



# How Education Works

## A technological perspective

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**8th International Conference on “Cloud Computing, Data  
Science & Engineering” Confluence-2018**

**A story of technological  
*momentum***

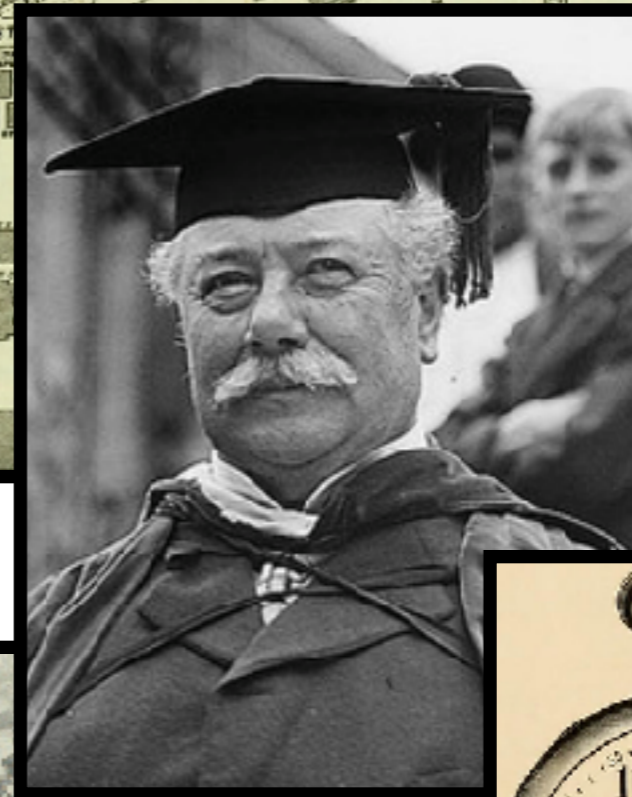
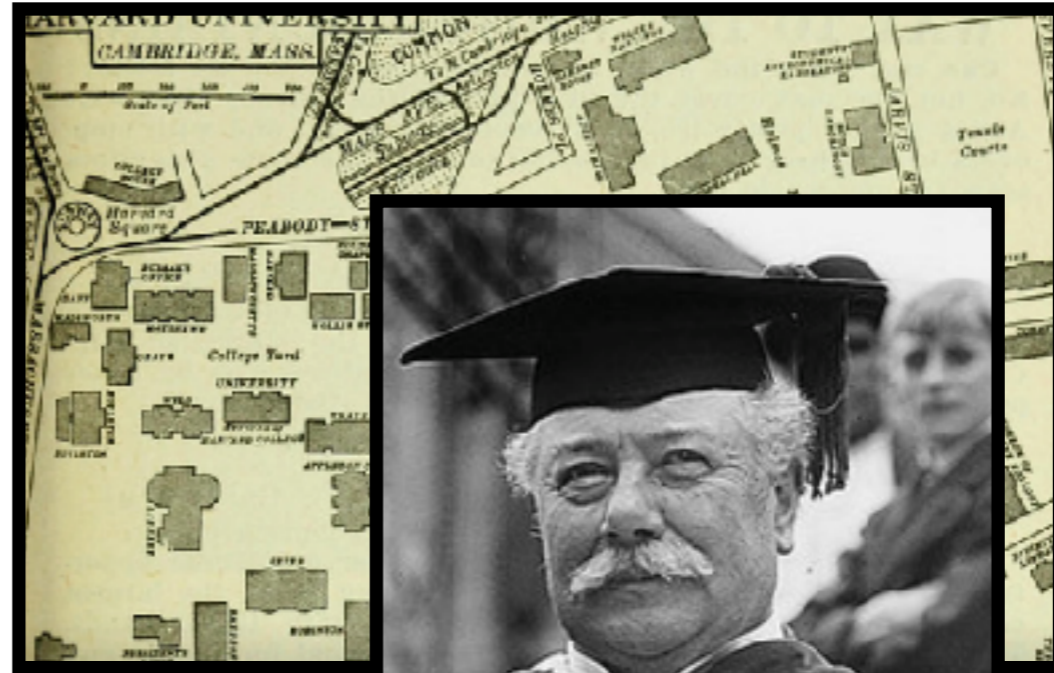
**not technological  
*determinism***

**The problem:  
knowledge and skills  
held by the few**

(and a need to impart them to the many)

