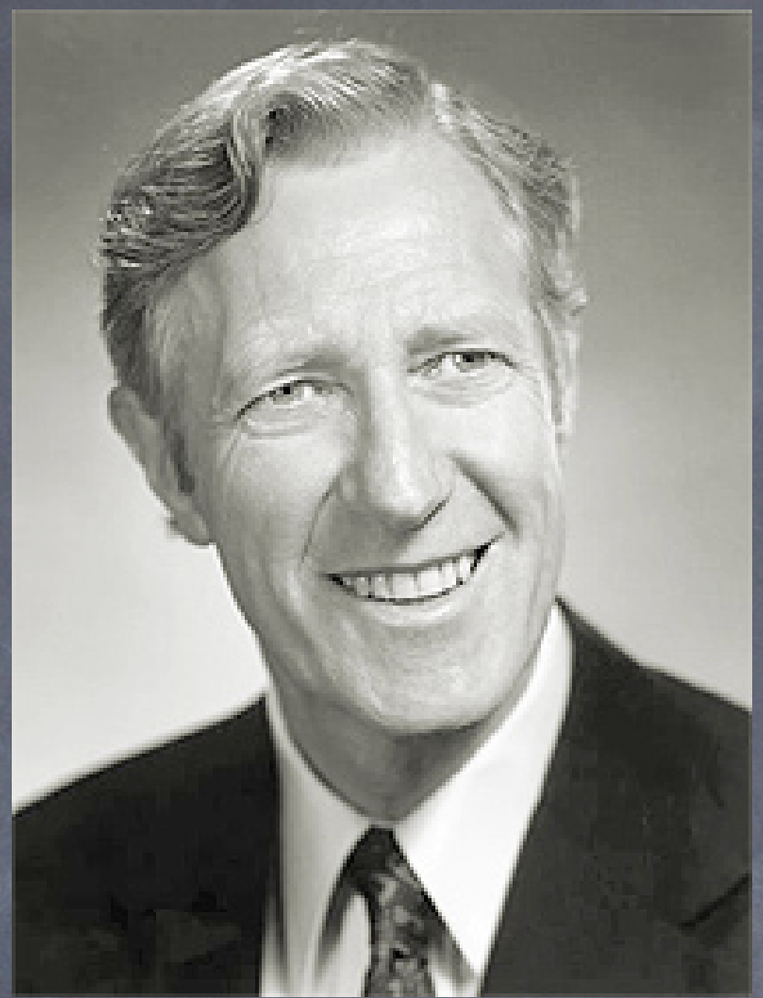

Frank Rhodes, Cornell

" In the basic business of teaching resident students, universities have not diverged much from the methods of Socrates, except that most faculty members have now moved inside."

Socrates Tears Alcibiades from the Embrace of Sensual Pleasure

Federal Aviation Administration

Pilots Topics
- Become a Pilot
- Flight Planning
- International Flight
- Medical Certification
- Pilot Licenses & Records
- Pilot Regulations
- Pilot Safety

Become a Pilot

What is the first step to becoming a pilot?

Decide what you want to fly. FAA's rules for getting a pilot's license (certificate) differ depending on the type of aircraft you fly. You can choose among airplanes, gyroplanes, helicopters, gliders, balloons, or airships. If you are interested in flying ultralight vehicles, you don't need a pilot's license.

You should also think about what type of flying you want to do. There are several different types of pilot's licenses, from student pilot all the way up to airline transport pilot. The information below describes the eligibility, training, experience, and testing requirements for Student Pilots, Recreational Pilots and Private Pilots.

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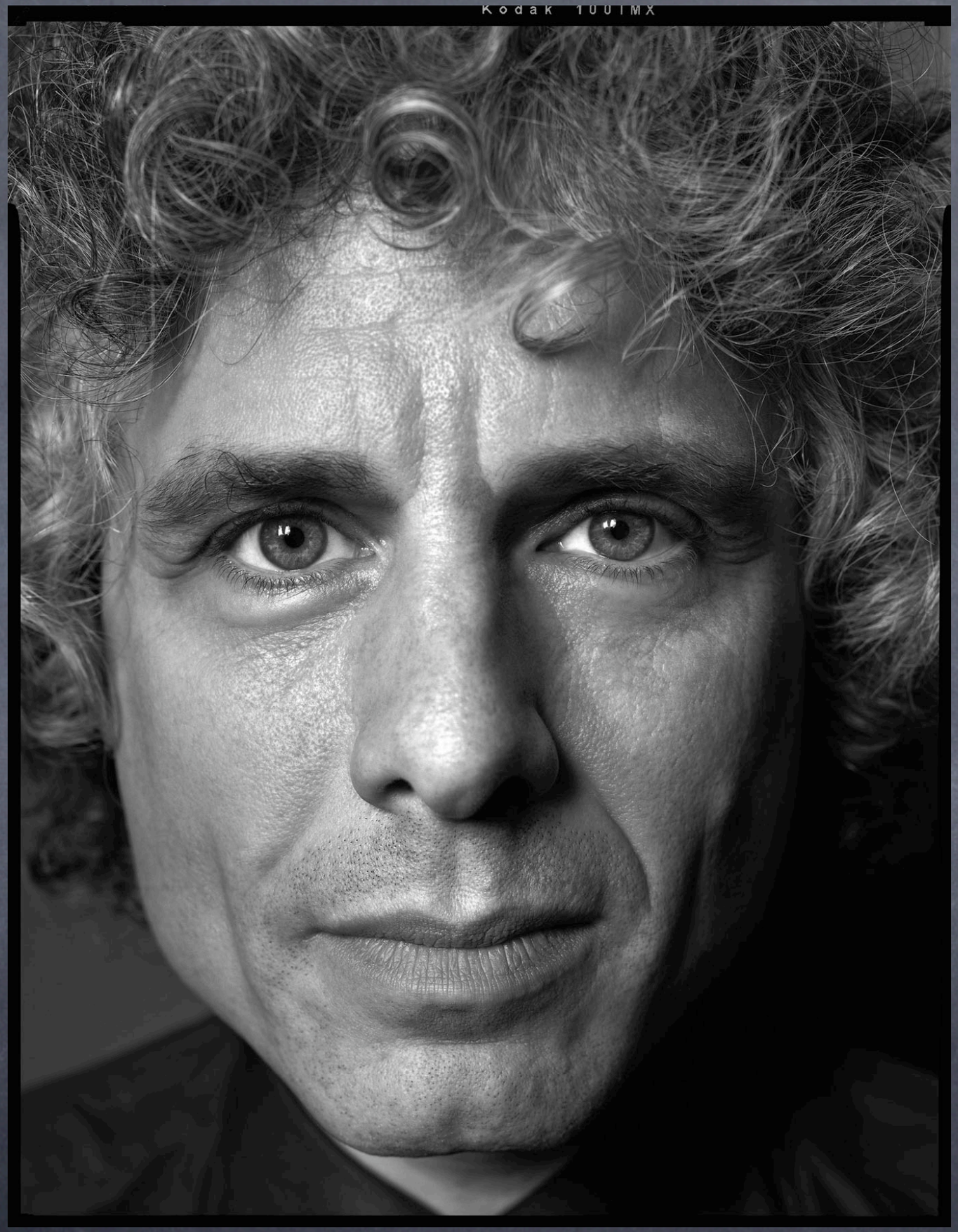

