Online Astronomy Courses for Formal and Informal Learners

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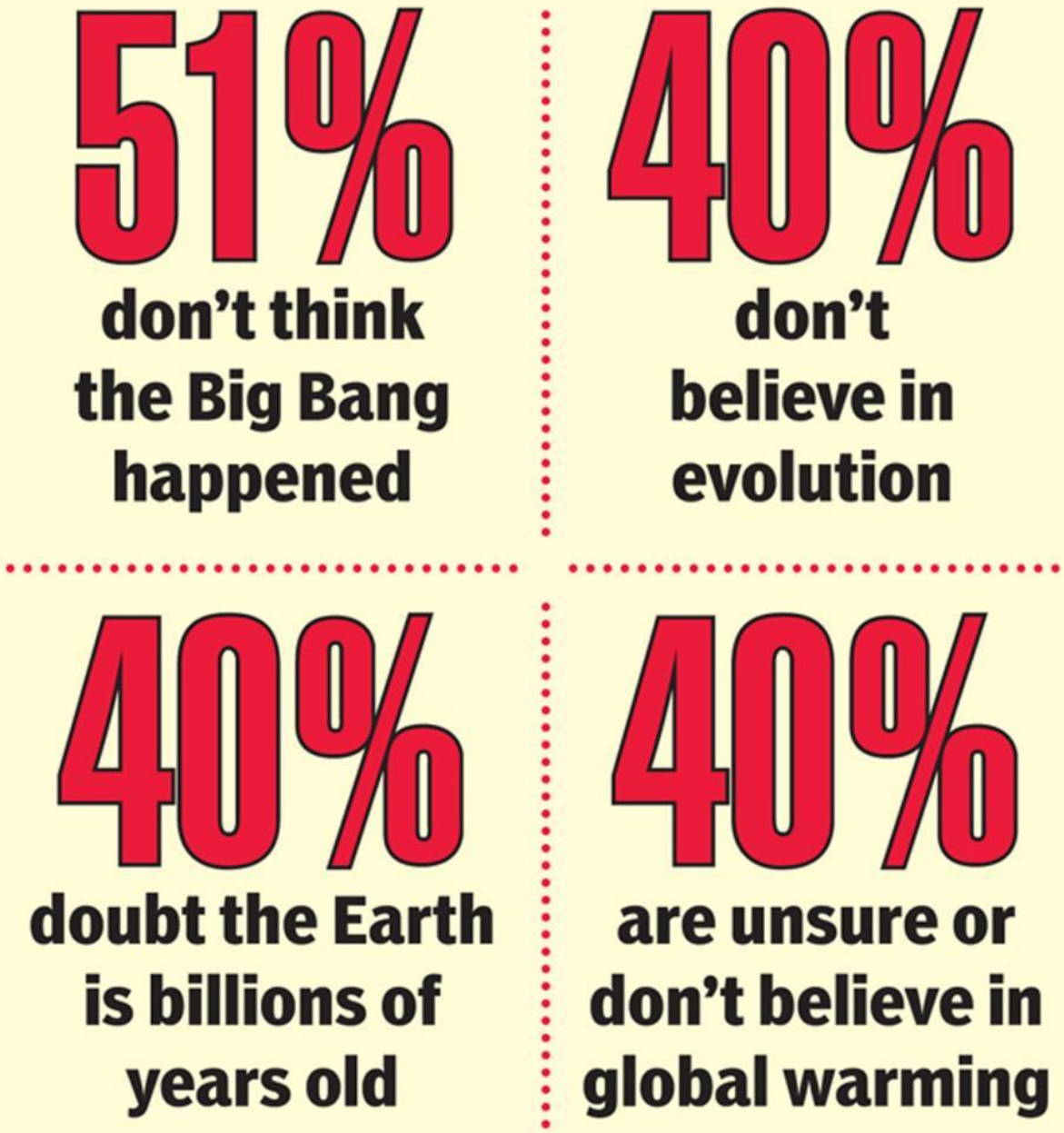
Critical Science Education Issues