# The context:

Physical  
boundaries  
and  
scarce resources



**classes**

**faculties**

semesters

**terms**

**schools**

universities

tests

textbooks

**accreditation**

**timetables**

assignments

**exams**

seminars

**The solutions**

convocations

**lectures**

**courses**

**programs**

tutorials

**learning outcomes**

**curricula**

libraries

desks

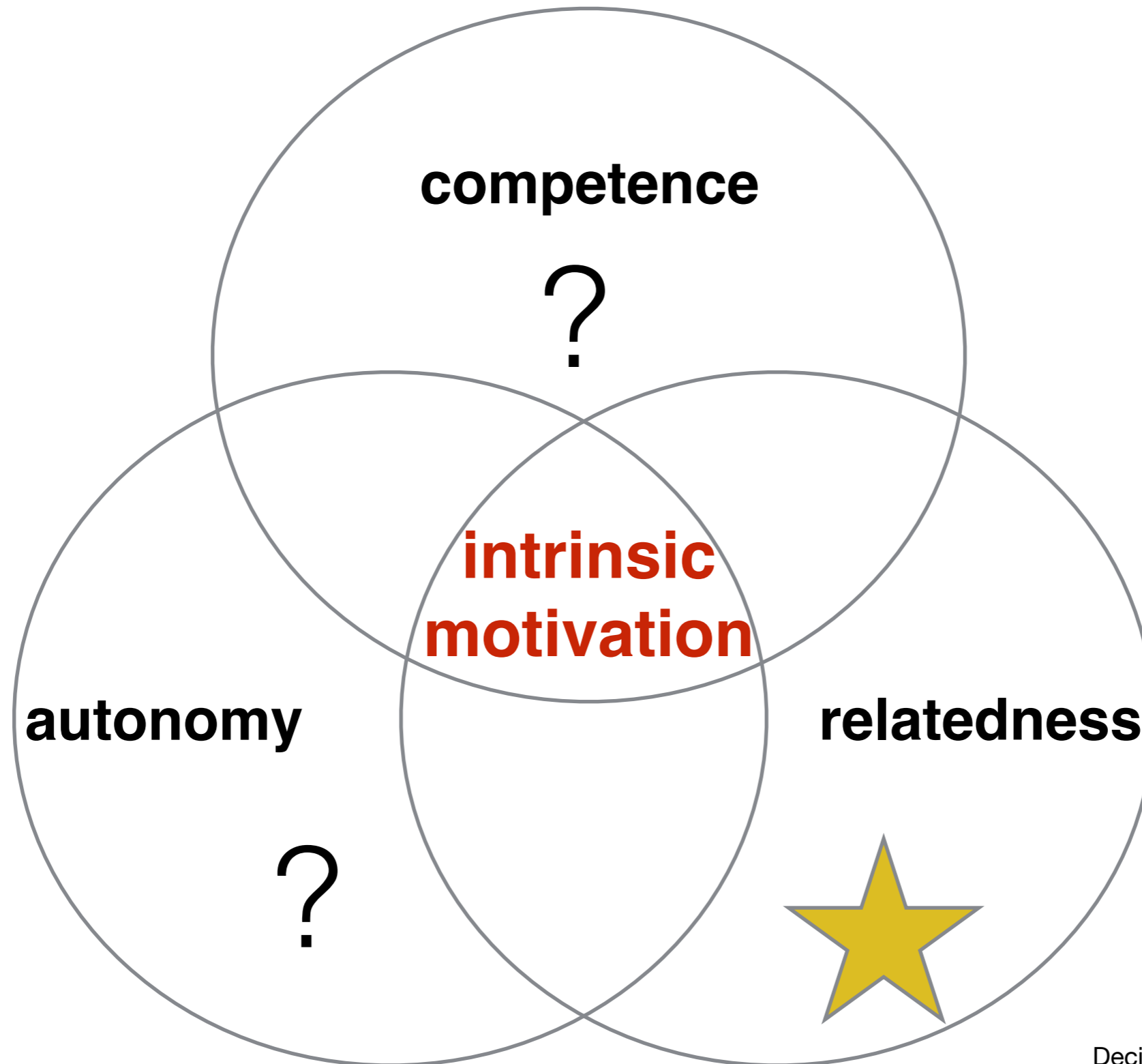
**rules & regulations**

And, most importantly...



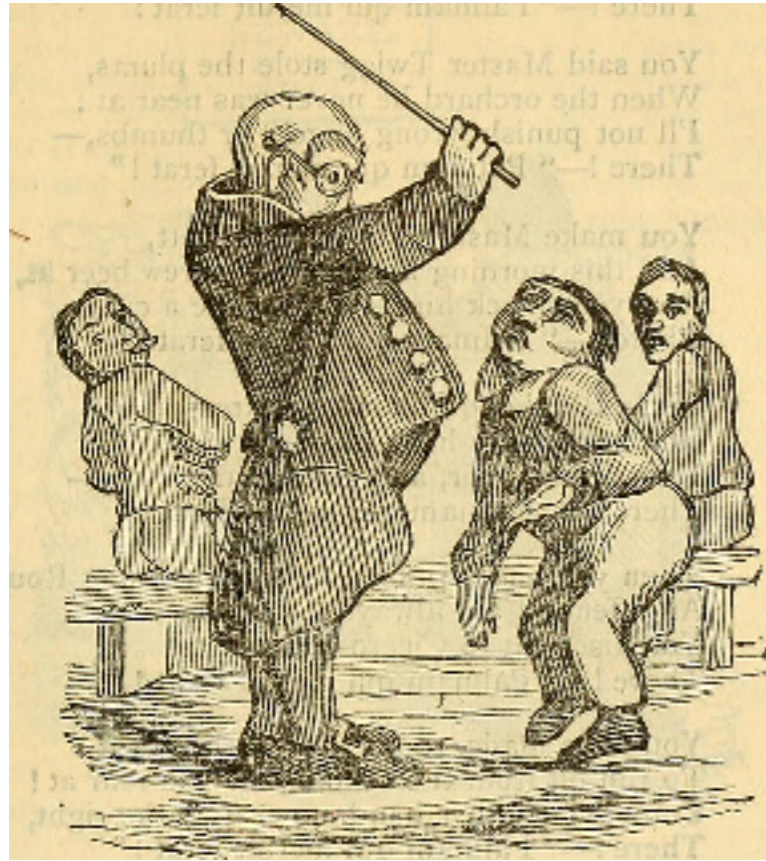
people that *do not want to be there*  
a context that is *by definition*  
demotivating

# Classroom motivation



<http://selfdeterminationtheory.org>

Deci, E.L., & Ryan, R.M. (2000). The “What” and “Why” of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry*, 11, 227-268