Stephen Pinker (MIT)

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Small businesses

Enterprises

Schools

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Communicate and connect

Gmail
Email with 2 GB of storage per account, mail search tools and integrated chat.

Google Talk
Free text and voice calling around the world.

Google Calendar
Coordinate meetings and school events with sharable calendars.

Collaborate and publish

Start Page
Access your inbox, calendar, docs and campus info, plus search the web from one place.

Docs & Spreadsheets
Create, share and collaborate on documents in real-time.

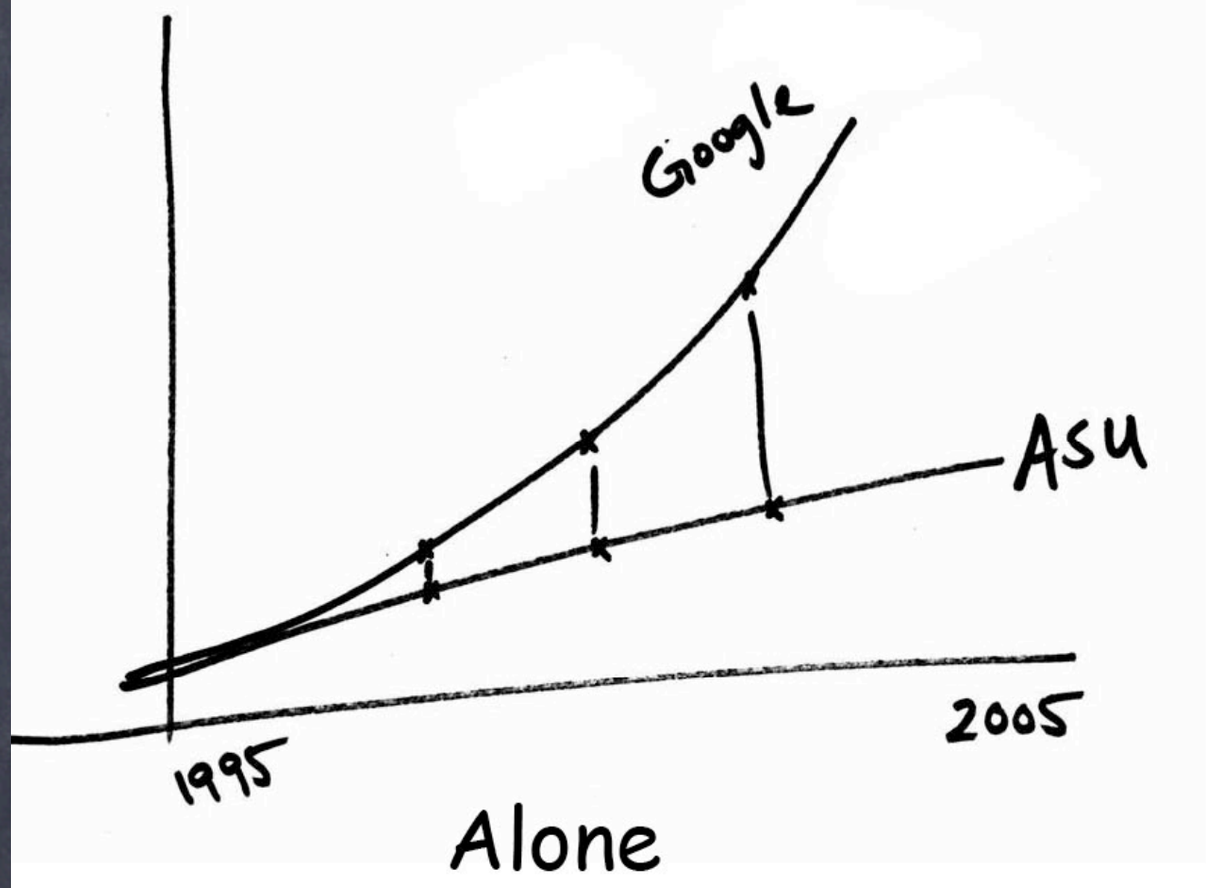
Page Creator
Easily create and publish web pages.