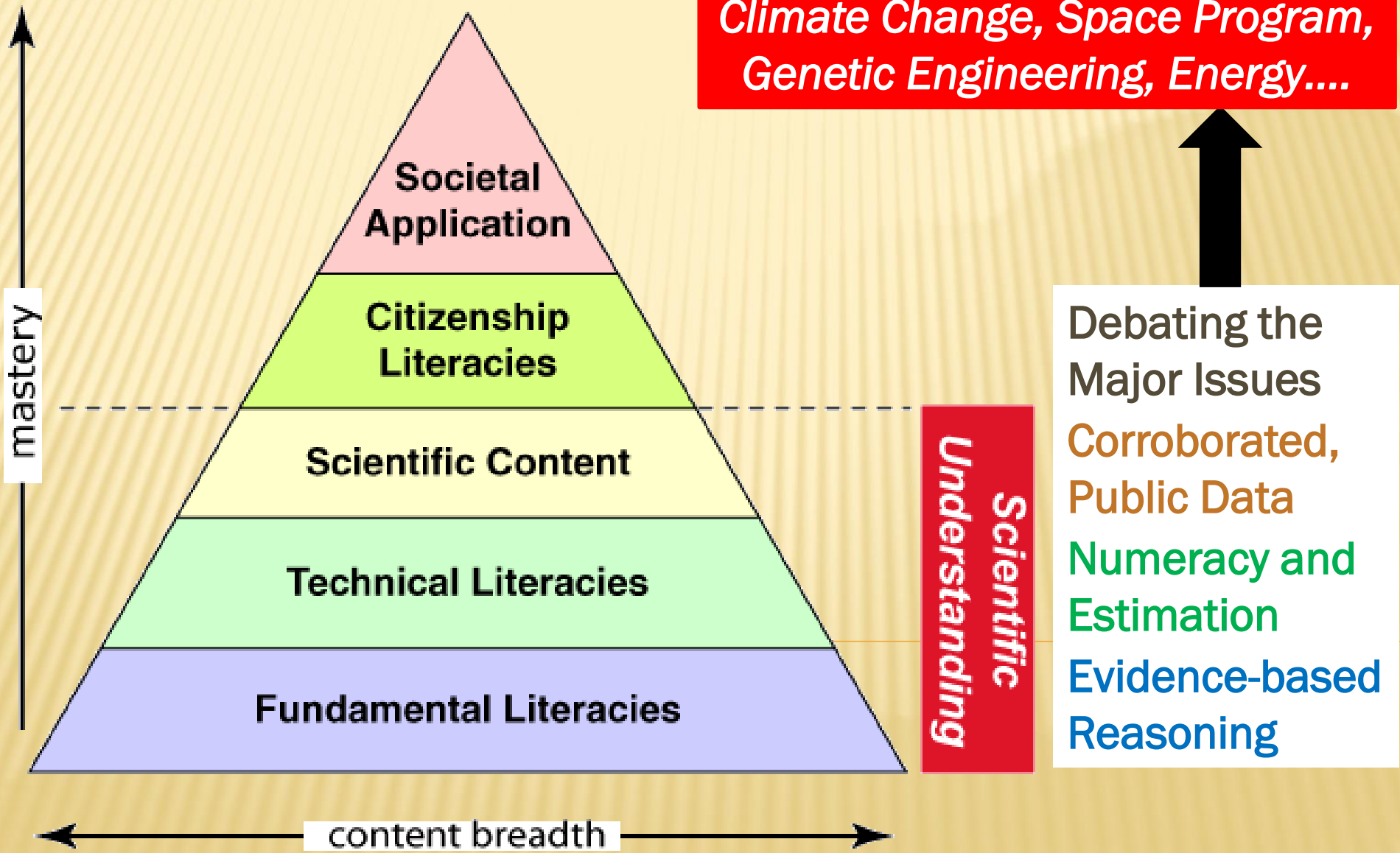
Litera

agogy



United States/Source: AP-GfK Poll

Science Literacy Schema

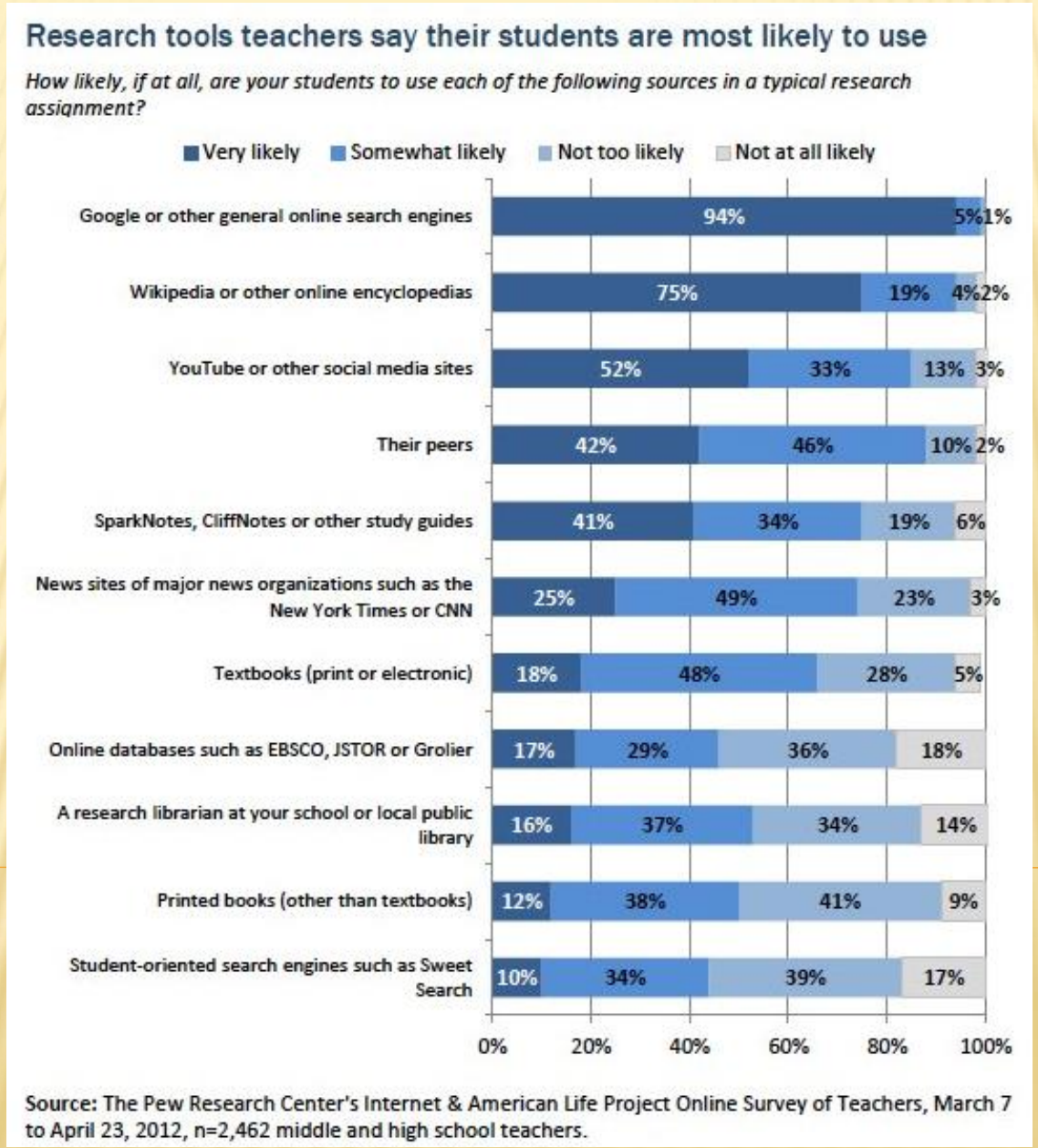


Sources of Science Information

- In open-ended responses, the Internet is given as the first place to look for information by 60%. **Only 2% turn to a book first.**
- In their science classes, students get information online (70%), then their course (40%), textbooks come in last (7%).
- In terms of importance of the information source, the top picks are teachers (90%), Internet (80%), and **Wikipedia in particular (50%).**

College students turn primarily to the Internet for science information, although teachers are seen as more reliable. Books are rarely used, despite being authoritative sources.