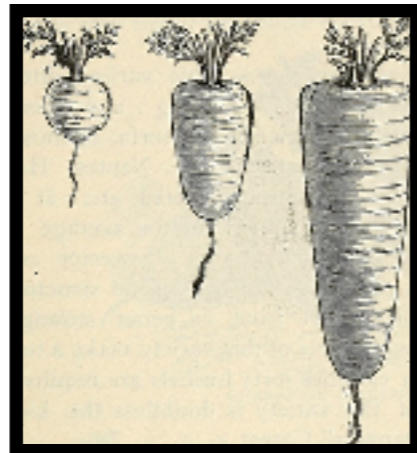
sticks  
and  
carrots







Extrinsic motivation crowds out Intrinsic motivation



<http://selfdeterminationtheory.org/>

# A Sisyphean task

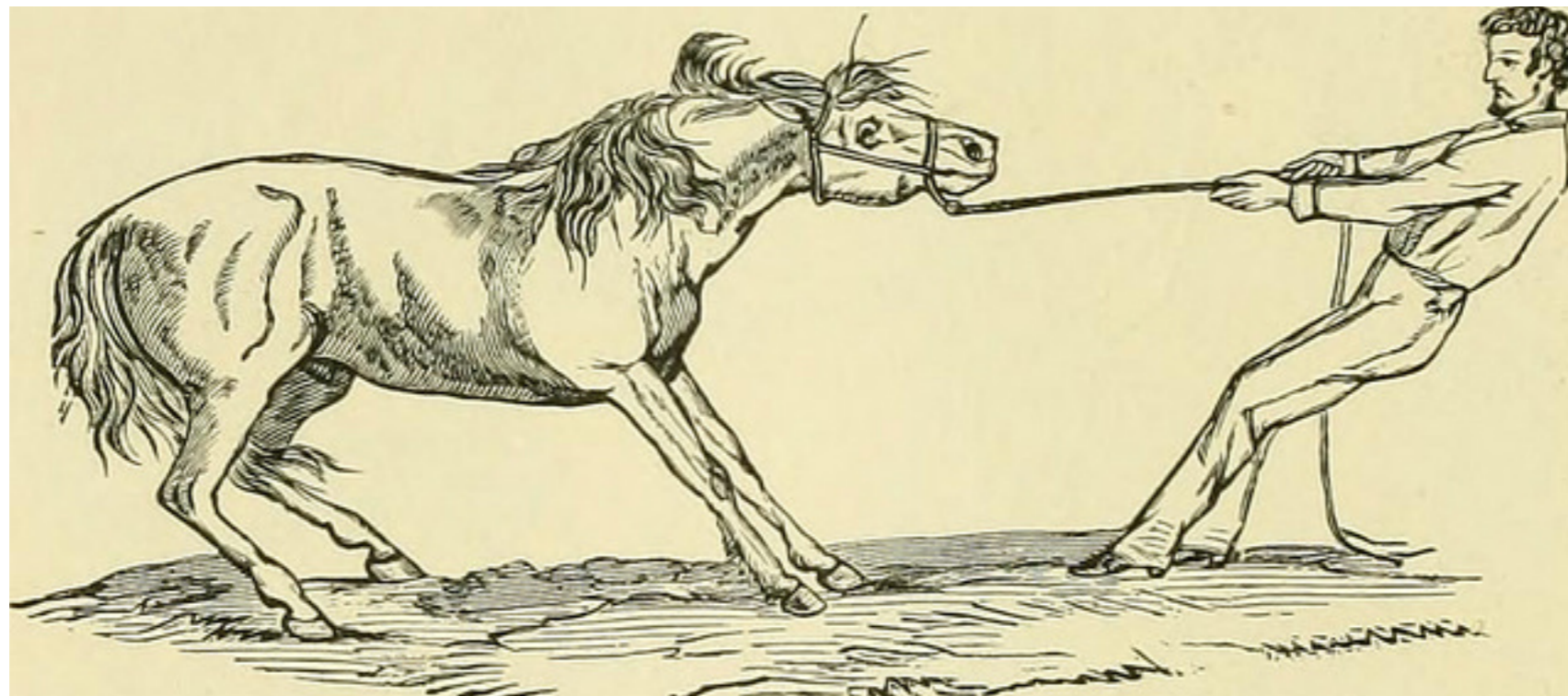


**An essential compromise...**

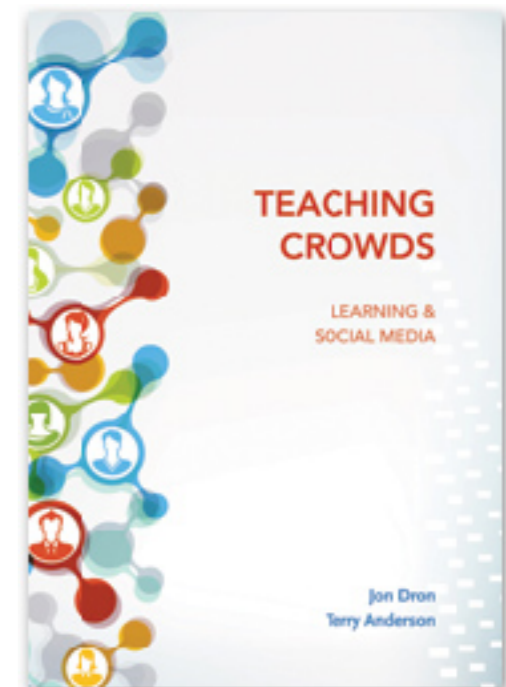
Physical classroom-based systems are **systematically demotivating** because of physical, non-negotiable boundaries

**The essence of good teaching lies in overcoming this compromise**

Why do we not ban  
cellphones in online  
classrooms?



# Online freedoms...





and yet, when the need is gone....

Course categories

Undergraduate (66)

Graduate (2)

Winter 2015 (10)

Fall 2014 (12)

Individualized Study - Graduate Courses (3)

Spring 2014 (3)

Undergraduate - Archived Courses (29)

Graduate - Archived Courses

Spring 2012 (1)

Winter 2014 (10)

Fall 2013 (10)

Winter 2013 (12)