Manage your se

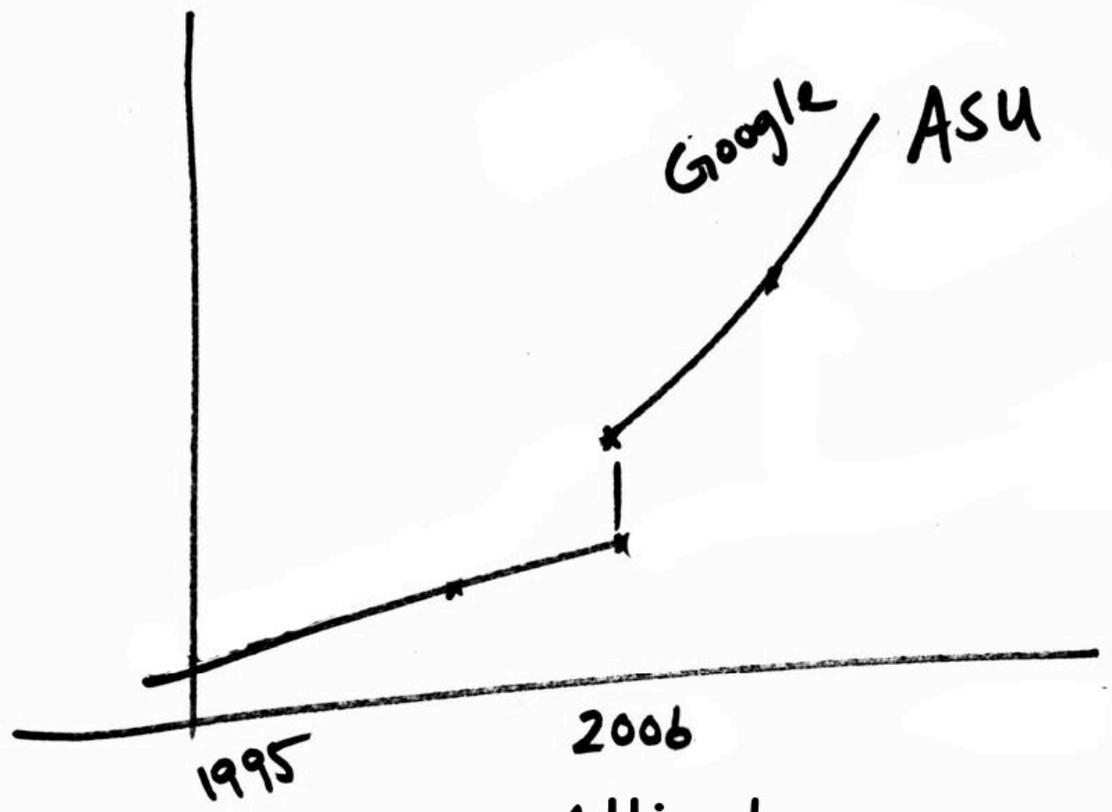
Control Pan
Manage you

Extensibilit
Integrate wit
solutions.

Help and su
24/7 assista
issues.



Alone



Allied

"Like technology from an advanced alien culture..." Adrian Sannier, Arizona State Univ.

2.6. Setting Up a School Web Site

NOTE

The *Setting Up Google Apps Standard Edition* Short Cut covers Page Creator in more detail; this section will provide a basic tour of its features and ca

Google Apps for Education provides free web site hosting for your domain, with 100 MB of storage for web pages and graphics. You'll need domain admin Creator and to build your web site. As a bit of background, you can:

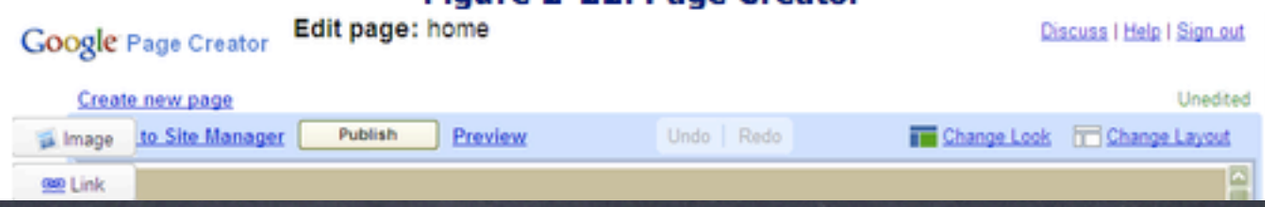
- Pick a template for your web page "look-and-feel."
- Pick another template for the layout (number) of columns.
- Use a word-processor-like editor (Page Creator) to create content for your pages.
- Use the link tool to link pages together.
- Upload any graphics you'd like to use on your web pages, and place these on your pages via Page Creator.

Everything is controlled through the Site Manager, which a domain admin can access by clicking the Web Pages link on the administrative dashboard. The pages and uploaded graphics, and from there you can create new pages (Figure 2-21).

Figure 2-21. Site Manager page

From the Site Manager, you can simply click any of the existing pages or click "Create a new page" to launch the Page Creator. The Page Creator has fam along the left, while in the upper right are controls to change the look and layout templates (Figure 2-22).