Googling Equals Research



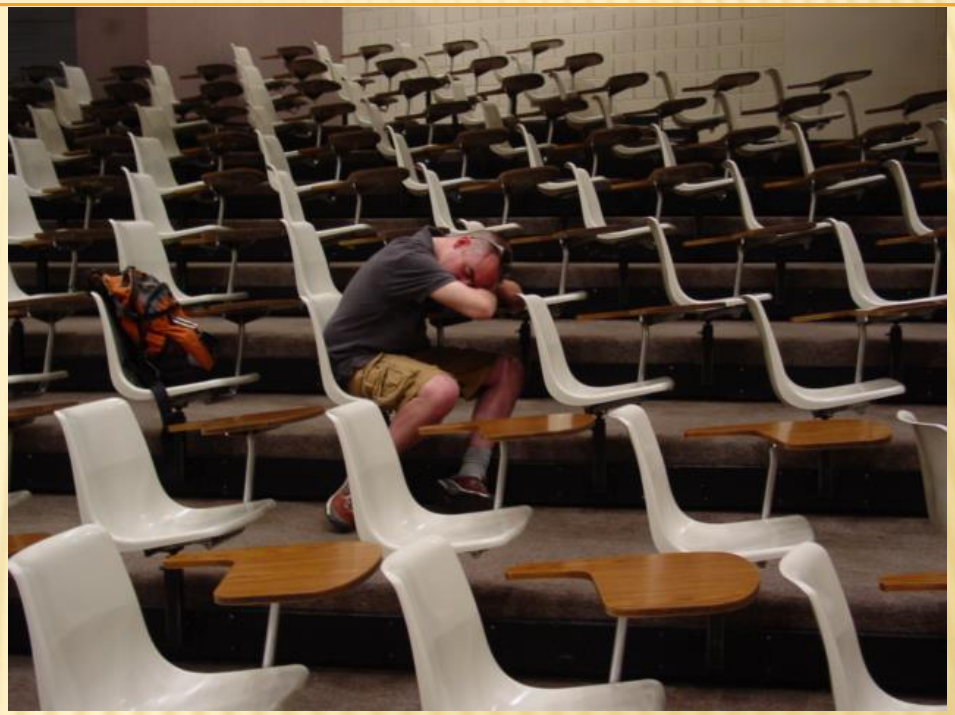
Survey of Science Literacy

- College graduates have a slightly higher scientific literacy than the general public, with small gains over four years (snapshot, not cohorts).
- **Strong pseudoscience beliefs and superstitions** are resistant to instruction; concept of scientific method is simplistic and shallow.
- **Number of science courses taken** is the strongest predictor of performance, but it **only accounts for 3% of the variance** in literacy scores.

College science courses have at most a marginal impact on the science literacy and beliefs of undergraduates. Also the conception of how science actually works is very primitive.

Traditional STEM Teaching

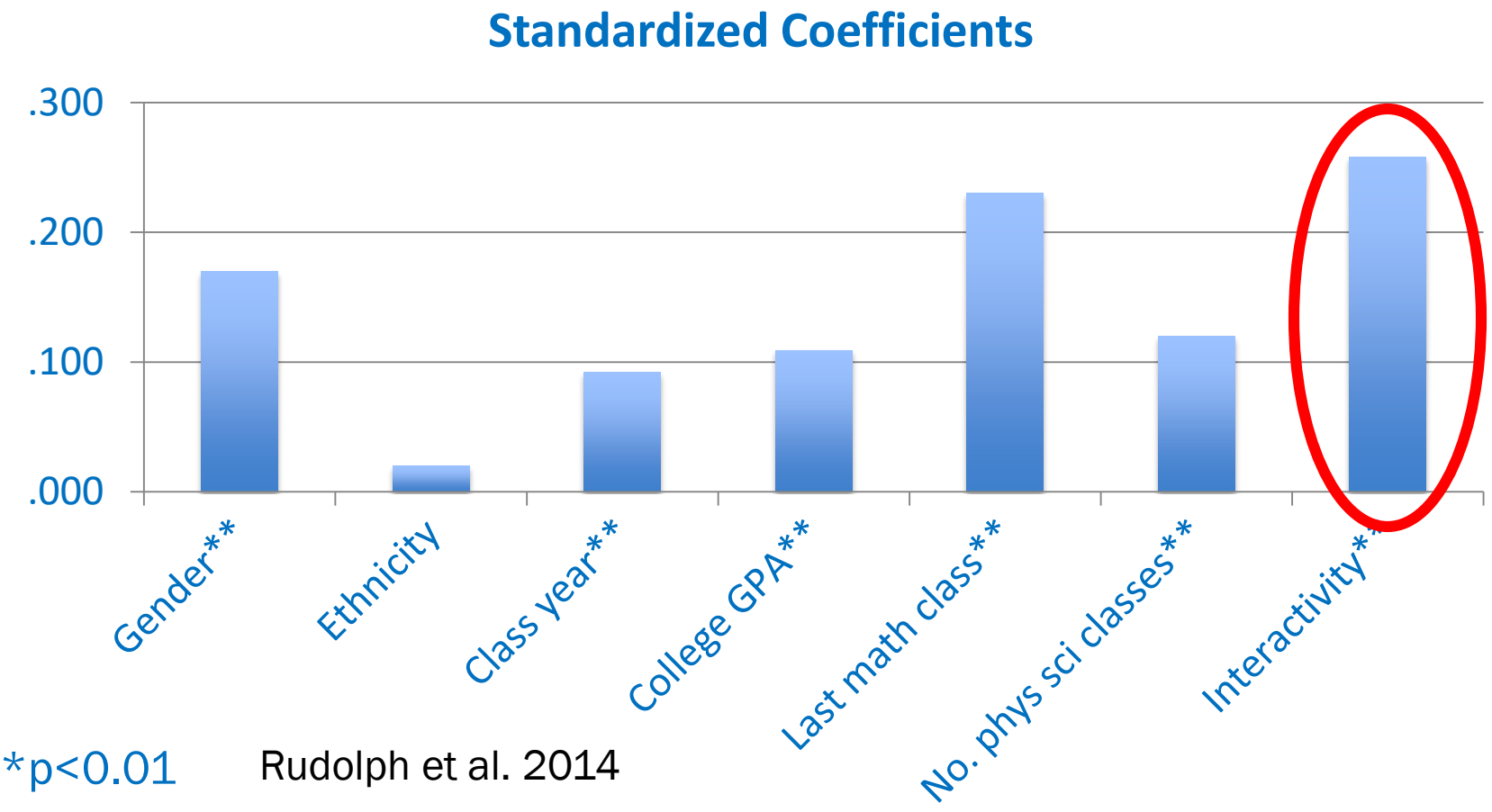
200 A.D



2017 A.D.

Most college STEM classes are still taught in a traditional, transmissive way (large lecture), despite its poor effectiveness in increasing learning.