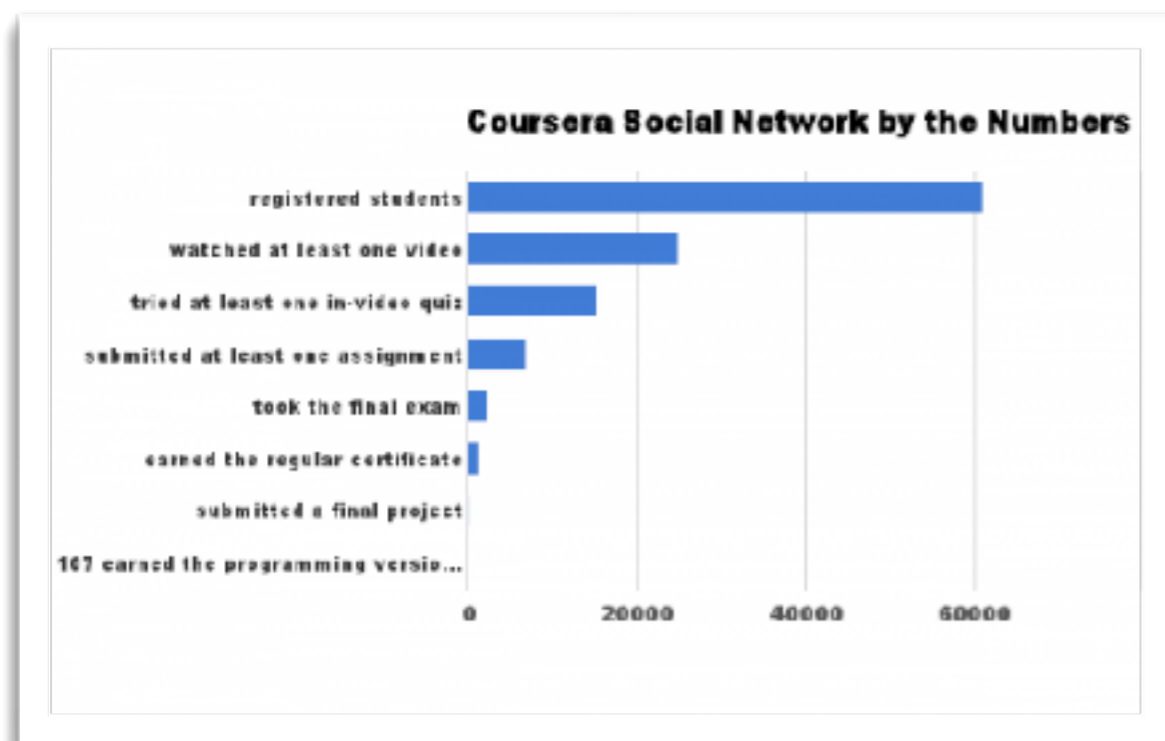
Spring 2013 (10)

Fall 2012 (11)

The screenshot shows the 'studentcentral' website interface. At the top, there is a navigation bar with 'Home', 'Community', and 'Online Library' tabs. Below this, a 'Welcome, Jon' message is displayed. The main content area is divided into several sections:
 

- Tools:** A vertical list of utility tools including Calendar, User Directory, Student email, Staff email, Tasks, Address Book, Personal settings, and MS Office Viewers.
- Life Support:** A vertical list of support services such as Careers & Part-time Jobs, Childcare, Computing, Libraries & Media, Counselling, Disability & Dyslexia, Health & Wellbeing, International Living here, Money, Partner Colleges, Religious Life, Restaurants, Cafes & Shops, Rights & Responsibilities, Safety & Security, Sport Brighton, and Student Handbook.
- My Study Areas:** A section titled 'Expand All' containing a list of courses and programs, such as 'CMIS Staff Area', 'my course: MScIS - Masters in Information Systems', 'my programme: Computing Undergraduate Programme', and various modules like 'C105 - Computing in Context' and 'C106/161/162 - Professional practice Computing'.
- My Announcements:** A section stating 'No new system announcements have been posted today.' It includes a 'Sport Brighton' announcement about 'Cockcroft Sports Centre Holiday Closing Times' and a 'News Flash' section with items like 'Exercise Tolerance Symposium', 'Student E-mail Unavailable 3/4/07', 'Casia Cafe Bar closed 2-6 March', and 'Community Downtime and Competition - Reminder'.
- Clubs and Societies:** A section titled 'Organizations in which you are participating:' with a link to 'Student Chat'.

# What happens when you take away the power of the teacher (but keep the same pedagogies)?



<http://cogdogblog.com/2012/11/27/owning-massive/>

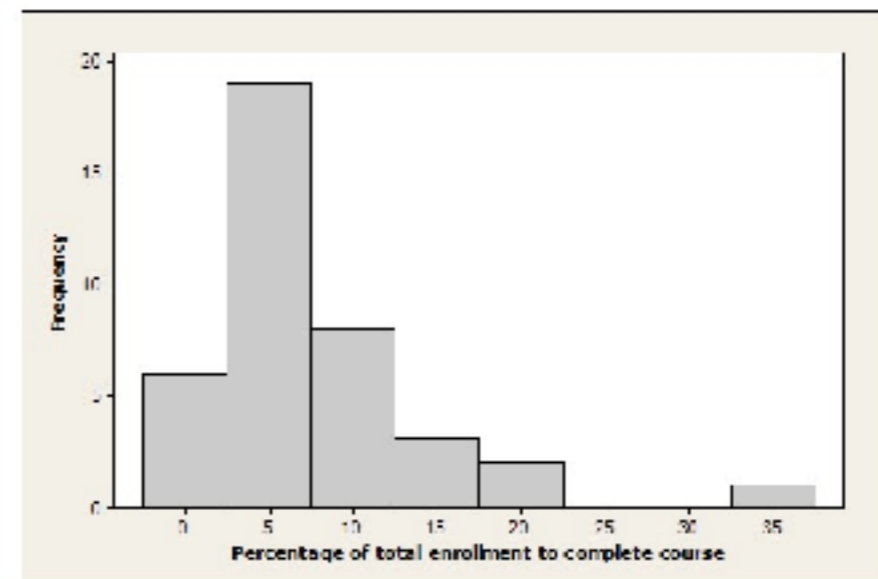


Figure 4. Histogram of completion rates for the sampled courses (n = 39).

“Completion rates range from 0.9% to 36.1%, with a median value of 6.5%”

**Q: how did this  
happen?**

**A: it's in the nature of  
technology evolution**

# What is a technology?

tech·nol·o·gy/tek'näləjē/

Noun.

1. The application of scientific knowledge for practical purposes, esp. in industry: "computer technology"; "recycling technologies".
2. Machinery and equipment developed from such scientific knowledge.

