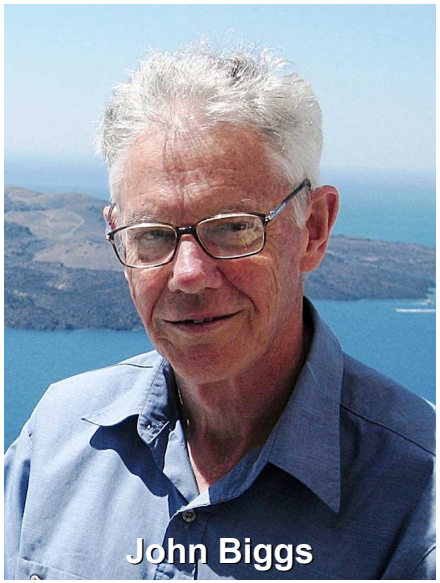
Evidence based teaching and learning

Know Thy Impact!



Focus On What the Student Does!

Practice Retrieval of Information!

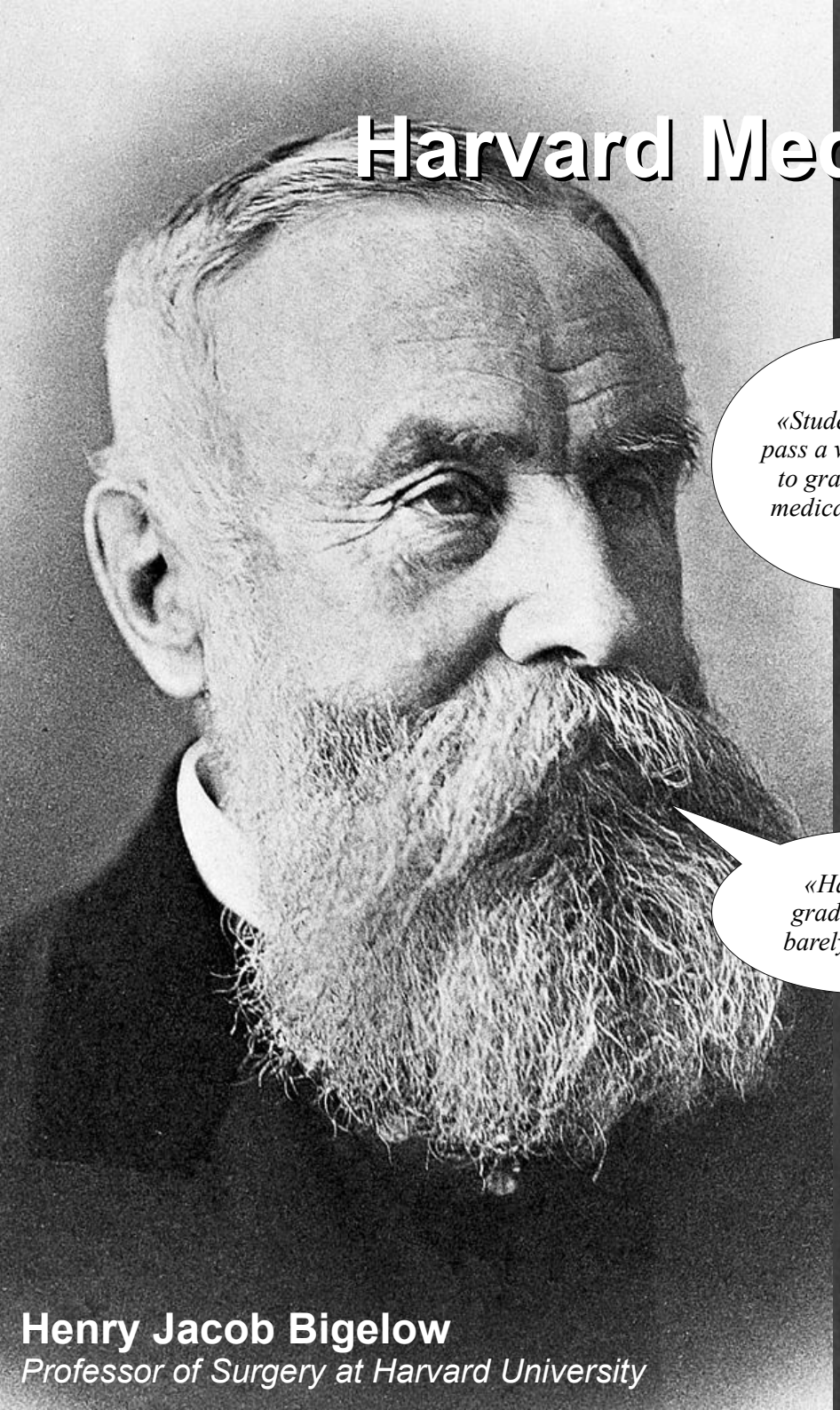
Be the Guide on the Side (not sage on the stage)!

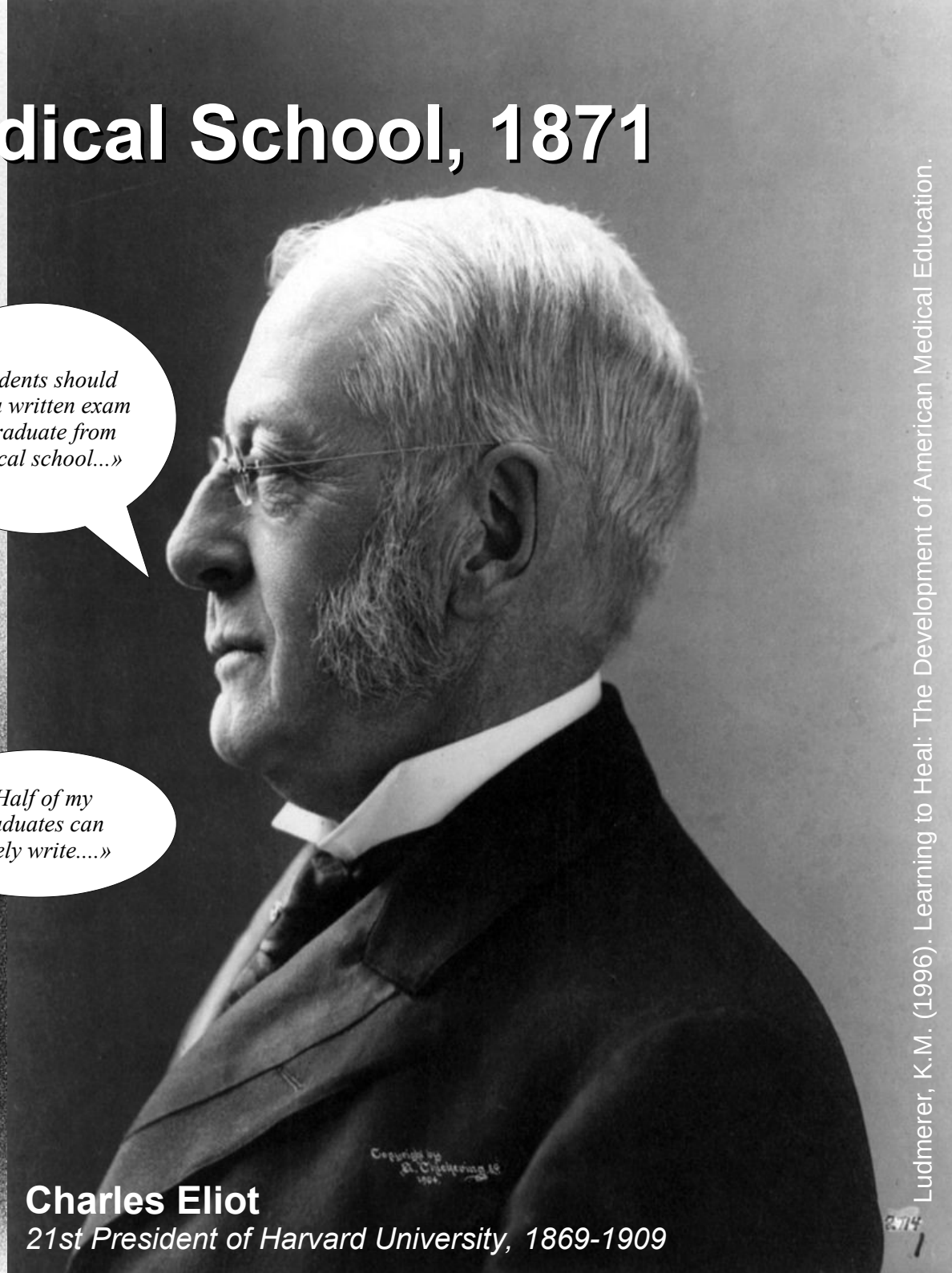
NOFE, 2023
Trondheim

Børge LIllebo
Associate Professor

NTNU
Kunnskap for en bedre verden

Harvard Medical School, 1871





«Students should pass a written exam to graduate from medical school...»

«Half of my graduates can barely write....»

Henry Jacob Bigelow
Professor of Surgery at Harvard University

Charles Eliot
21st President of Harvard University, 1869-1909

Ludmerer, K.M. (1996). Learning to Heal: The Development of American Medical Education.