Figure 2-22. Page Creator



2.1.5. Using Google Earth to Teach a Current Events Lesson

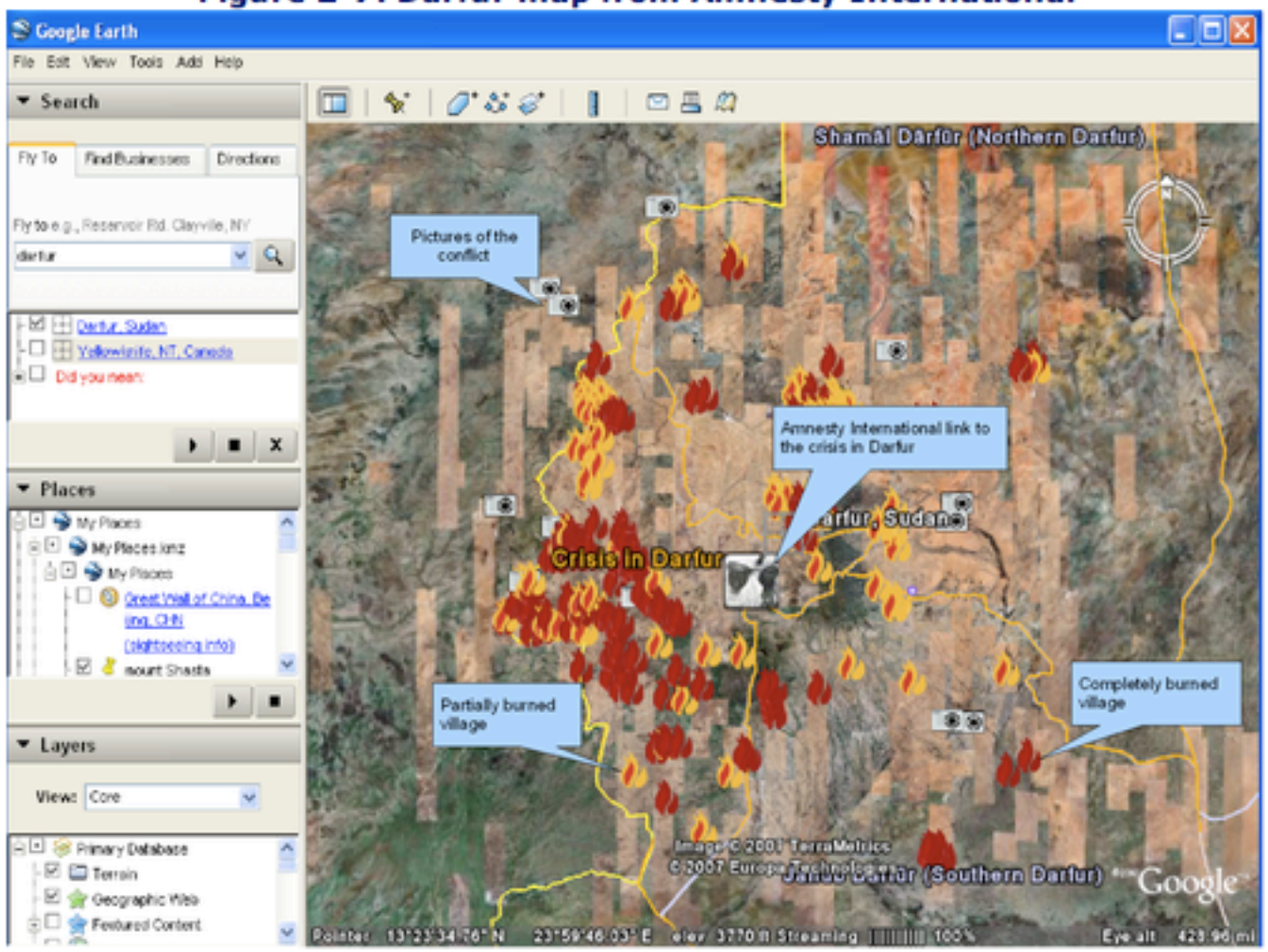
A common problem when teaching current events is that many students have no way of connecting their own experiences to what is happening
Earth, you can help students understand the impact that something such as the crisis in Darfur has had on the people living there.

1. To search for a topic of a current events lesson, go to www.google.com and in the search box type keywords about your topic plus t
   will return anything available in Google Earth on the subject. Another way is to go to the Google Earth Community web site and sea

2. In our Darfur conflict example, Amnesty International has already created a map and an overview of the Darfur crisis (Figure 2-7).

3. In this particular map of Darfur, villages that have been completely destroyed are red, and villages that have been partially destroye
   icons brings up pictures of burned villages and of human sacrifice.

Figure 2-7. Darfur map from Amnesty International



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... Reports. **Ivory-billed Woodpecker** (Campephilus principalis) Persists in Continental North America. ... 5. JT Tanner, The **Ivory-billed Woodpecker**, Research Report No. ...
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[BOOK] **Ivory-billed Woodpecker**: Campephilus Principalis
JA Jackson, A Ornithologists'Union, Academy of ... - 2002 - Birds of North America, Inc
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[CITATION] Status of the **Ivory-billed Woodpecker** (Campephilus principalis) in Cuba: almost certainly extinct
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Benjamin Bloom