Synonyms:

technics - engineering - technique

“Anything invented after you were born” (Kay)

“Everything that doesn't work yet” (Hillis)

“Ways that people get complicated things done” (Bessant & Francis)

“A combination of artefacts and what you do with them” (Nye)

“Tools with a context” (Papert)

“Not a thing but a verb” (Kelly)

“The way things are done around here” (Franklin)





# technology

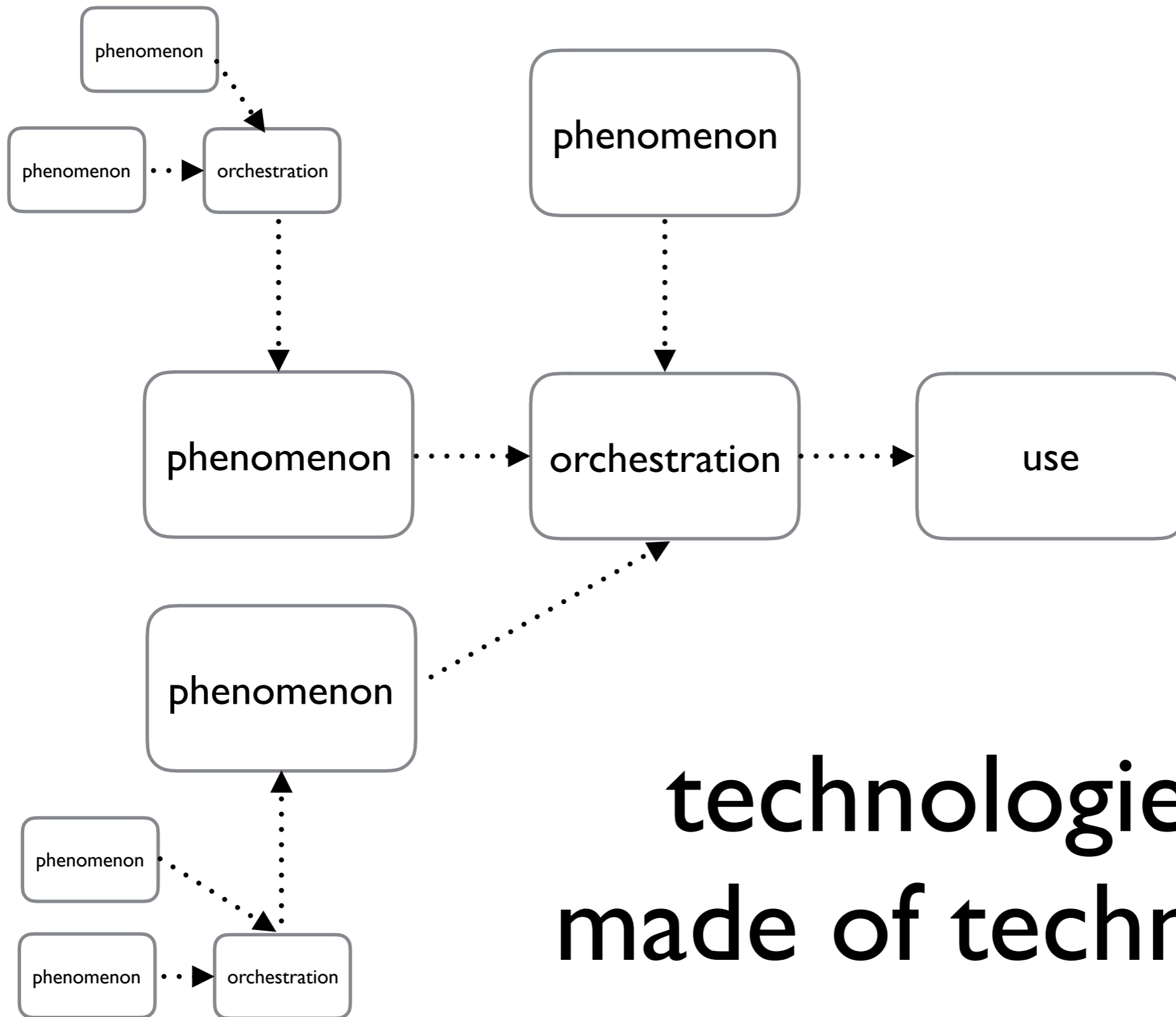
“the orchestration of phenomena for  
some use”

(W. Brian Arthur)

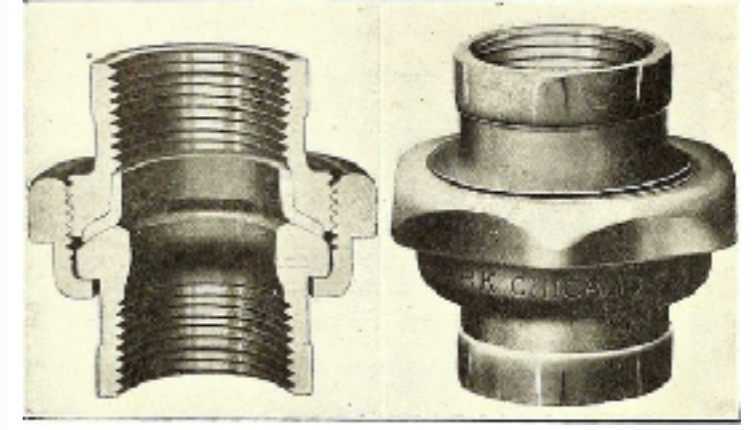
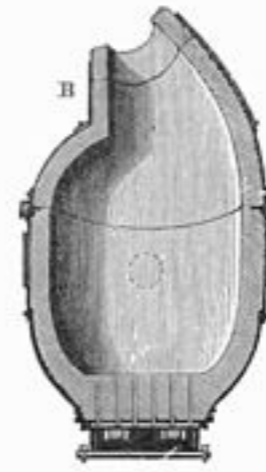
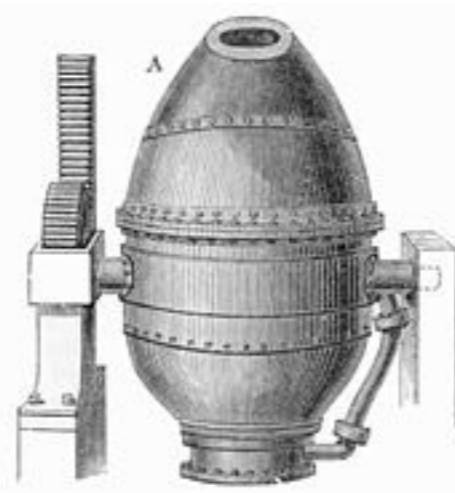
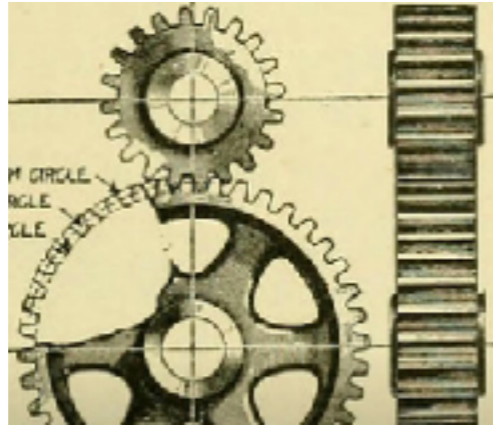
# technologies are assemblies