1902

Leger	**900**
Befolkning	**2.3** millioner
Gjennomsnittlig liggetid	**40** døgn
Spesialiteter	**0**

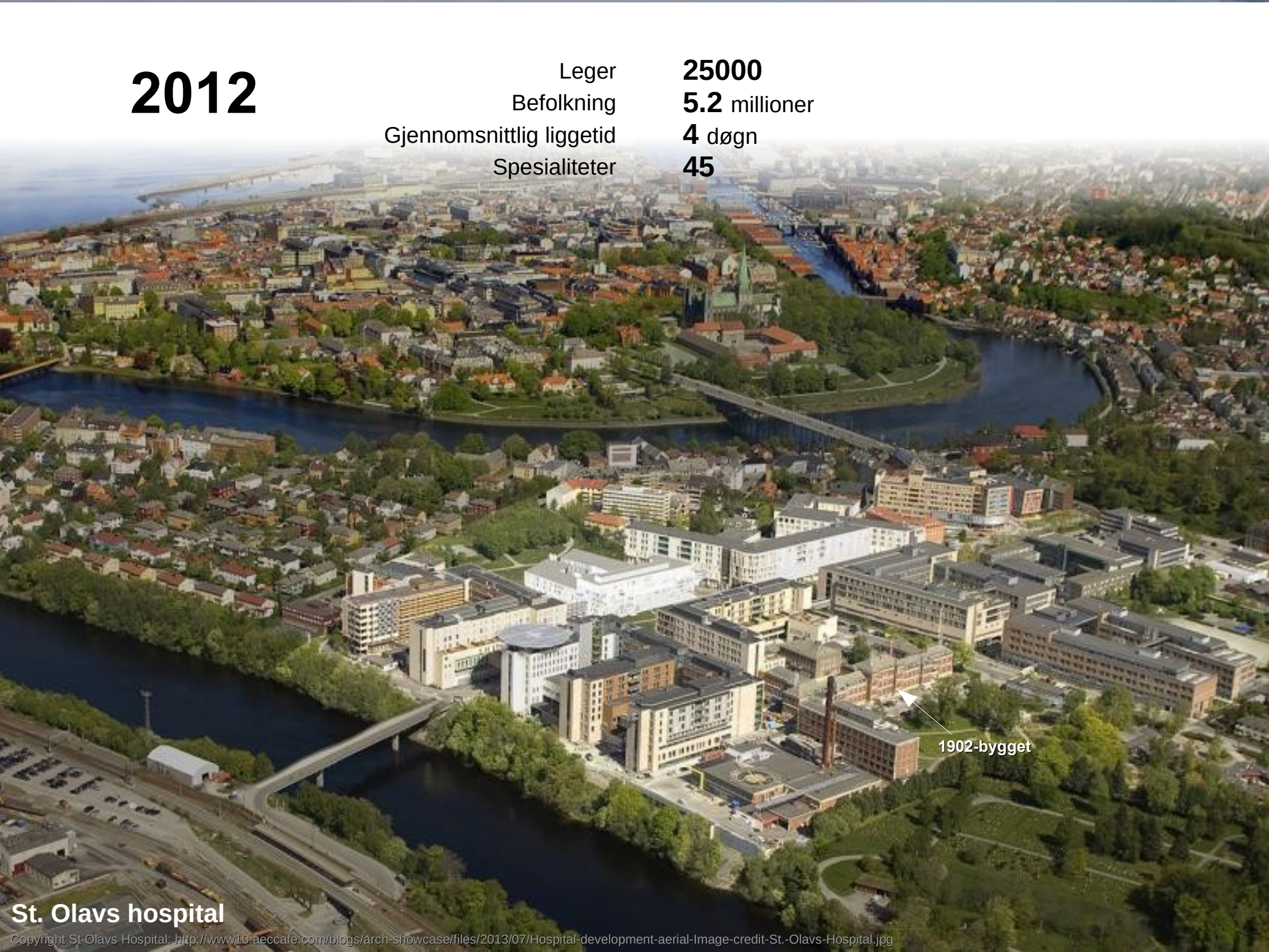
"Fortidsbygg for framtida"
http://www.helsebygg.no/vedlegg/30257/1902--m.-etasjekart.pdf

Trondhjem. Sykehuset.

http://farm3.staticflickr.com/2486/3941383710_01065a6839.jpg

2012

Leger	**25000**
Befolkning	**5.2** millioner
Gjennomsnittlig liggetid	**4** døgn
Spesialiteter	**45**



St. Olavs hospital

LEARNING FROM LECTURES VS. LEARNING FROM READINGS

STEPHEN M. COR

University of Nebra

Numerous investigations have been ma
tive value of different teaching methods
higher learning. The attitude of colleg
instruction seems to be changing from "la
bit more provocative to student learning.

Rohrer, D., & Pashler, H. (2010). Recent research on human learning challenges conventional instructional strategies. Educational Researcher, 39(5), 406-412.

Reviews/Essays

Recent Research on Human Learning Challenges Conventional Instructional Strategies

Doug Rohrer and Harold Pashler

There has been a recent upsurge of interest in exploring how choices of methods and timing of instruction affect the rate and persistence of learning. The authors review three lines of experimentation—all conducted using educationally relevant materials and time intervals—that call into question important aspects of common instructional practices. First, research reveals that testing, although typically used merely as an assessment device, directly potentiates learning and does so more effectively than other modes of study. Second, recent analysis of the temporal dynamics of learning show that learning is most durable when study time is distributed over much greater periods of time than is customary in educational settings. Third, the interleaving of different types of practice problems (which is quite rare in math and science texts) markedly improves learning. The authors conclude by discussing the frequently observed dissociation between

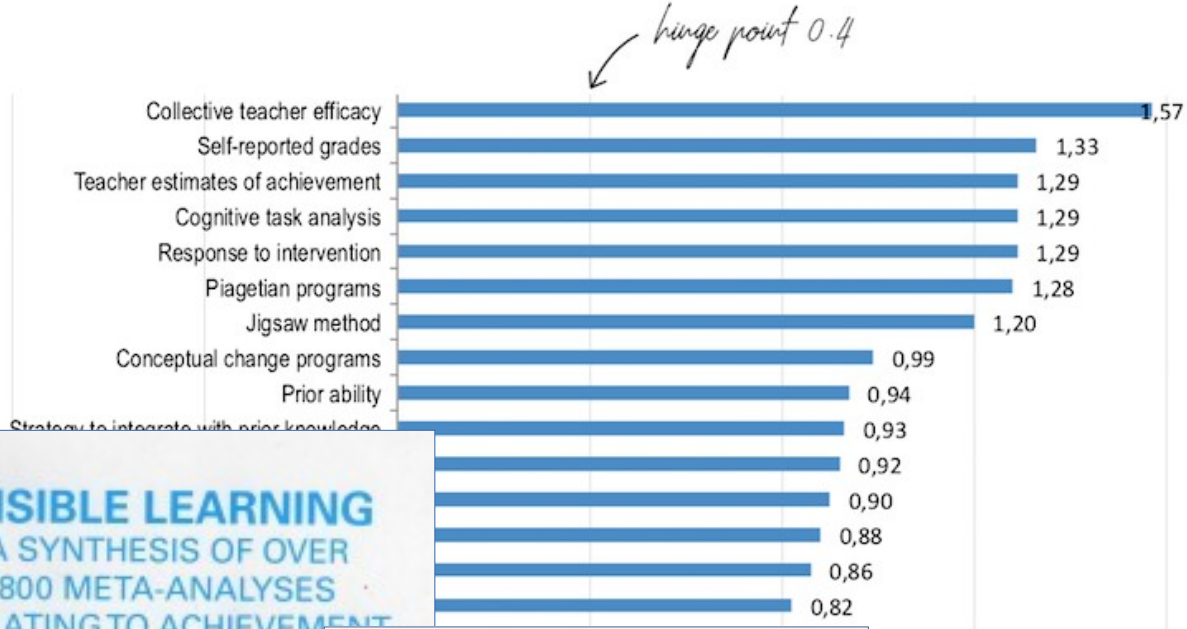
temporal spacing, and the effects of interleaving different types of materials.

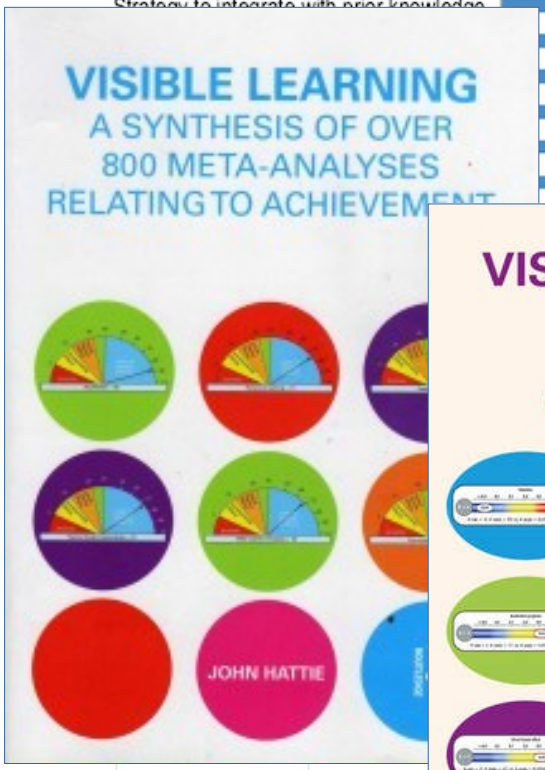
Learning Through Testing

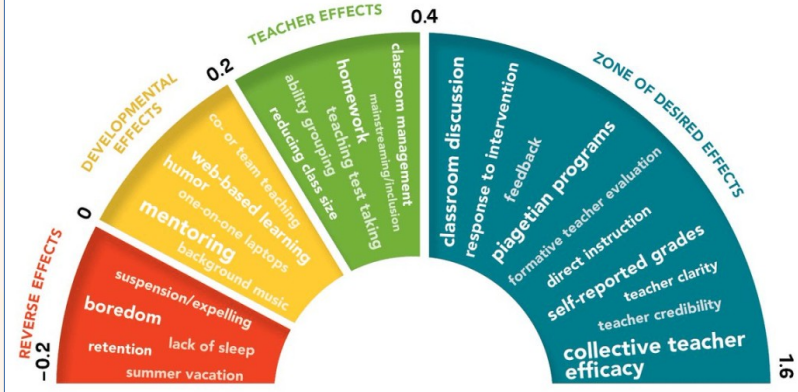
Tests of student mastery of content material are customarily viewed as assessment devices, used to provide incentives for students (and in some cases teachers and school systems as well). However, memory research going back some years has revealed that a test that requires a learner to retrieve some piece of information can directly strengthen the memory representation of this information (e.g., Spitzer, 1939). More recent studies, however, have shown that a combination of study and tests is more effective than spending the same amount of time reviewing the material in some other way, such as rereading it (e.g., Carrier & Pashler, 1992; Cull, 2000; for reviews, see McDaniel, Roediger, & McDermott, 2007; Roediger & Karpicke, 2006b).