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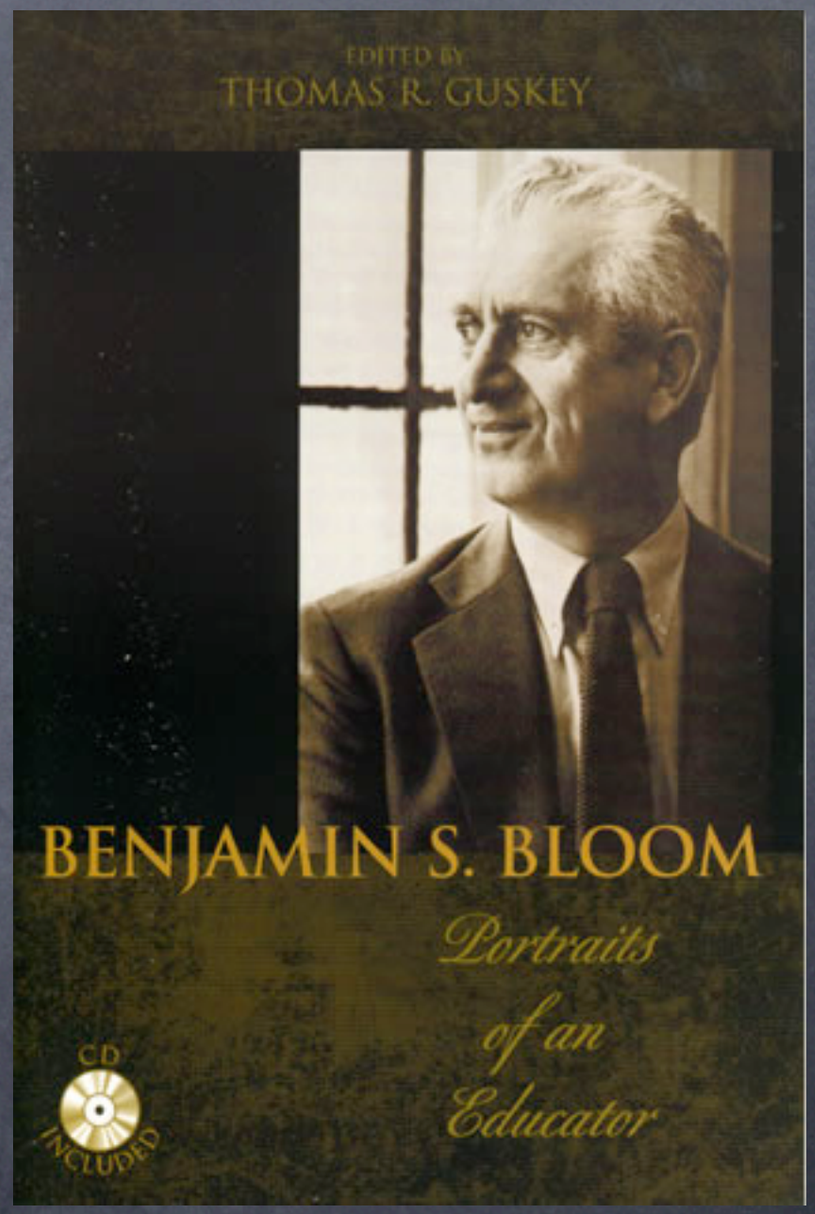
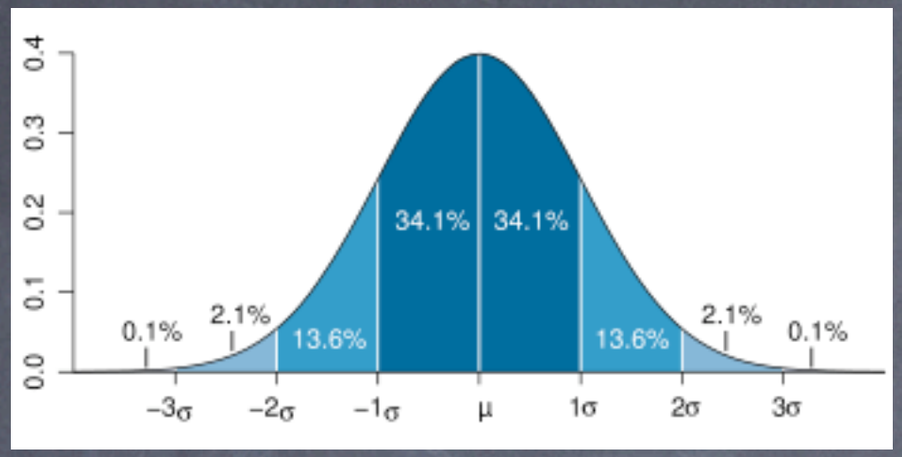
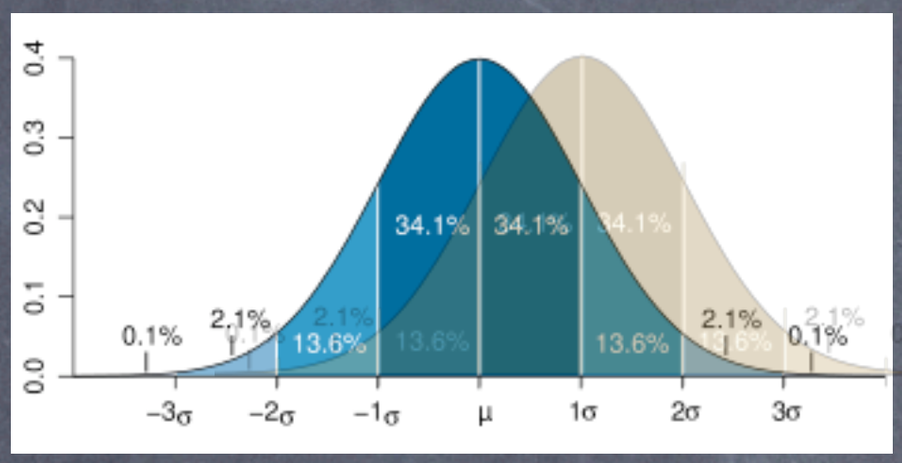




Control:

50% above the mean

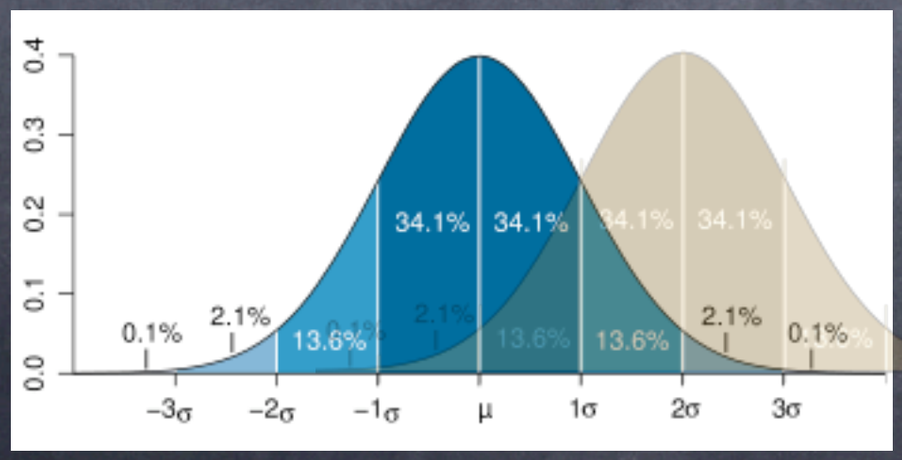
2% doing "really well"



Mastery Learning:

84% above control mean

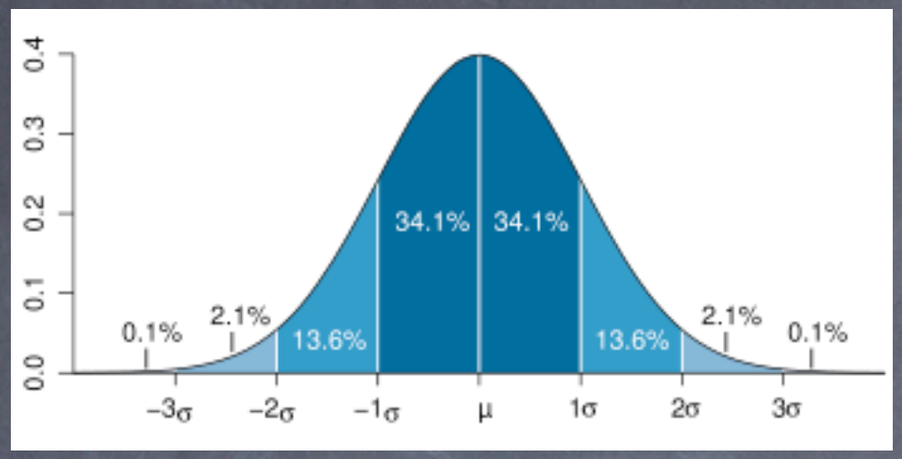
16% doing "really well"



Tutoring:

98% above control mean

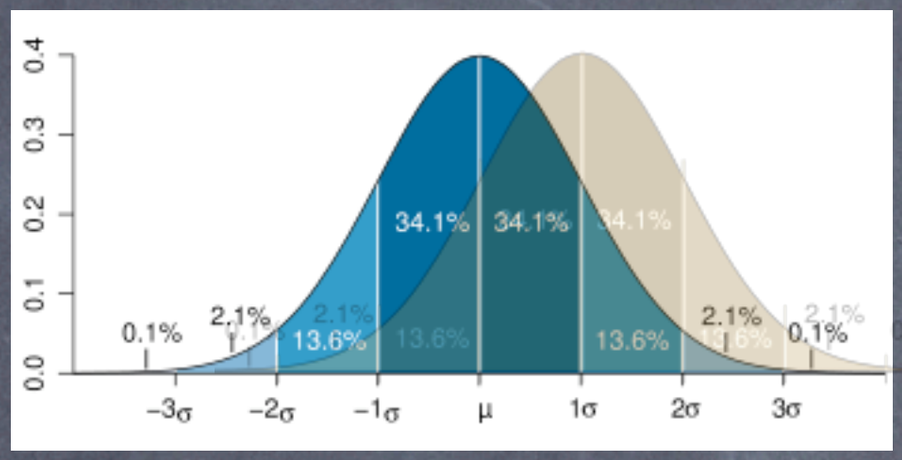
50% doing "really well"



Control:

65% time on task

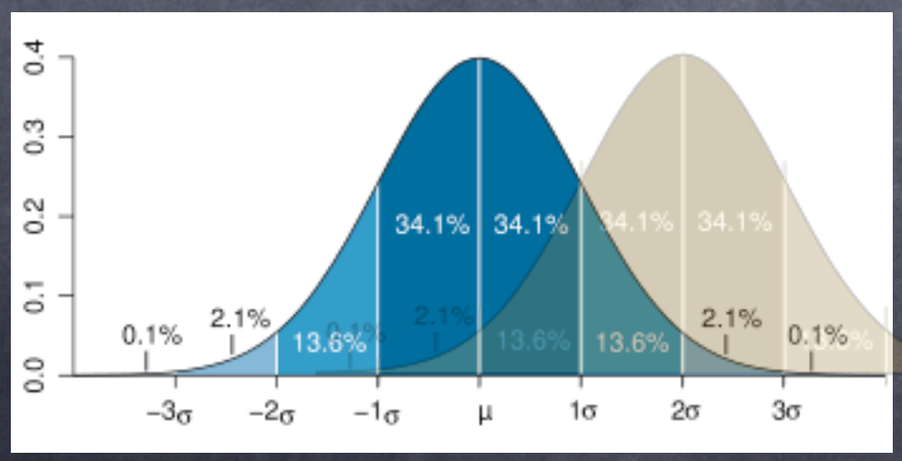
.60 aptitude/achievement correlation



Mastery Learning:

75% time on task

.35 correlation



Tutoring:

90% time on task

.25 correlation

1. Review previous material in, e.g., Algebra II. (Enhanced Cues, Participation, and Reinforcement)

2. A student support system in which groups of two or three students study together

3. Special programs for reading and study skills

4. Computer learning (for motivated students)

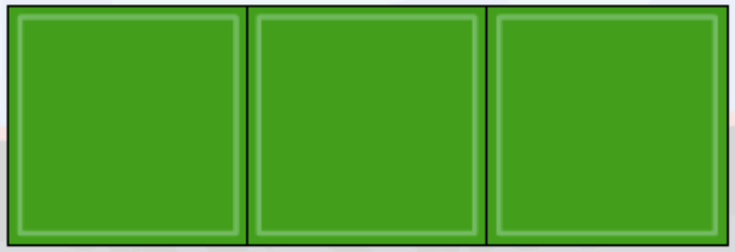
Which Kids Today are Doing "Really Well?"

One season, Deckham scored three times as many goals as Mc. Brian.

Beardsley scored 4 more goals than Mc. Brian.

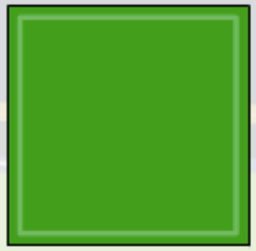
Given that they scored 34 goals between them, how many did each score?