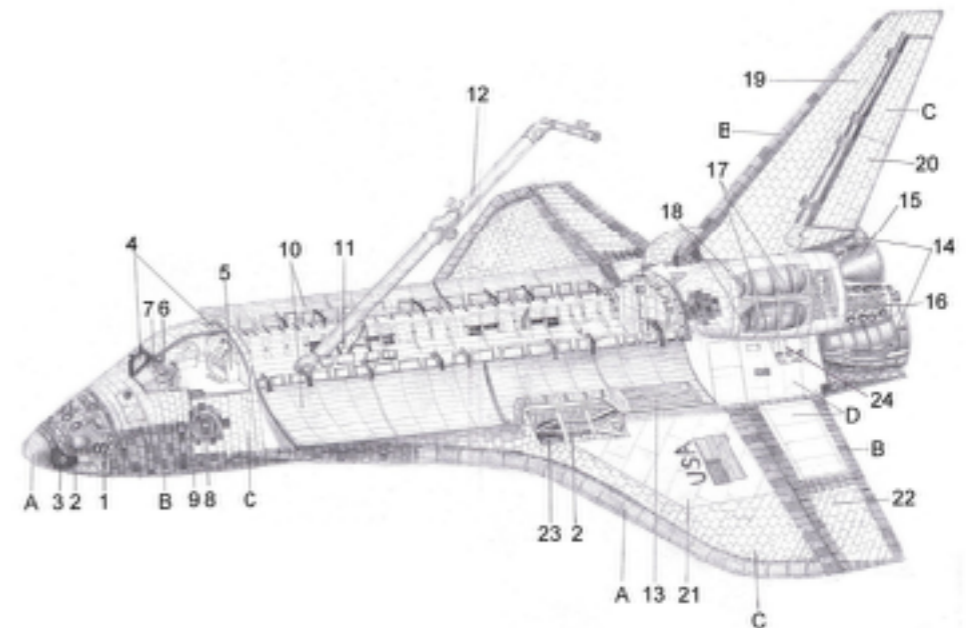
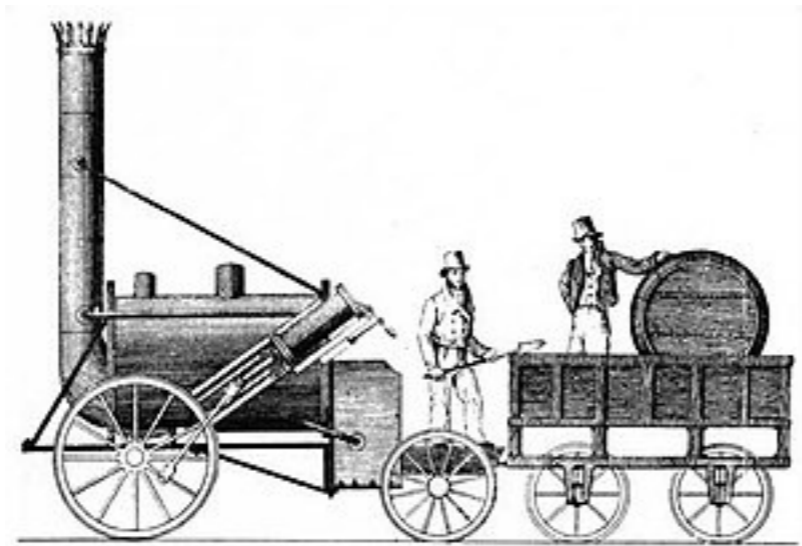
Arthur, W. B. (2009). *The Nature of Technology: what it is and how it evolves*. New York, USA: Free Press.



**technologies are  
made of technologies**



**technologies evolve  
by assembly**



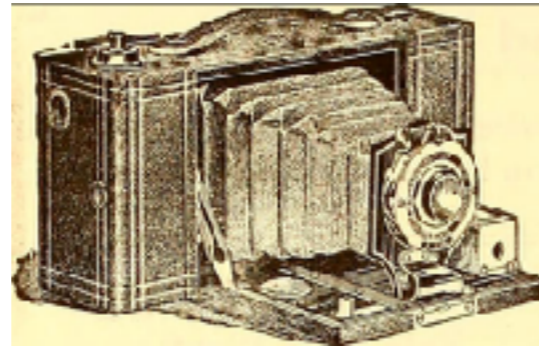
# Hard technologies

Orchestration  
of  
phenomena  
embedded in  
the  
technology



May need skill to use them *correctly*

# Soft technologies



Active  
orchestration  
of  
phenomena  
by people

[http://commons.wikimedia.org/wiki/File:François\\_Barraud\\_-\\_Palette\\_et\\_Pinceaux.jpg](http://commons.wikimedia.org/wiki/File:François_Barraud_-_Palette_et_Pinceaux.jpg)

Skill needed to use them *well*

<http://www.fupress.net/index.php/formare/article/view/12613>

# points of view



Image by Jules Feiffer, from The Phantom Tollbooth, by Norton Juster

# not the same technology

**teacher view**

Athabasca University

Computer Science 470  
Web Server Management (Revision 1)

Home ▶ My courses ▶ Undergraduate ▶ COMP470 R1

**Active users**  
(last 5 minutes)  
jond

**Latest news**  
Add a new topic...

3 Jan, 10:10  
stuck  
To all SCIS students - ASP.NET developer needed

7 Nov, 15:07  
and  
Welcome to the course

Oct, 10:14  
stuck  
Mobile Device Battery Performance Survey

7 Oct, 14:14  
viam  
PhD in Computing and Information Systems and MSc in Learning Technologies Survey  
Older topics ...