Hattie's 2018 updated list of factors related to student achievement: 252 influences and effect sizes (Cohen's d)

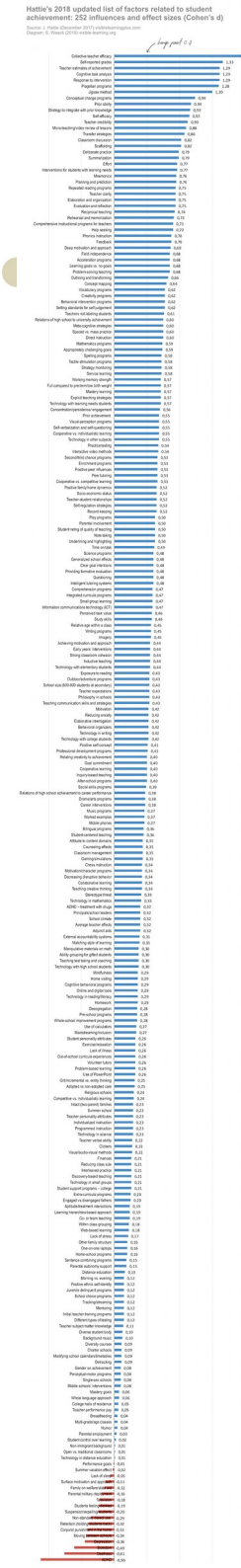
Source: J. Hattie (December 2017) visiblelearningplus.com
Diagram: S. Waack (2018) visible-learning.org