DECKHAM



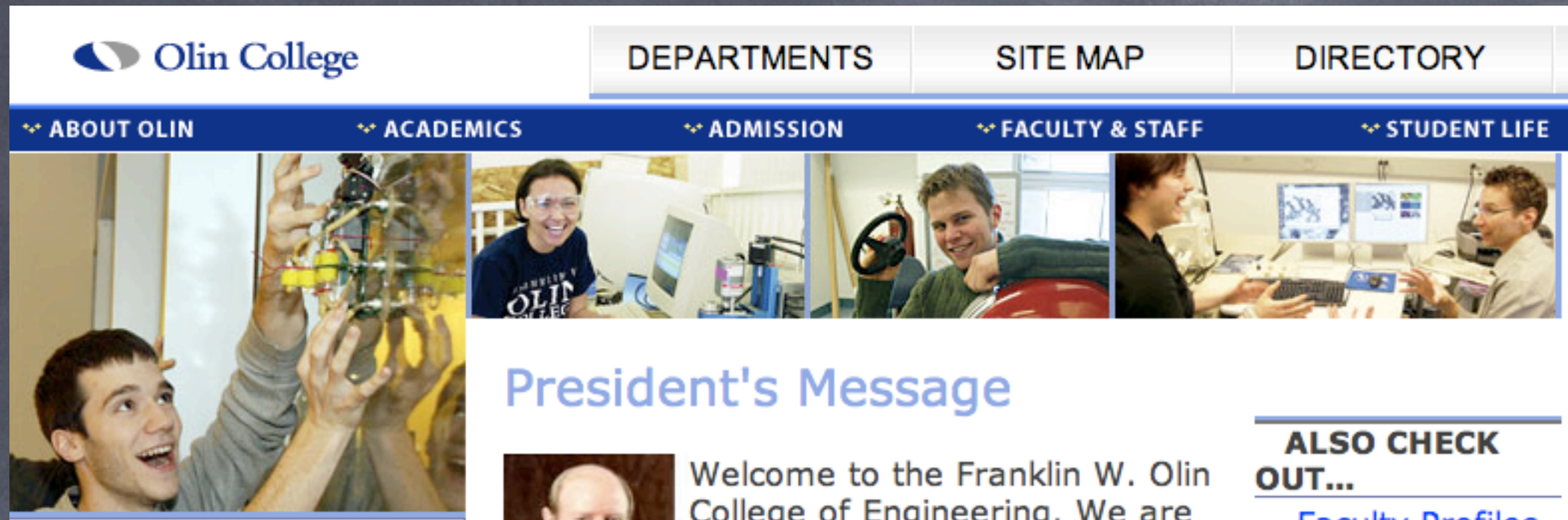
Three times as many goals

MC.BRIAN



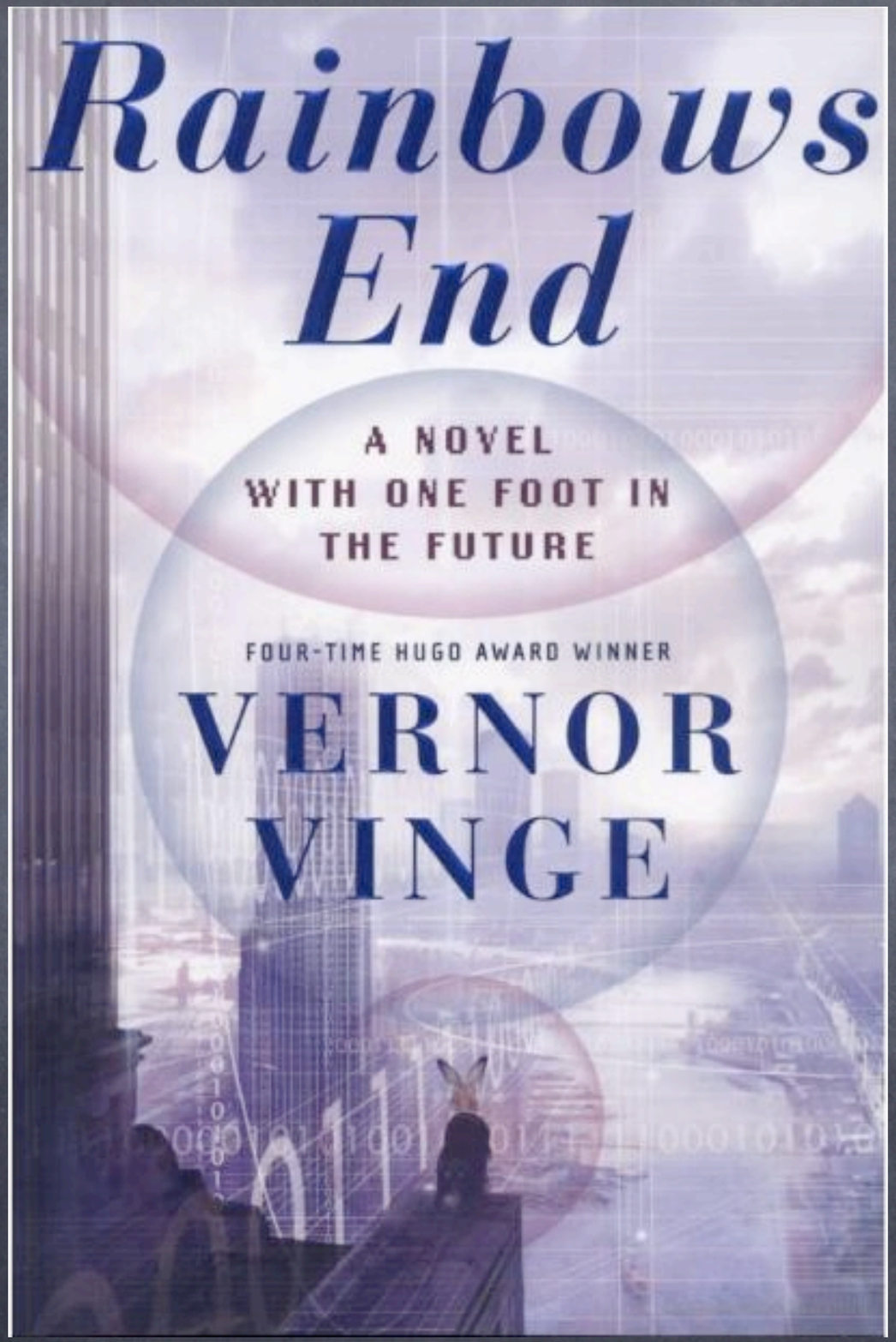
George Hotz, 17 (unlocked iPhone)