Concept Inventory Learning Gains



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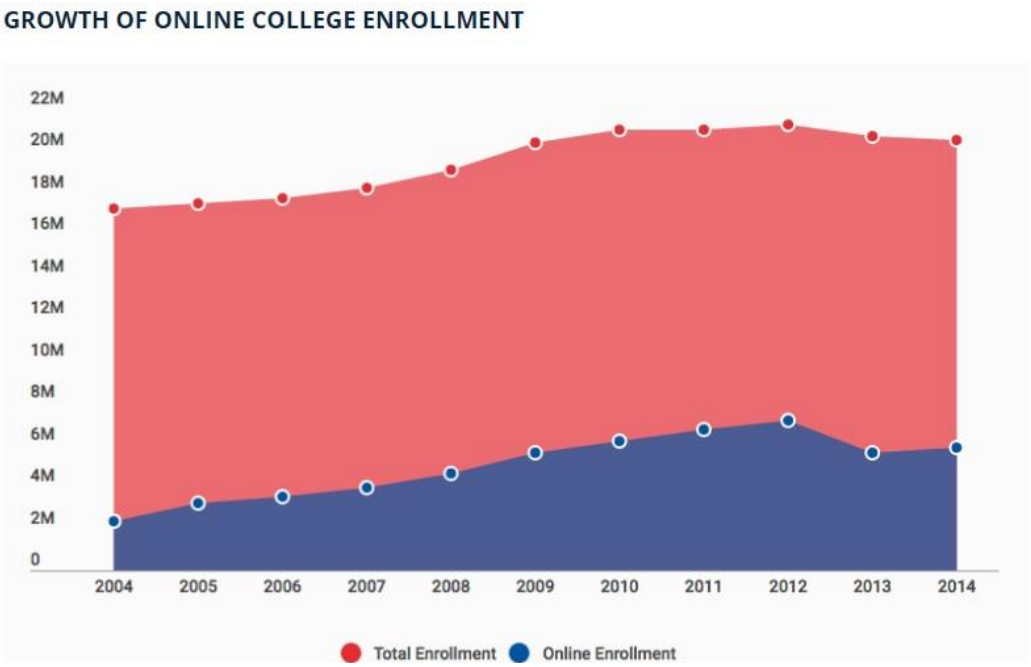
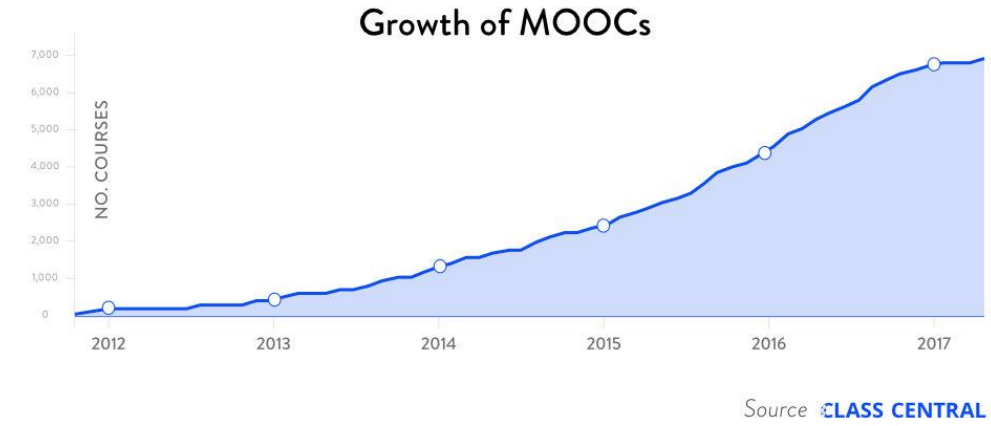
Rudolph et al. 2014

Active learning methods: lecture tutorials, small group activities, think-pair-share, debates, clickers, role play.

Online Enrollment is Soaring





Online enrollment has doubled in last decade. Less than 20% take all classes in classrooms.

Enrollment in massive open online classes or MOOCs has grown even more rapidly in 5 years.

Massive Open Online Classes

coursera

Over 110 thousand served for 4 years, and 500,000 hours of videos watched

udemy

But how well served? Can we increase typically low completion rates, create instructionally rich environments, and learn to effectively use social media?