**Navigation-AU**

- Getting Started
- Online and Characteristics
- Open versus Closed systems
- Management Concerns
- Security 1: SSL
- Web Server Configuration
- The HTTP Protocol
- Security 2: Policies
- Wicked Problems
- Final Reflections
- Course Evaluation

**Web Server Management**

If you have previously taken online courses, you will probably find some of the approaches of you: this is not about drilling content into your head. Instead this course invites you to start the course by reading the Course Information to complete your orientation.

Tutor Wiki (PRMPTD) (Faculty)  
Tutor Forum

**Getting Started**

- Course Information
- Podcast - Welcome to the Course
- Quick Survey: Your attitudes to learning (do this first)

**Communication**

- Course News and Announcements
- General Discussion Forum on the Landing
- General Discussion Forum
- General Course Chat (real time)
- General Course Wiki
- COMP470 group on the Landing

**Assessments**

- Submit Work for Formative Assessment **5 new 3 returned**
- Submit Work for Summative Assessment

**student view**

Athabasca University

Computer Science 470  
Web Server Management (Revision 1)

Home ▶ My courses ▶ Undergraduate ▶ COMP470 R1

**Online users**  
(last 5 minutes)  
jond

**Latest news**

3 Jan, 18:10  
stuck  
To all SCIS students - ASP.NET developer needed

7 Nov, 15:07  
and  
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Oct, 10:14  
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**Web Server Management**

If you have previously taken online courses, you will probably find some of the approaches of you: this is not about drilling content into your head. Instead this course invites you to start the course by reading the Course Information to complete your orientation.

**Getting Started**

- Course Information
- Podcast - Welcome to the Course
- Quick Survey: Your attitudes to learning (do this first)

**Communication**

- Course News and Announcements
- General Discussion Forum on the Landing
- General Course Chat (real time)
- General Course Wiki
- COMP470 group on the Landing

**Assessments**

- Submit Work for Formative Assessment No submission
- Submit Work for Summative Assessment No submission

different phenomena + different orchestration + different uses = a different technology



resilience

flexibility

diversity

creativity

control

hard is easy  
soft is hard

precision

replicability

accuracy

speed

ease of use

# Pedagogies are technologies too



# Learning technologies



where pedagogies  
form part of the  
orchestrated  
assembly



# Embedded pedagogies, embedded constraints



Tue	29 May	9:00	W2**	1hr30m	
Tues	29 May	9:30	W305	3 Hrs	Baib.4.
Tues	29 May	9:30	W502	3 Hrs	Acca.1
Tue	29 May	9:30	W507	2hrs	BEng/MEng CIVIL ENGI
Tue	29 May	9:30	W509	2hrs	BEng/MEng CIVIL ENGI
Tue	29 May	9:30	W623	2 hrs	PCS
Tues	29 May	10:00	W303	2 hrs	INAM
Tues	29 May	13:00	W303	1 hr	INAM
Tue	29 May	14:00	W306	2 hrs	
Tues	29 May	14:00	W507	2 Hrs	Baba-Hnd.1
Tue	29 May	14:00	W509	2hrs	BEng/MEng CIVIL ENGI
Tue	29 May	15:00	W303	2 hrs	
Tues	29 May	15:00	W623	3hrs+	M Pharm

As some students may take extra time / 15 min

Pedagogies are  
*soft* technologies.

They *rarely* come  
first

# hard learning technologies

The image shows a screenshot of a university student portal. At the top, the 'studentcentral' logo is visible with navigation links for Home, Community, and Online Library. A search bar is present in the top right. Below the navigation, a welcome message reads 'Welcome, Jon'. The main content area is divided into several sections:

- Tools:** A sidebar menu with links for Calendar, User Directory, Student email, Staff email, Tasks, Address Book, Personal settings, and MS Office Viewers.
- Life Support:** A sidebar menu with links for Careers & Part-time Jobs, Childcare, Computing, Libraries & Media, Counselling, Disability & Dyslexia, Health & Wellbeing, International, Living here, Money, Partner Colleges, Religious Life, Restaurants, Cafes & Shops, Rights & Responsibilities, Safety & Security, Sport Brighton, and Student Handbook.
- My Study Areas:** A section with 'Expand All' and 'My Teaching' links.
- My Announcements:** A section stating 'No new system announcements have been posted today.'
- Course Page:** The main content area displays 'COMP 602\_F07 Computer Science 602: Enterprise Information Management' under the 'School of Computing and Information Systems'. It includes a navigation bar with 'Home | Courses | Programs | Register Now | myAU' and a search bar. A login status 'You are logged in as Jon Dron (Logout)' is shown.
- Course Menu:** A sidebar for 'COMP 602\_F07' with links for Control Panel, Turn editing on, Gradebook, and a list of weeks (Weeks 1-7).
- Weekly outline:** A section with links for 'Welcome to COI', 'COMP 602 Sylla', 'News forum', 'COMP 602 Orac', 'COMP 602 Gene', and 'Course wiki'. Below this, there are links for 'TME 1 (1 new st)', 'TME 1 Forum', 'TME 2 (0 new st)', 'TME 2 Forum', 'TME 3 (0 new st)', and 'TME 3 Forum'.
- Introduction to Artificial Intelligence:** A banner for a course featuring a person wearing a mask and the text 'INTRODUCTION TO Artificial Intelligence' with a 'STANFORD ENGINEERING' logo.
- The instructors:** A section with two instructor profiles: 'Ebastian Thrun' (Professor of Computer Science at Stanford University) and 'Peter Norvig' (Director of Research at Google Inc.).
- Classroom Photo:** A black and white photograph of a classroom with a teacher standing at the front near a chalkboard and students sitting at desks.