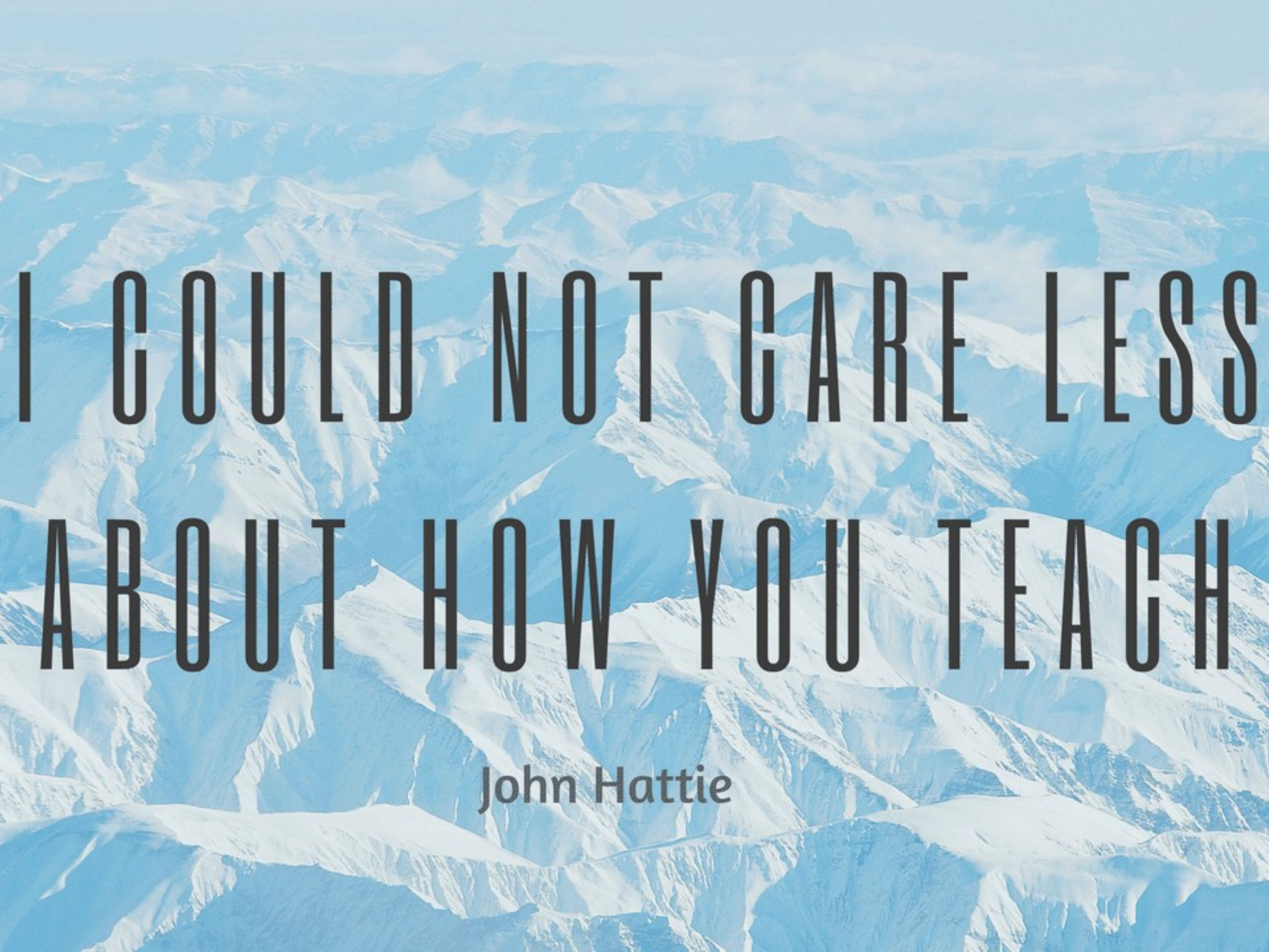


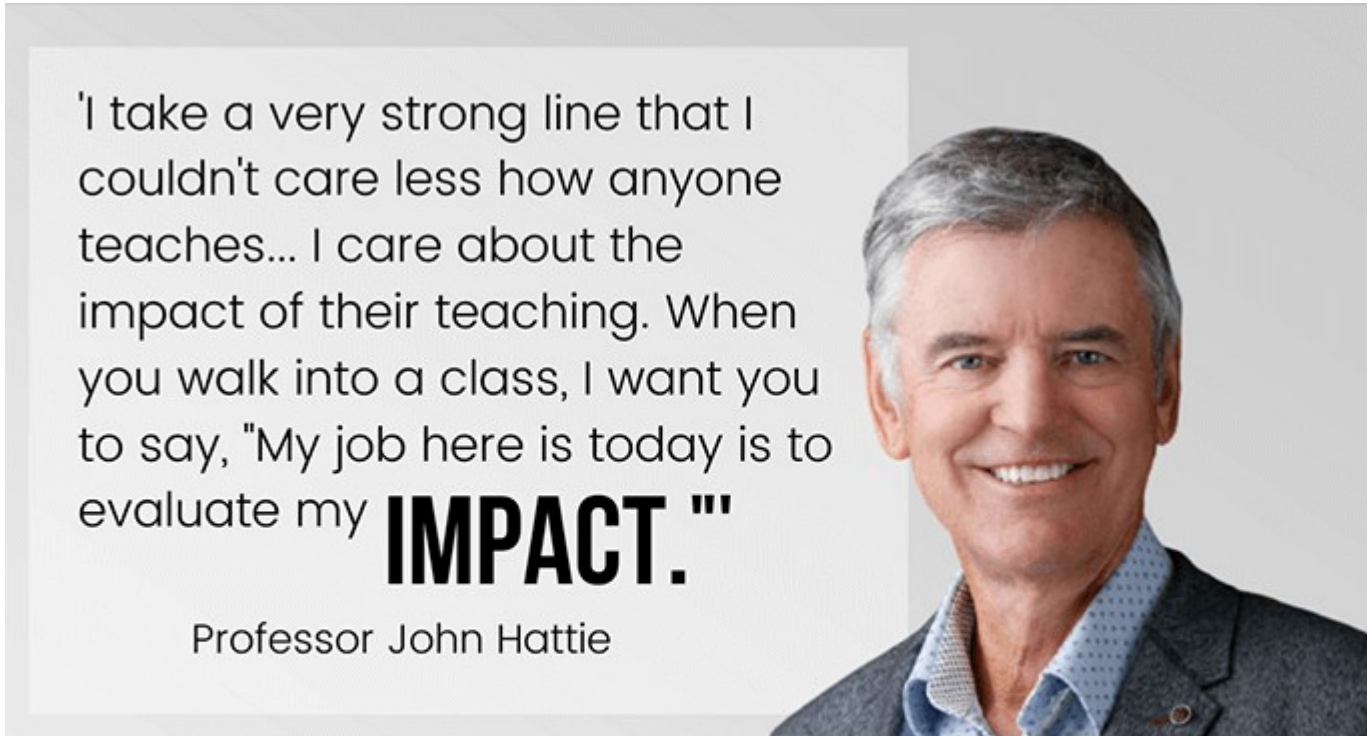


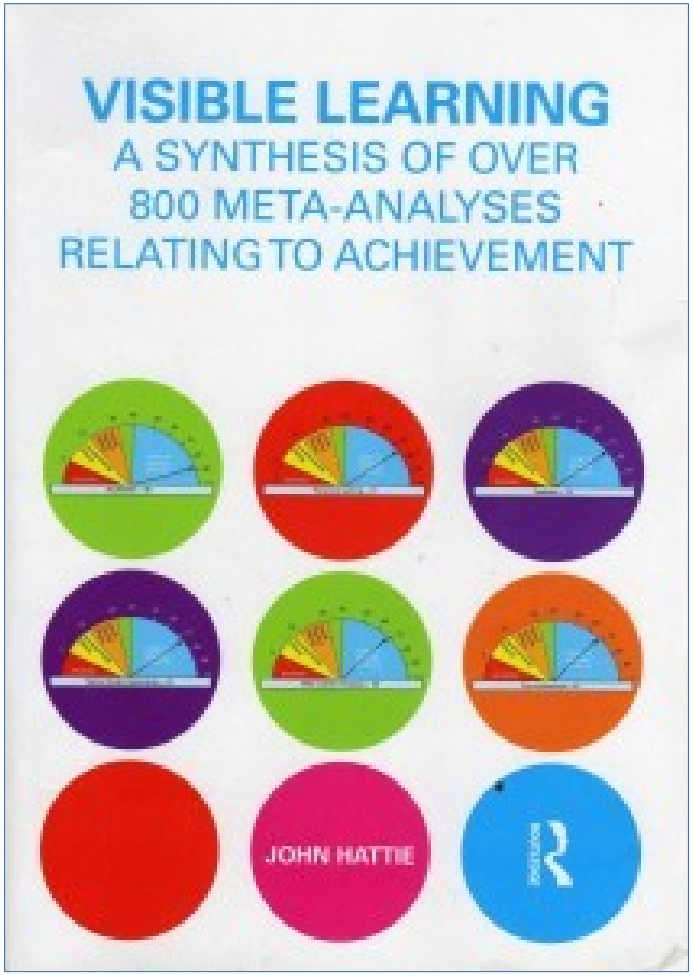


https://visible-learning.org/hattie-ranking-influences-effect-sizes-learning-achievement/




I COULD NOT CARE LESS
ABOUT HOW YOU TEACH
John Hattie


'I take a very strong line that I couldn't care less how anyone teaches... I care about the impact of their teaching. When you walk into a class, I want you to say, "My job here is today is to evaluate my IMPACT."'
Professor John Hattie



- Appropriate motivation
  - Relevant learning activity
  - Monitor learning
- Formative feedback
- Metacognitive strategies
- Social learning

Scholarship of Teaching and Learning in Psychology
2015, Vol. 1, No. 1, 79–91

2332-2101/15/$12.00 http://dx.doi.org/10.1037/stl0000021

TEACHER-READY RESEARCH REVIEW

The Applicability of Visible Learning to Higher Education

John Hattie
University of Melbourne

The Visible Learning research is based on a synthesis of 1200 meta-analyses relating to influences on achievement. This article focuses specifically on the evidence and implications for higher education teachers. As nearly every intervention can show some evidence of success, we need to ask not "What works?" but "What works best" and seek comparisons between different ways of influencing student learning. The major implications relate to teachers who work with others to seek evidence of their impact on students, who inform students early what success looks like especially about surface and deep learning, who provide appropriate levels of challenge and feedback, and who have aligned their claims about success, assessment, and teaching.

Keywords: learning, meta-analysis, teaching strategies

Today's university students are diverse, not necessarily self-regulated, having varying skills in learning strategies, and need to be deliberately taught. This begs for a robust discipline about the scholarship of teaching and learning at the university level to best identify what works. Whereas many thousands of studies on university learning exist, few major syntheses exist (see Pascarella & Terenzini, 2005). This article uses a synthesis of meta-analyses relating to university students from the Visible Learning (VL) research based on more than 65,000 studies including [1/4] million students aged 4 to 20–25 (Hattie, 2009, 2012; Hattie & Anderman, 2013; Hattie & Yates, 2014; Hattie, Masters, & Birch, 2015). The aim is to summarize key findings related to university aged cohort and discuss key implications for higher education (see also Hattie, 2011).

More is demanded from higher education students than knowing much and surviving through three-plus years of study. Forty-five years ago, Chickering (1969) outlined seven major outcomes from university study which are still applicable: achieving competence; managing emotions (including those that interfere with learning such as anger, anxiety, hopelessness and those that enable learning such as optimism, hopefulness); mature interpersonal relations (such respecting differences and working with peers); moving from autonomy to independence (including moving from needing assurance and approval of others to self-sufficiency), problem solving, and making decisions; establishing identity including enhanced self-esteem and self-efficacy; developing purpose (from Who am I? and Where am I? to Where am I going?); and developing integrity. Higher education is as much as about identity, reputational enhancement, and growing as it is about becoming knowledgeable, critics, and problem solvers. The (valuable) by-products are knowing more about a topic, being passionate about content, and being learned about a subject. With the more recent push for developing 21st century skills, there is a renewed emphasis on the latter 6, although developing subject matter expertise remains dominant.

The VL story argues that when teachers see teaching and learning through the eyes of their students, and when students become their own teachers then outcomes and engagement are maximized. It is not sufficient to stand up front and look and behold a great multitude from every nation and all tribes and peoples and

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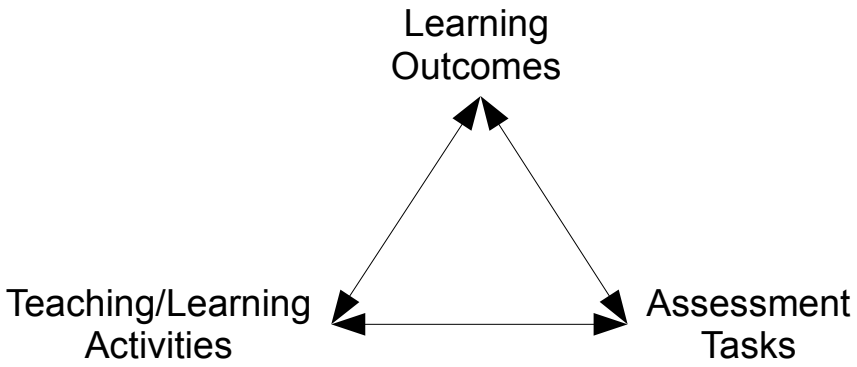
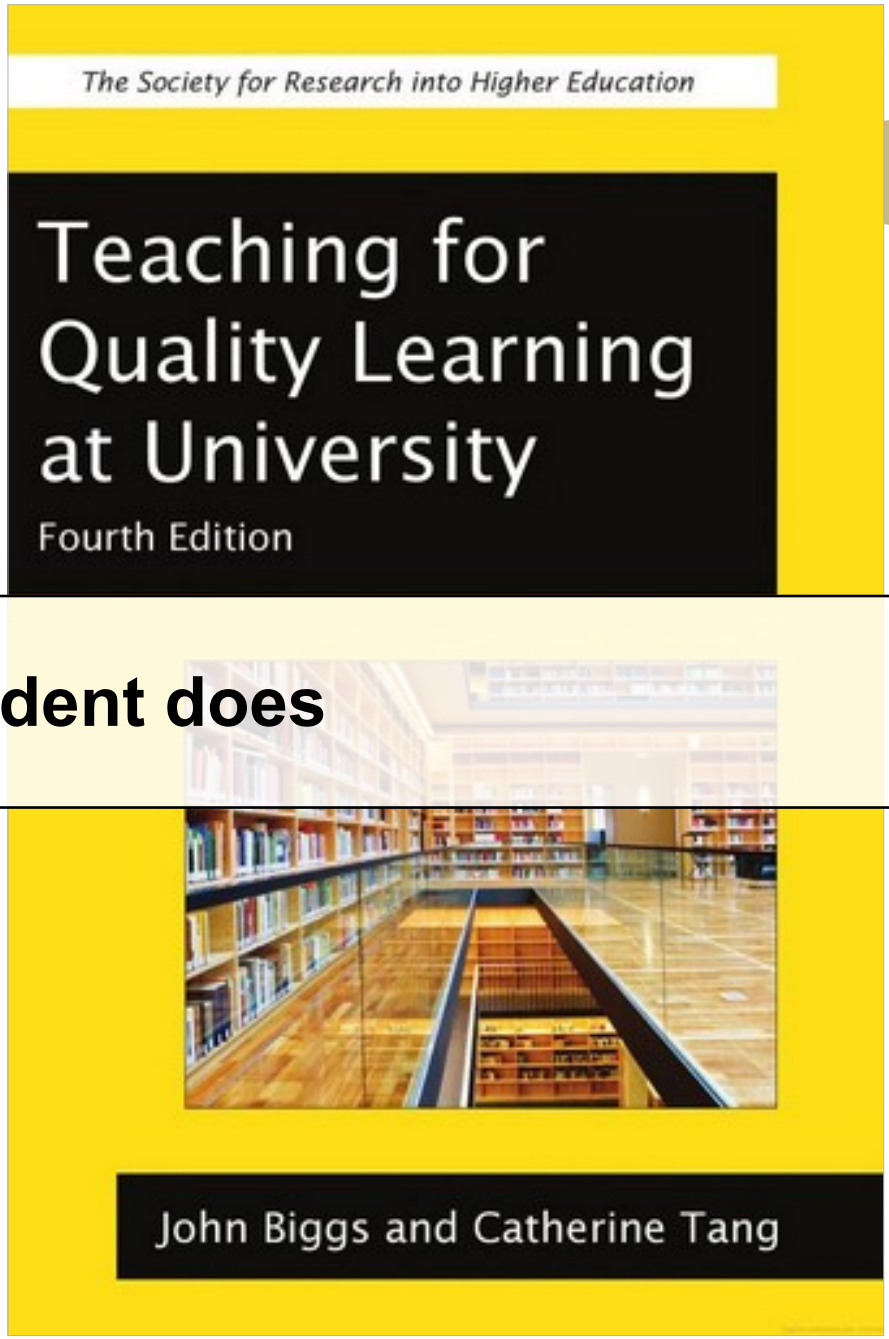
The major VL story can be summarized by six key findings. impact on student learning is heightened:

1. When teachers believe their major role is to evaluate their impact (d = .91);
2. When teachers work together to know and evaluate their impact (d = .91);
3. When teachers base their teaching on students' prior learning (what they bring to the lesson; d = .85);
4. When teachers explicitly inform the students about what success looks like near the start of a series of lessons (.77);
5. When teachers implement programs that have the optimal proportions of surface and deep learning (d = .71); and
6. When teachers set appropriate levels of challenge and never expect 'do your best' (d = .57).