Astronomy State of the Art MOOC

51,500 enrolled in 165 countries

Completion Rate ~7%

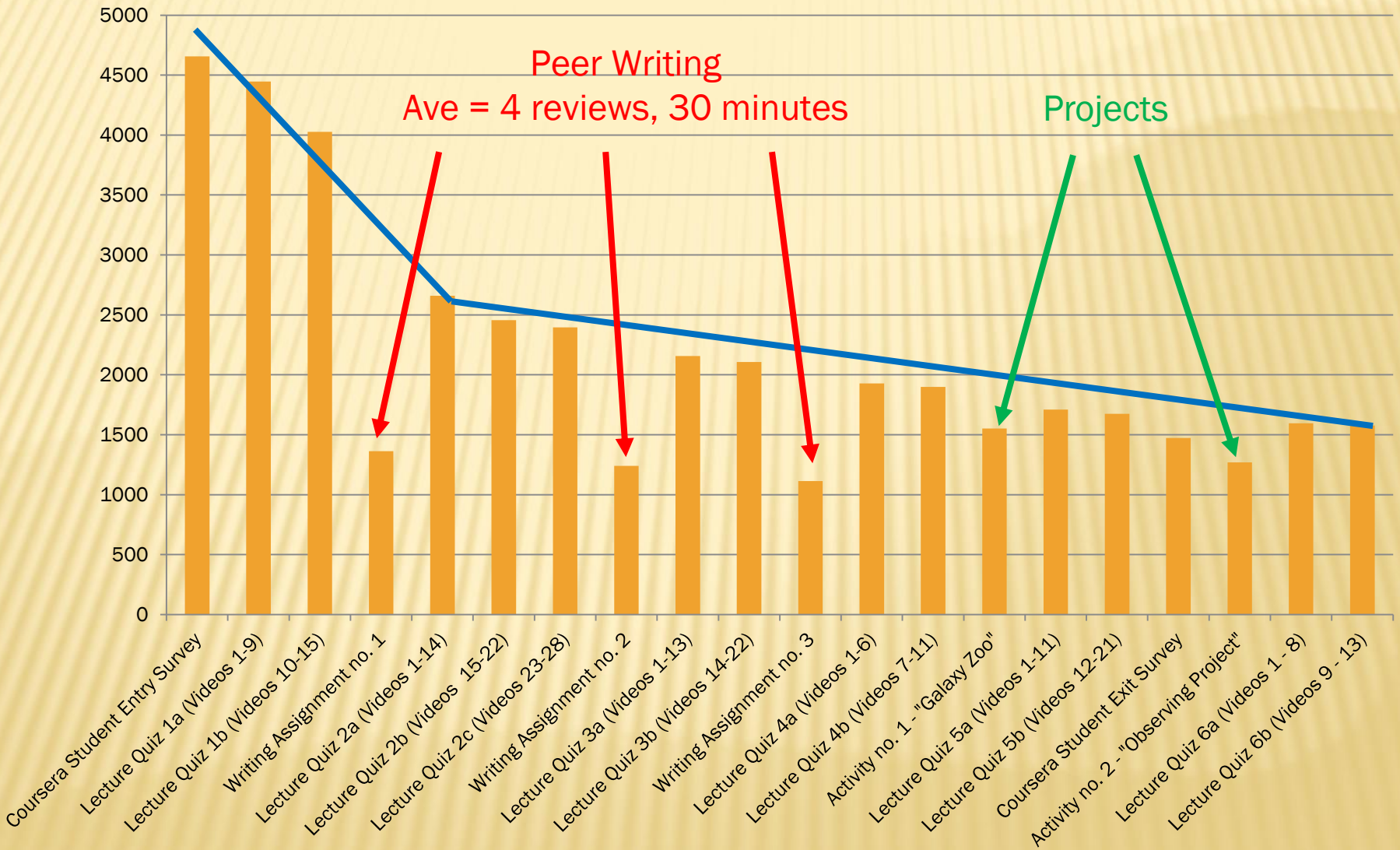
Spanish Translation Complete

Online Book+Google Translate

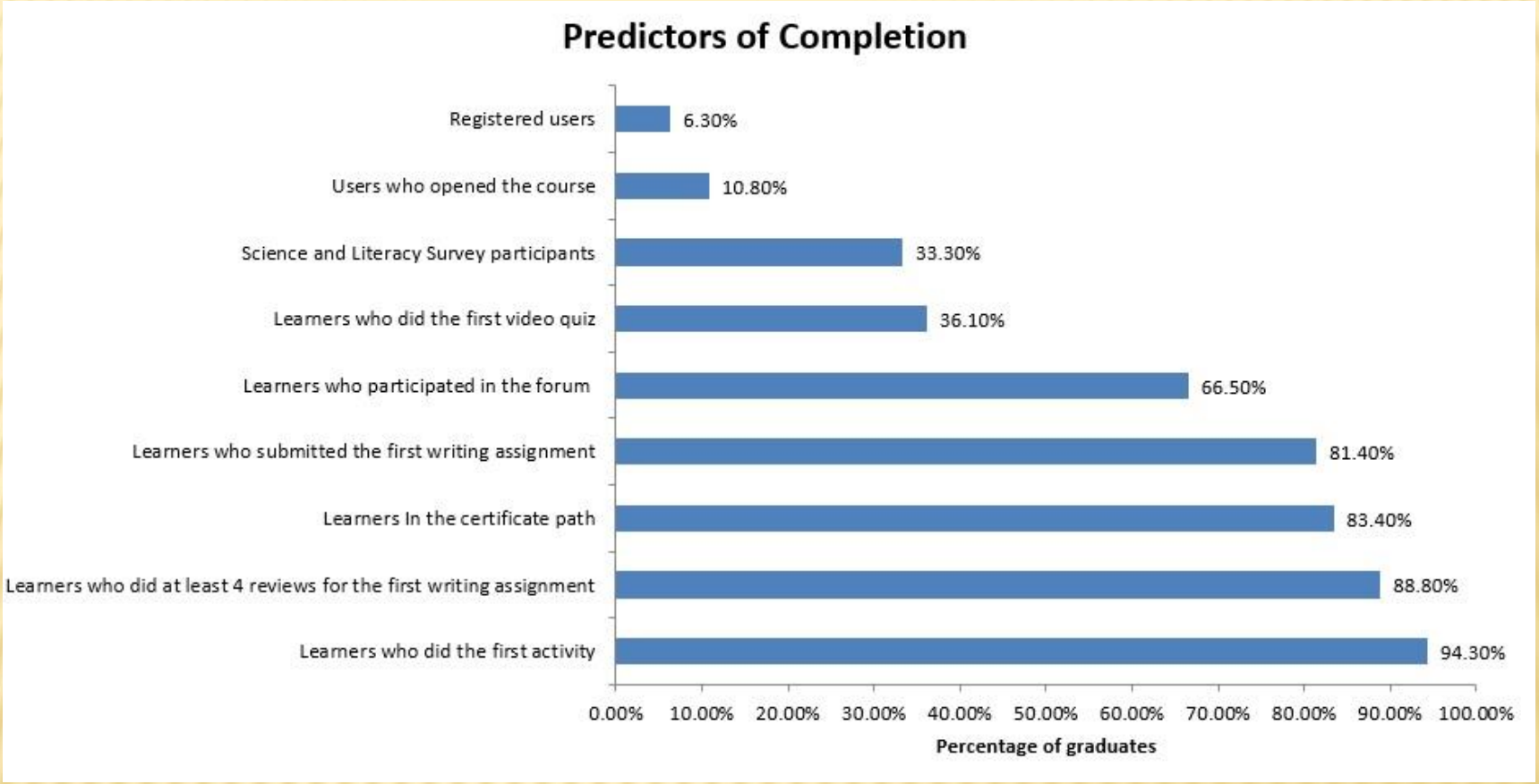
500,000 Hours Engagement

	Country / Territory	Sessions	% Sessions
1.	United States	30,265	45.66%
2.	United Kingdom	4,107	6.20%
3.	India	3,320	5.01%
4.	Canada	3,118	4.70%
5.	Australia	2,892	4.36%
6.	South Africa	1,614	2.44%
7.	Mexico	1,541	2.32%
8.	Brazil	994	1.50%
9.	Spain	915	1.38%
10.	Colombia	810	1.22%