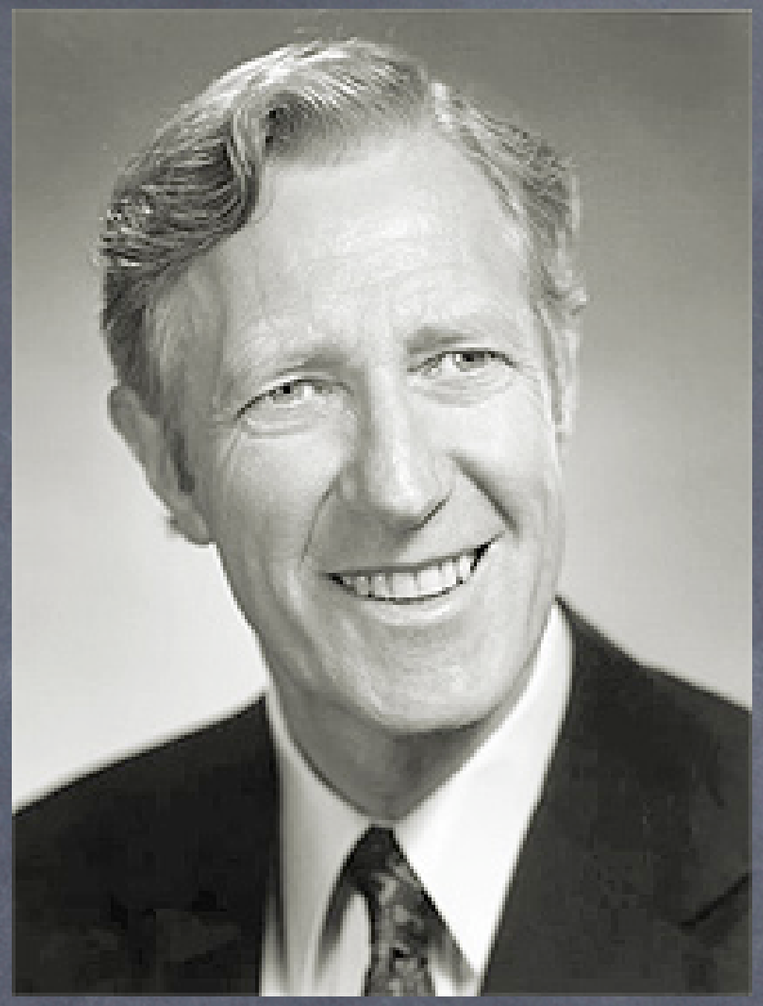
"After hundreds of hours and with the help of a few online friends..."



(IEEE Spectrum, May 2006)


HEALTHDYNE
TECHNOLOGIES
950
%SpO2
98
102


Rainbows End
A NOVEL WITH ONE FOOT IN THE FUTURE
FOUR-TIME HUGO AWARD WINNER
VERNOR VINGE



Frank Rhodes, Cornell

Hal Abelson, MIT

The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring

BENJAMIN S. BLOOM
University of Chicago and Northwestern University

Two University of Chicago doctoral students in education, Anania (1982, 1983) and Burke (1984), completed dissertations in which they compared student learning under the following three conditions of instruction:

1. *Conventional.* Students learn the subject matter in a class with about 30 students per teacher. Tests are given periodically for marking the students.
2. *Mastery Learning.* Students learn the subject matter in a class with about 30 students per teacher. The instruction is the same as in the conventional class (usually with the same teacher). Formative tests (the same tests used with the conventional group) are given for feedback followed by corrective procedures and parallel formative tests to determine the extent to which the students have mastered the subject matter.
3. *Tutoring.* Students learn the subject matter with a good tutor for each student (or for two or three students simultaneously). This tutoring instruction is followed periodically by formative tests, feedback-corrective procedures, and parallel formative tests as in the mastery learning classes. It should

The students were randomly assigned the three learning conditions, and their initial aptitude tests scores, previous achievement in the subject, and initial attitudes and interests in the subject were similar. The amount of time for instruction was the same in all three groups except for the corrective work in the mastery learning and tutoring groups. Burke (1984) and Anania (1982, 1983) replicated the study with four different samples of students at grades four, five, and eight and with two different subject matters, Probability and Cartography. In each sub-study, the instructional treatment was limited to 11 periods of instruction over a 3-week block of time.

Most striking were the differences in final achievement measures under the three conditions. Using the standard deviation (sigma) of the control (conventional) class, it was typically found that the average student under tutoring was about two standard deviations above the average of the control class (the average tutored student was above 98% of the students in the control class).[1] The average student under mastery learning was about one standard deviation above

dents under conventional instructional conditions. (See Figure 1.)

There were corresponding changes in students' time on task in the classroom (65% under conventional instruction, 75% under Mastery Learning, and 90+% under tutoring) and students' attitudes and interests (least positive under conventional instruction and most positive under tutoring). There were great reductions in the relations between prior measures (aptitude or achievement) and the summative achievement measures. Typically, the aptitude-achievement correlations changed from +.60 under conventional to +.35 under mastery learning and +.25 under tutoring. It is recognized that the correlations for the mastery learning and tutoring groups were so low because of the restricted range of scores under these learning conditions. However, the most striking of the findings is that under the best learning conditions we can devise (tutoring), the average student is 2 sigma above the average control student taught under conventional group methods of instruction.

The tutoring process demonstrates that *most* of the students do have the potential to reach this high

Most education should be:

1. Centered on engaging, real-world projects.

2. Explored in teams.

3. Teachers are facilitators and can point to theoretical knowledge when it is needed. Which is less than you'd think.

4. Different students learn differently. But let them figure it out from the world full of information, don't try to create materials ahead of time.