Constructive Alignment





What the student does

Biggs, J. B., & Tang, C. (2011). Teaching for quality learning at university: what the student does.

Retrieval practice

https://www.youtube.com/watch?v=gkJz0PpvGf4

Rohrer, D., & Pashler, H. (2010). Recent research on human learning challenges conventional instructional strategies. Educational Researcher, 39(5), 406-412.

Recent Research on Human Learning Challenges Conventional Instructional Strategies

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There has been a recent upsurge of interest in exploring how choices of methods and timing of instruction affect the rate and persistence of learning. The authors review three lines of experimentation—all conducted using educationally relevant materials and time intervals—that call into question important aspects of common instructional practices. First, research reveals that testing, although typically used merely as an assessment device, directly potentiates learning and does so more effectively than other modes of study. Second, recent analysis of the temporal dynamics of learning show that learning is most durable when study time is distributed over much greater periods of time than is customary in educational settings. Third, the interleaving of different types of practice problems (which is quite rare in math and science texts) markedly improves learning. The authors conclude by discussing the frequently observed dissociation between people's perceptions of which learning procedures are most effective and which procedures actually promote durable learning.

Keywords: cognition; instructional design/development; memory

The experimental study of human learning and memory began more than 100 years ago and has developed into a major enterprise in behavioral science. Although this work has revealed some striking laboratory phenomena and elegant quantitative principles, it is disappointing that it has not thus far given teachers, learners, and curriculum designers much in the way of concrete and nonobvious advice that they can use to make learning more efficient and durable. In the past several years, however, there has been a new burst of effort by researchers to identify and test concrete principles that have this potential, yielding a slew of recommended strategies that have been listed in recent reports (e.g., Halpern, 2008; Mayer, in press; Pashler et al., 2007). Some of the most promising results involve the effects of testing on learning and different ways of scheduling study events. Those skeptical of behavioral research might assume that principles of learning would already be fairly obvious to anyone who has been a student, yet the results of recent experimentation challenge some of the most widely used study practices. We discuss three topics, focusing on the effects of testing, the role of temporal spacing, and the effects of interleaving different types of materials.

Learning Through Testing

Tests of student mastery of content material are customarily viewed as assessment devices, used to provide incentives for students (and in some cases teachers and school systems as well). However, memory research going back some years has revealed that a test that requires a learner to retrieve some piece of information can directly strengthen the memory representation of this information (e.g., Spitzer, 1939). More recent studies, however, have shown that a combination of study and tests is more effective than spending the same amount of time reviewing the material in some other way, such as rereading it (e.g., Carrier & Pashler, 1992; Cull, 2000; for reviews, see McDaniel, Roediger, & McDermott, 2007; Roediger & Karpicke, 2006b). Interestingly, however, surveys of college students show that most of them study almost entirely by rereading, with self-testing relatively rarely employed (Carrier, 2003; Karpicke, Butler, & Roediger, 2009).

Recent research shows that testing not only enhances learning but also slows the rate of forgetting. Roediger and Karpicke (2006a) found that a period of time devoted to a combination of study and tests rather than study alone impaired performance on a test given 5 minutes later yet improved performance on a test given 1 week later (Figure 1). Testing also retarded the rate of forgetting in two studies with test delays as long as 42 days (Carpenter, Pashler, Wixted, & Vul, 2008).

While one might attribute the benefit of the initial test to heightened attention, it seems more likely that it arises from the retrieval itself, as evidenced by a study by Kang, McDermott, and Roediger (2007) showing that an initial test requiring respondents to choose the correct answer from a list of alternatives (i.e., a multiple-choice question) did not produce as much benefit as a test requiring recall (i.e., a short-answer question). Moreover, these authors found that explicit retrieval, as required by a recall task rather than a recognition task, strengthened knowledge better than a multiple-choice test even when the final test itself involves multiple choice—and thus the effect is not attributable to a simple principle that practicing a given type of test best enhances performance on the same type of test.

A number of studies have shown that sizable benefits of testing generalize to classroom-based studies. In a study reported by

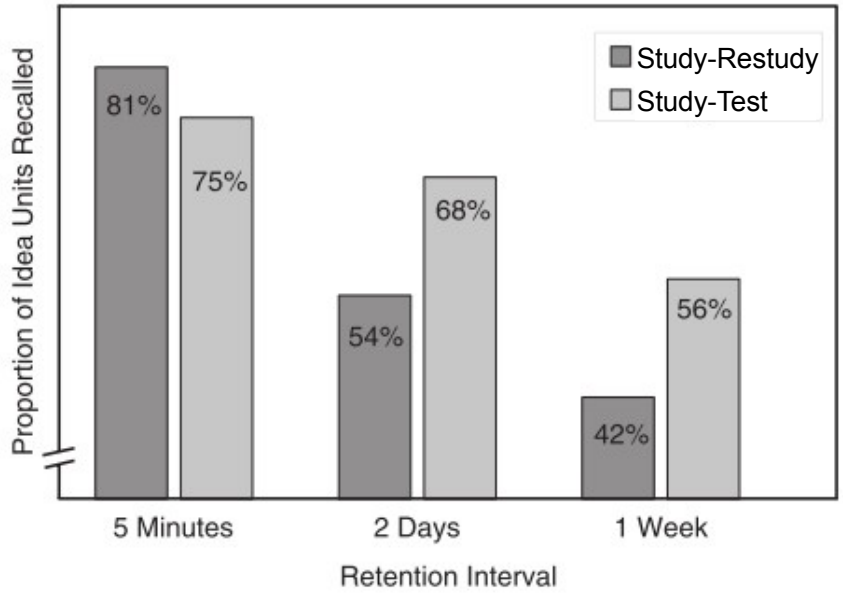
Educational Researcher, Vol. 39, No. 5, pp. 406–412
DOI: 10.3102/0013189X10374770

The Testing Effect

Rohrer, D., & Pashler, H. E. (2010). Recent Research on Human Learning Challenges Conventional Instructional Strategies. Educational Researcher, 39, 406–412.

«Study-Restudy»

«Study-Test»



«instructional practices would be more effective if the proportion of learning time that learners spend retrieving information were dramatically increased»

The Critical Importance of Retrieval for Learning

Jeffrey D. Karpicke and Henry L. Roediger, Science, 2008

Number	Swahili	English
1	adhama	honor
2	adui	enemy
3	bustani	garden
4	buu	maggot
5	chakula	food
6	dafina	treasure
7	elimu	science
8	embe	mango
9	fagio	broom
10	farasi	horse
11	fununu	rumour
12	godoro	mattress
13	goti	knee
14	hariri	silk
15	kaa	crab
16	kaburi	grave
17	kaputula	shorts
18	leso	scarf
19	maiti	corpse
20	malkia	queen
21	mashua	boat
22	ndoo	bucket
23	nyanya	tomato
24	pazia	curtain
25	pipa	barrel
26	pombe	beer
27	punda	donkey
28	rembo	ornament
29	roho	soul
30	sala	prayer
31	sumu	poison
32	tabibu	doctor
33	theluji	snow
34	tumbili	monkey
35	usingizi	sleep
36	vuke	steam
37	yai	egg
38	zeituni	olives
39	ziwa	lake
40	zulia	carpet

Table 1. Conditions used in the experiment, average number of trials within each study or test period, and total number of trials in the learning phase in each condition. S_N indicates that only vocabulary pairs not recalled in the previous test period were studied in the current study period. T_N indicates that only pairs not recalled in the previous test period were tested in the current test period. Students in all conditions performed a 30-s distracter task that involved verifying multiplication problems after each study period.

Condition	Study (S) or test (T) period and number of trials per period								Total number of trials
	1	2	3	4	5	6	7	8	
ST	S	T	S	T	S	T	S	T	
	40	40	40	40	40	40	40	40	320
S_NT	S	T	S_N	T	S_N	T	S_N	T	
	40	40	26.8	40	8.0	40	2.0	40	236.8
ST_N	S	T	S	T_N	S	T_N	S	T_N	
	40	40	40	27.9	40	11.8	40	3.3	243.0
S_NT_N	S	T	S_N	T_N	S_N	T_N	S_N	T_N	
	40	40	27.1	27.1	8.8	8.8	1.5	1.5	154.8

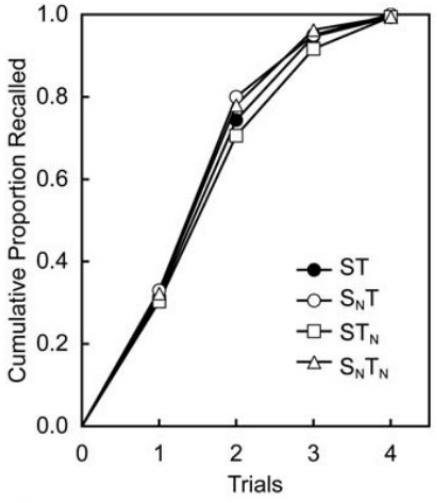


Fig. 1. Cumulative performance during the learning phase.