Participation in Assignments

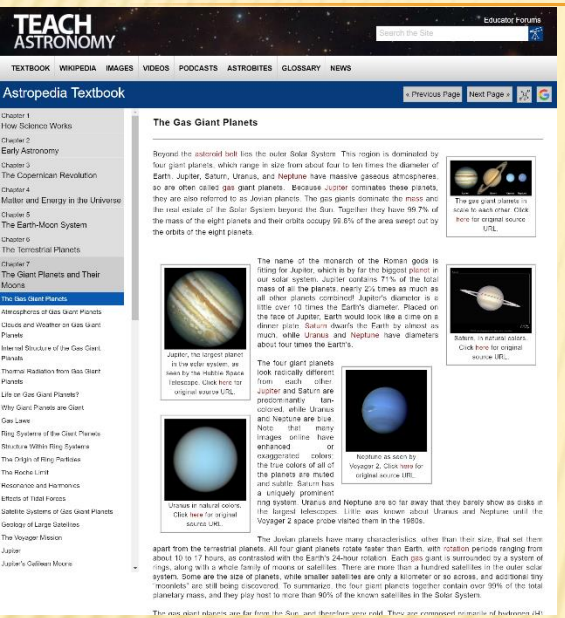


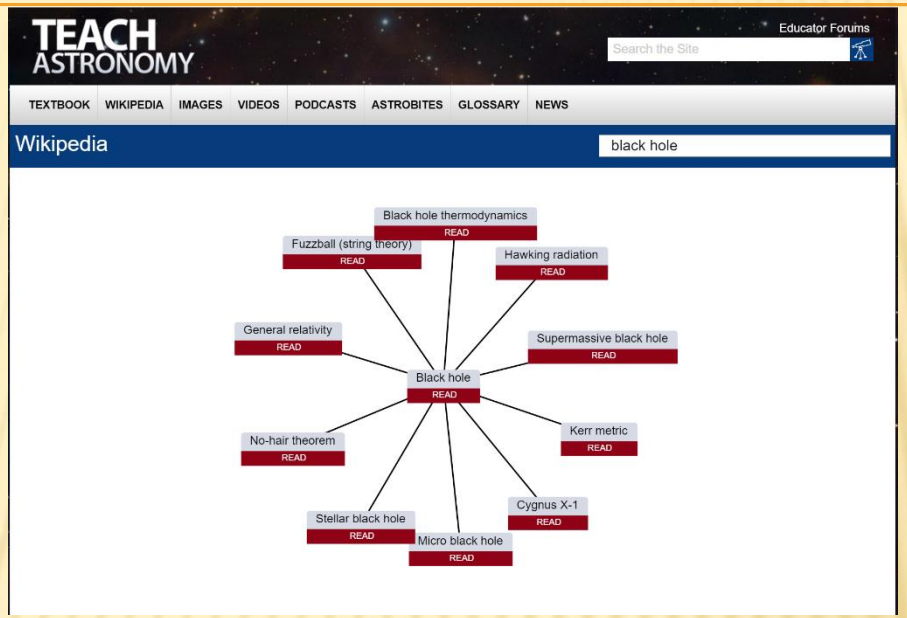
How to Improve MOOC Outcomes

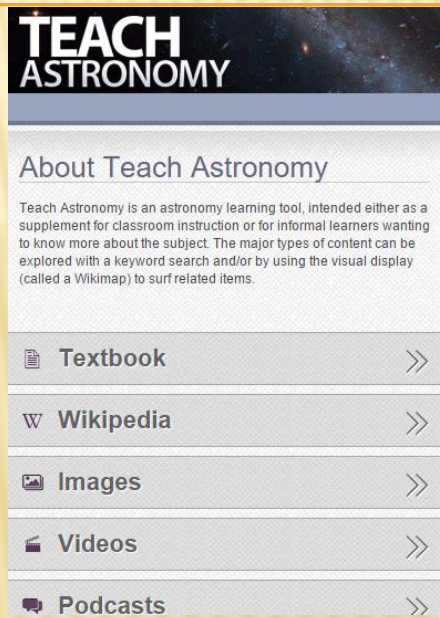


Our key strategies for increasing engagement and completion: peer writing, citizen science, activities (peer review validated for thousands of participants)

Teach Astronomy Web Site





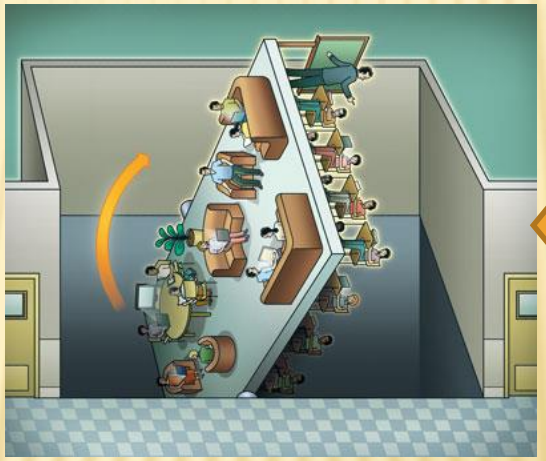


- Free web site supporting astronomy education/outreach
- Over 750,000 unique users, 130,000 page views/month
- Online book: 550 articles, 2000 images, and a quiz tool
- Over 12,000 images and over 75,000 Wikipedia articles
- All content indexed and clustered, with visual navigation
- Video FAQ, timeline tool, Google Home + Amazon Alexa

Next Generation Science Class

Massive scale (Informal)

Interactivity



Citizen Science
Peer Instruction
Facilitated Wiki
Social Media

Fully online (Formal)

Current Research Questions

- What are the impacts on learning, retention and engagement of flipped vs. face-to-face classes?
- Can learner-centered tools like lecture tutorials be successfully adapted to an online class?
- Is there any relation between learning outcomes and use of citizen science and social media?
- What factors in an online learning environment most influence engagement and completion?
- Do learner-centered methods improve retention of STEM majors or attract students into STEM?

THE END