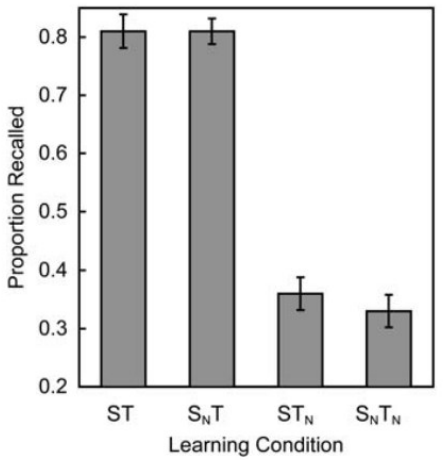


Fig. 2. Proportion recalled on the final test 1 week after learning. Error bars represent standard errors of the mean.

The Role of the Teacher

https://youtu.be/Z9orbxoRofI?si=fYSqoPag47EB7i2X

Mazur's simple learning model:

1) SENSE INFORMATION → **2) MAKE SENSE OF INFORMATION**

Traditionally

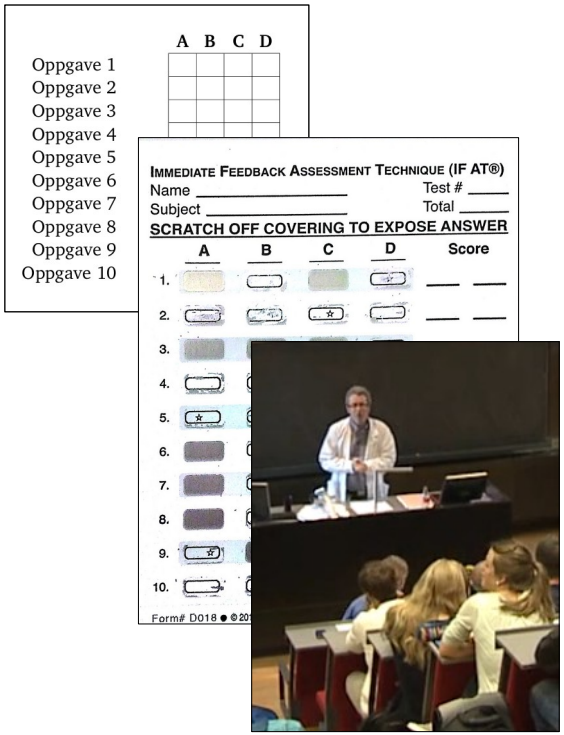
Focus: «Informing students» (Sage on the Stage)

Evidence based

Focus: «Formative assessment» (Guide on the Side)

Teambased learning (TBL)

FORBEREDELSE (Preparation)	OPPVARMING (Readiness Assurance Process)				GRUPPEARBEID (Team Applications)
Individuell lesing	iRAT	tRAT	Appell	Feedback	tAPP
	Ca. 45 min				Ca. 90 min



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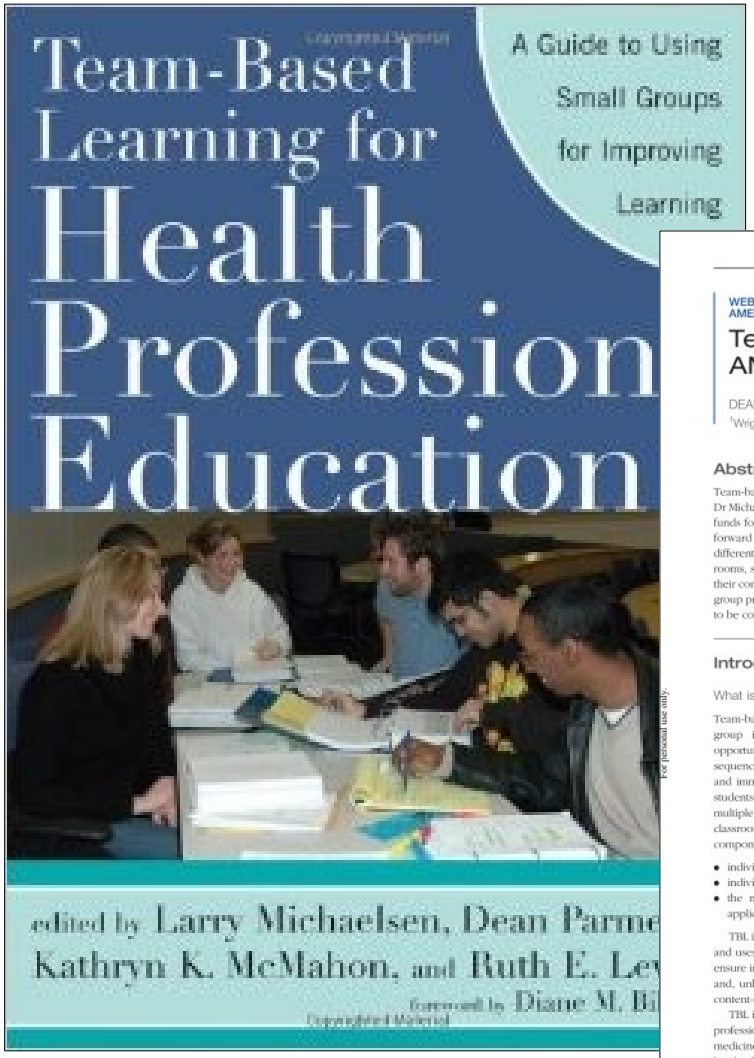
Kunnskap for en bedre verden



2012; 34: e275–e287 MEDICAL TEACHER

WEB PAPER
AMEE GUIDE

Team-based learning: A practical guide: AMEE Guide No. 65

DEAN PARMELEE[1], LARRY K. MICHAELSEN[2], SANDY COOK[3] & PATRICIA D. HUDES[1]

[1]Wright State University, USA, [2]University of Central Missouri, USA, [3]Duke-NUS Graduate Medical School, Singap

Abstract

Team-based learning™ (TBL) is an instructional strategy developed in the business school environment in the early
Dr Michaelsen who wanted the benefits of small group learning within large classes. In 2001, a US federal granting agency
funds for educators in the health sciences to learn about and implement the strategy in their educational programs; TBL
forward as one such strategy and as a result it is used in over 60 US and international health science professional schools. T
different from problem-based learning (PBL) and other small group approaches in that there is no need for multiple
rooms, students must come prepared to sessions, and individual and small groups of students (teams) are highly accoun
their contributions to team productivity. The instructor must be a content-expert, but need not have any experience or ex
group process to conduct a successful TBL session. Students do not need any specific instruction in teamwork since they l
to be collaborative and productive in the process. TBL can replace or complement a lecture-based course or curriculum

Introduction

What is team-based learning?

Team-based learning™ (TBL) is an active learning and small group instructional strategy that provides students with opportunities to apply conceptual knowledge through a sequence of activities that includes individual work, teamwork and immediate feedback. It is used with large classes (>100 students) or smaller ones (<25 students), incorporating multiple small groups of 5–7 students each, in a single classroom. TBL is specifically characterized by three key components:

- individual advance student preparation;
- individual and team readiness assurance tests (tRATs); and
- the majority of in-class time devoted to decision-based application assignments done in teams.

TBL is highly learner-centered (yet has critical faculty input) and uses grading, peer evaluation and immediate feedback to ensure individual and team accountability to promote learning and, unlike other group-based instructional approaches, one content-expert instructor can instruct 20 or more teams.

TBL is used in over 60 US and international health science professional schools, including medicine, dentistry, veterinary medicine, nursing, and allied health disciplines, at several levels of training: undergraduate, postgraduate, and continuing professional education.

When TBL is conducted correctly, there is little question that academic outcomes are equivalent or improved in comparison to either lecture-based formats or more traditional small group learning models (McKiernan 2003; Levine et al. 2004; Koles et al. 2005, 2010; Shell et al. 2009; Zgheib et al. 2010; Thomas & Bowen 20

Unlike typical group learning, the high performe suffer – by either having to do all the work or poor pe dragging their scores down. The process holds accountable for their own individual work and the in contribution to their team. The better a team works the better their team and individual scores. Extens teaching occurs within each team.

Faculty may fear that the team scores mask th performing student. In reality, TBL provides more dat about an individual's weaknesses and permits team

Practice points

- TBL is a learner-centered, instructor-directed stra small group active learning in large group edu settings.
- Learners are *accountable*, expected to prepare of class and collaborate with their team mem solve authentic problems and make decisions in
- Only one content-expert instructor is needed whole class in one room.
- Students learn how to work in teams throu process of TBL – they do not need additional ins nor does the instructor need be a group process
- A backward design, outcomes-based appro used to stay focused on what the learners sh able to do.
- One must use TBL's key components and foll process for TBL to be successful.

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ISBN 0142–159X print/ISBN 1466–187X online/12/050275–13 © 2012 Informa UK Ltd.
DOI: 10.3109/0142159X.2012.651179

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VITENSKAPELIG PUBLIKASJON

UNIVERSITETSFORLAGET

ÅRGANG 40, NR. 3 2017, S. 207–221
ISSN ONLINE: 0333 3781
DOI: 10.18261/ISSN: 0333-3781-2017-03-03

Teambasert læring – en studentaktiviserende og lærerstyrt undervisningsform

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SAMMENDRAG

Bakgrunn: Studentaktiviserende undervisning er viktig for å oppnå god læring. I teambasert læring (TBL) aktiviseres studentene individuelt, gruppevis og i plenum under ledelse av faglærer. TBL er i liten grad prøvd ut og evaluert i medisinsk utdanning i Norge. Vi ville derfor undersøke hvorvidt TBL kan være egnet som undervisningsform i grunnutdanningen av leger.

Materiale og metode: Vi arrangerte TBL i generell patologi for andreårs medisinstudenter i 2013 og 2014. TBL-sesjonen varte i tre timer og inkluderte individuell og gruppevis oppvarmingstest, gruppearbeid, plenumdiskusjon og oppsummering fra faglærer. Svarene på oppgavene ble samlet inn for å sammenlikne individuelle og gruppevise prestasjoner på testene. Studentene ble også bedt om å evaluere undervisningen.

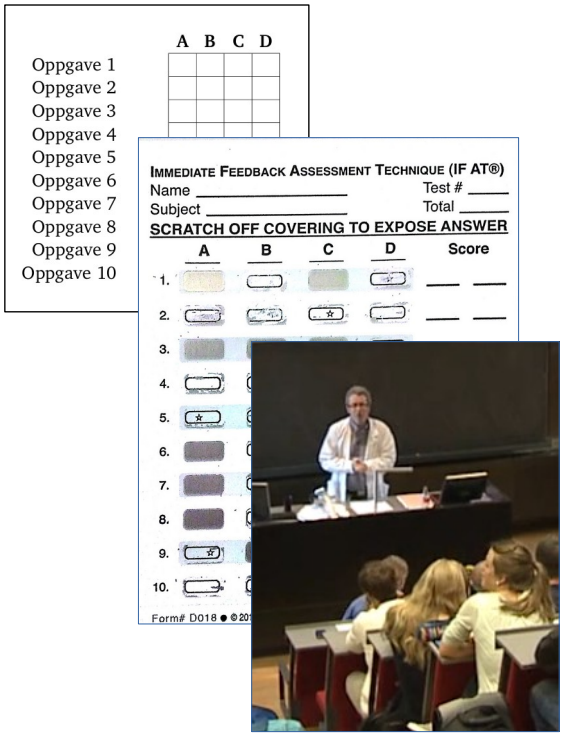
Resultater: Gruppenes prestasjoner var bedre enn eller like gode som 84 % (2013) og 72 % (2014) av de individuelle prestasjonene. TBL ble av studentene oppfattet som en

Idunn

Den om teambasert læring

Teambased learning (TBL)

FORBEREDELSE (Preparation)	OPPVARMING (Readiness Assurance Process)				GRUPPEARBEID (Team Applications)
Individuell lesing	iRAT	tRAT	Appell	Feedback	tAPP
	Ca. 45 min				Ca. 90 min



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GRUPPEPLASSERING VED
TEAM-BASERT LÆRING
13
14
15
10
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16
12
7
8
9
5
6
4
3
2
1


A
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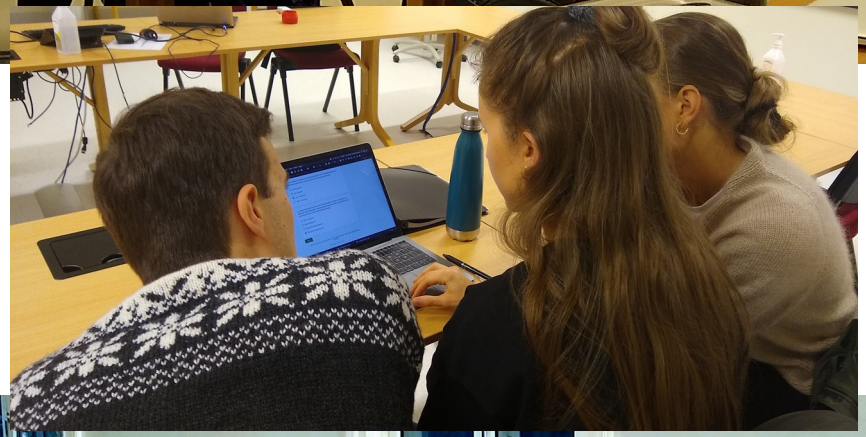
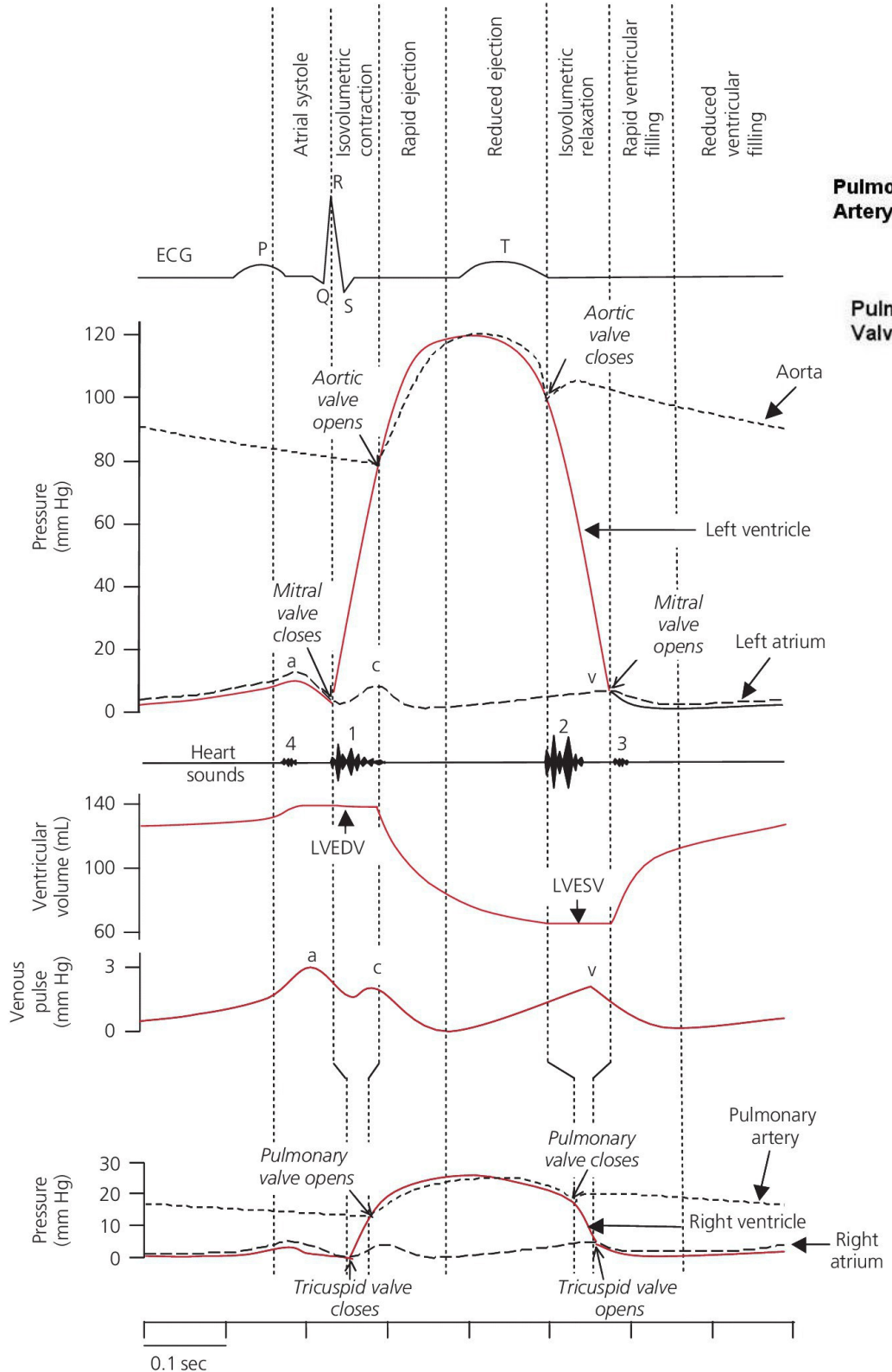
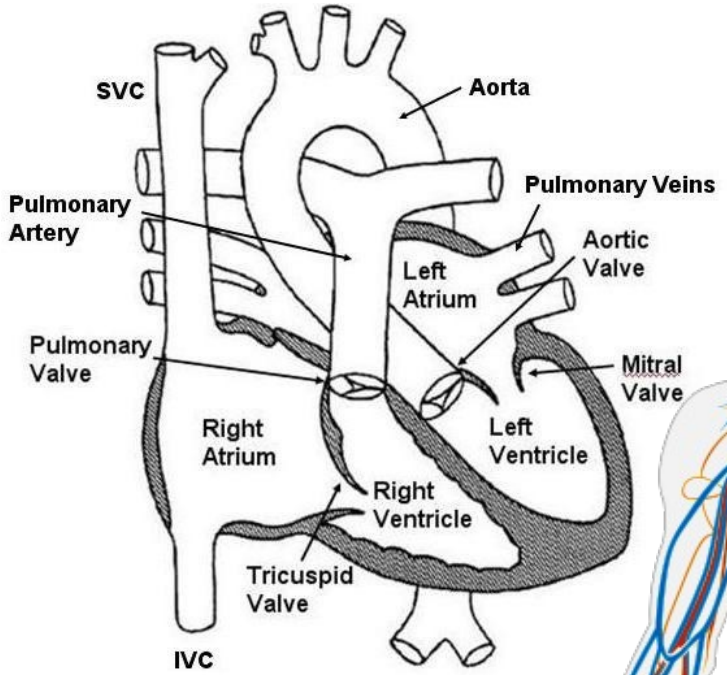
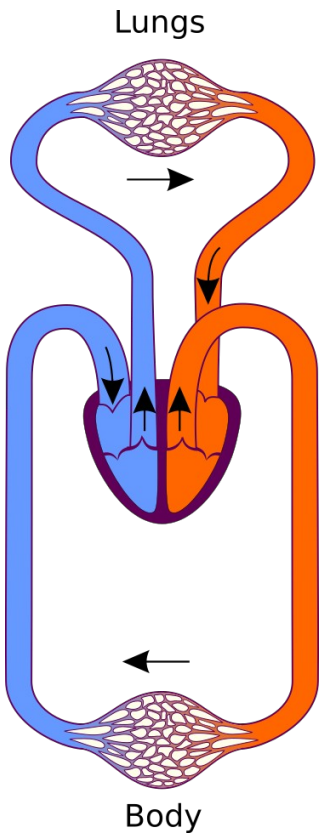
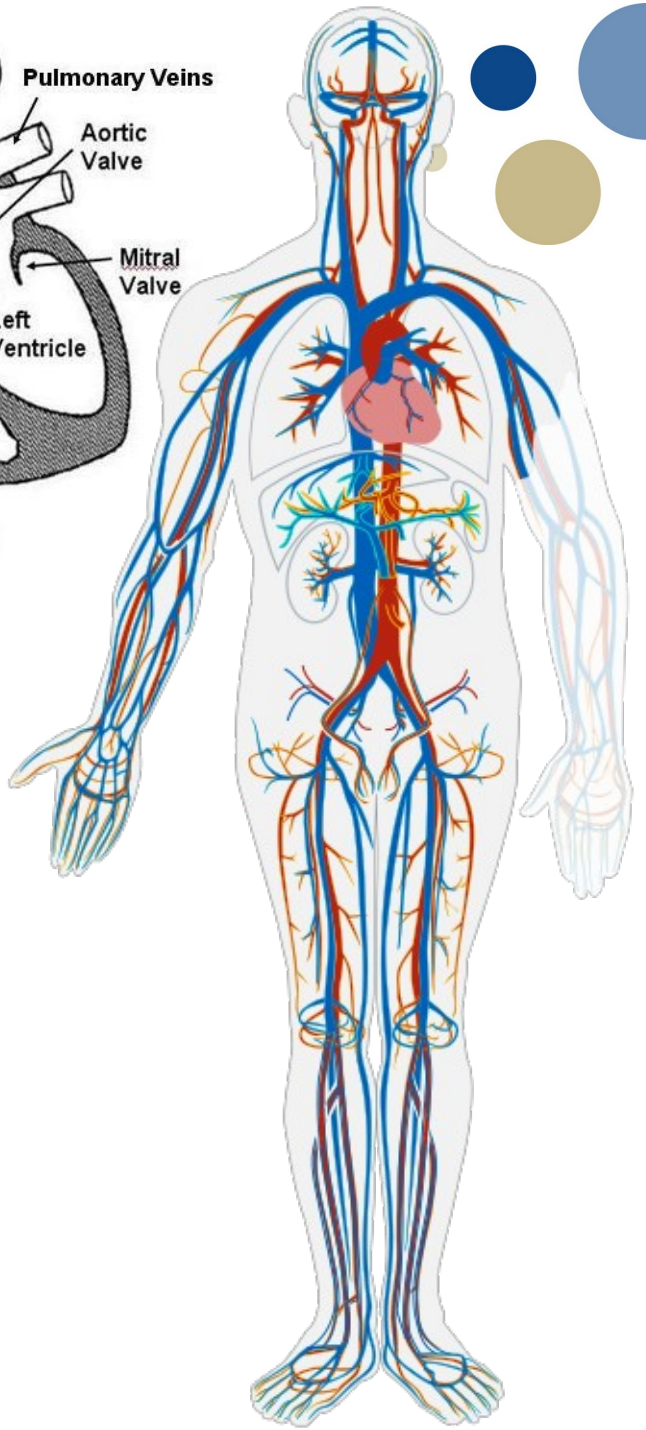



Atrial systole
Isovolumetric contraction
Rapid ejection
Reduced ejection
Isovolumetric relaxation
Rapid ventricular filling
Reduced ventricular filling
ECG
R
P
T
Q
S
Pressure (mm Hg)
120
100
80
60
40
20
0
Aortic valve opens
Aortic valve closes
Aorta
Left ventricle
Mitral valve closes
Mitral valve opens
Left atrium
a
c
v
Heart sounds
4
1
2
3
Ventricular volume (mL)
140
100
60
LVEDV
LVESV
Venous pulse (mm Hg)
3
0
Pressure (mm Hg)
30
20
10
0
Pulmonary valve opens
Pulmonary valve closes
Pulmonary artery
Right ventricle
Right atrium
Tricuspid valve closes
Tricuspid valve opens
0.1 sec


SVC
Aorta
Pulmonary Veins
Pulmonary Artery
Aortic Valve
Left Atrium
Pulmonary Valve
Mitral Valve
Right Atrium
Left Ventricle
Right Ventricle
Tricuspid Valve
IVC


Lungs
Body



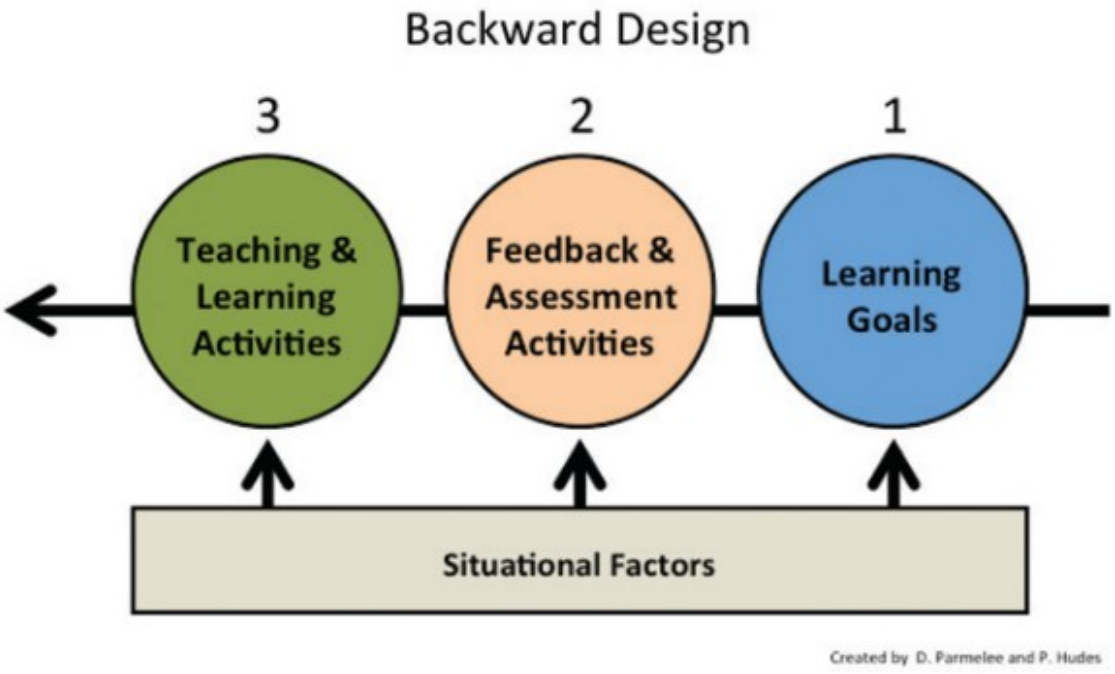
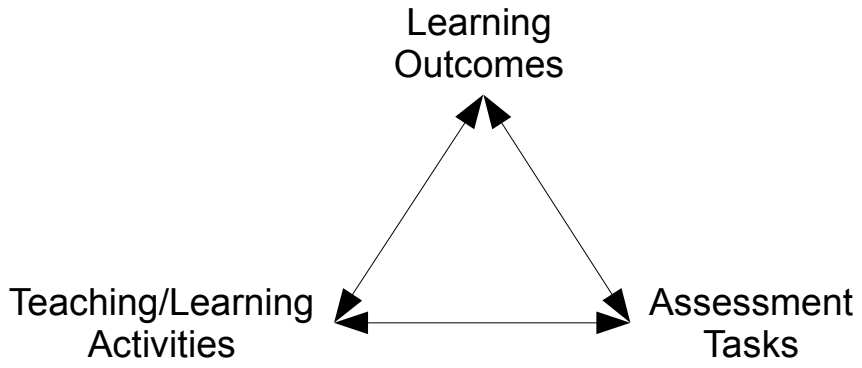


Figure 2. Backward design process.

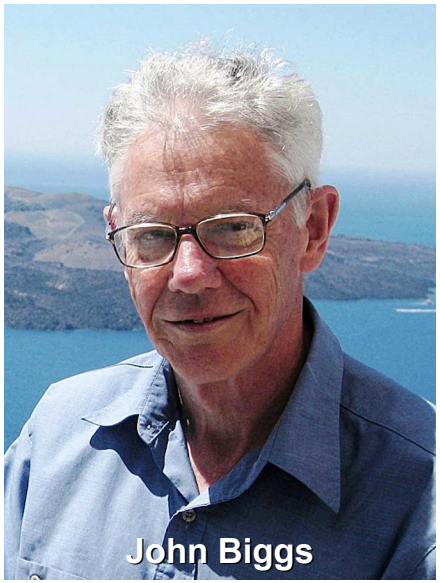
Constructive Alignment



Biggs, J. B., & Tang, C. (2011). Teaching for quality learning at university: what the student does.

Evidence based teaching and learning

Know Thy Impact!



Focus On What the Student Does!

Practice Retrieval of Information!

Be the Guide on the Side (not sage on the stage)!

Thank you!

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