# soft learning technologies



Google

Google Search    I'm Feeling Lucky

Google offered in: français



WIKIPEDIA  
The Free Encyclopedia

- Main page
- Contents
- Featured content
- Current events
- Random article
- Donate to Wikipedia
- Wikipedia store
- Interaction
- Help
- About Wikipedia
- Community portal

Main Page    Talk

Welcome to **Wikipedia**,  
the free encyclopedia that anyone can edit.  
5,948,481 articles in English

### From today's featured article



**Rochdale Cenotaph** is a First World War memorial in England based on the Cenotaph in London, topped by an effigy of a recumbent lion and a fund for the families, abandoned after a local dignitary purchased the site for a 17th Earl of Derby, unveiled the monument by Historic England. (Bill Settle)

Soft is hard

but very flexible



Computing, education,

Facebook, learning, widget,

550, law, social media, group,

virality, models, social

re.com 607, etc.

pocket =

learning, wikipedia:

domain in Canada and

the EU, but not the USA,

where the public domain

is different

songblog.net

Theorie und

Praxis der Online

Education: Building an

Integrated Model of

Human-Computer

Learning

Useful resources online

2017 re:invention

Disruptive education

learning



**Online Learning**  
OLJ • THE OFFICIAL JOURNAL

HOME    ABOUT    LOGIN    REGISTER    CONTACT

The PDF file you selected is not listed in our PDF reader plug-in installed (for example)

**contrasting soft and  
hard technologies**



*soft*  
(is hard)

**hard**  
(is easy)

signposts	<b>diverse</b>	<b>uniform</b>	fenceposts
freedom	<b>creative</b>	<b>efficient</b>	constraint
flexibility	<b>difficult</b> (to use)	<b>easy</b> (to use)	rigidity
bricolage	<b>adaptable</b>	<b>reliable</b>	engineering
networks	<b>flexible</b>	<b>fast</b>	hierarchies
builders	<b>complex</b>	<b>complicated</b>	users
open standards	<b>easy</b> (to create)	<b>difficult</b> (to create)	proprietary tools
interoperability			locked in
distributed			monolithic

# aggregation



**bricolage**

**engineering**



# replacement

# aggregation softens

it can make broken hard things work



but sometimes it is better to replace



# soft design patterns

- modification
- aggregation
- extension
- communication
- openness
- networks



# hard design patterns

- replacement
- automation
- constraint
- filtering
- hiding
- hierarchies



# Goldilocks Systems



Steel, Flora Annie. *English Fairy Tales*. Arthur Rackham, illustrator. New York: Macmillan Company, 1918.

not too hard, not too soft, just right

# conversations

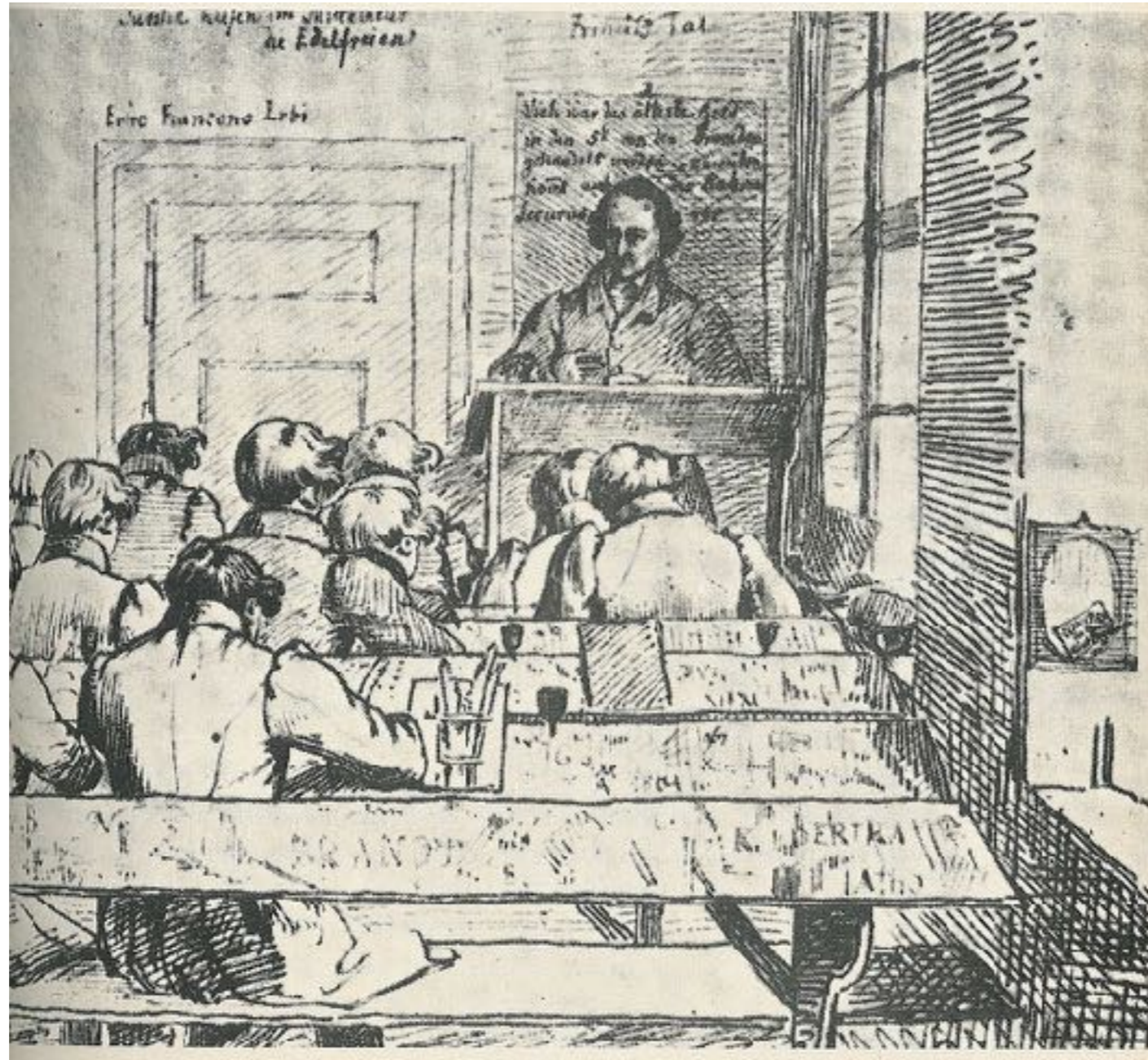


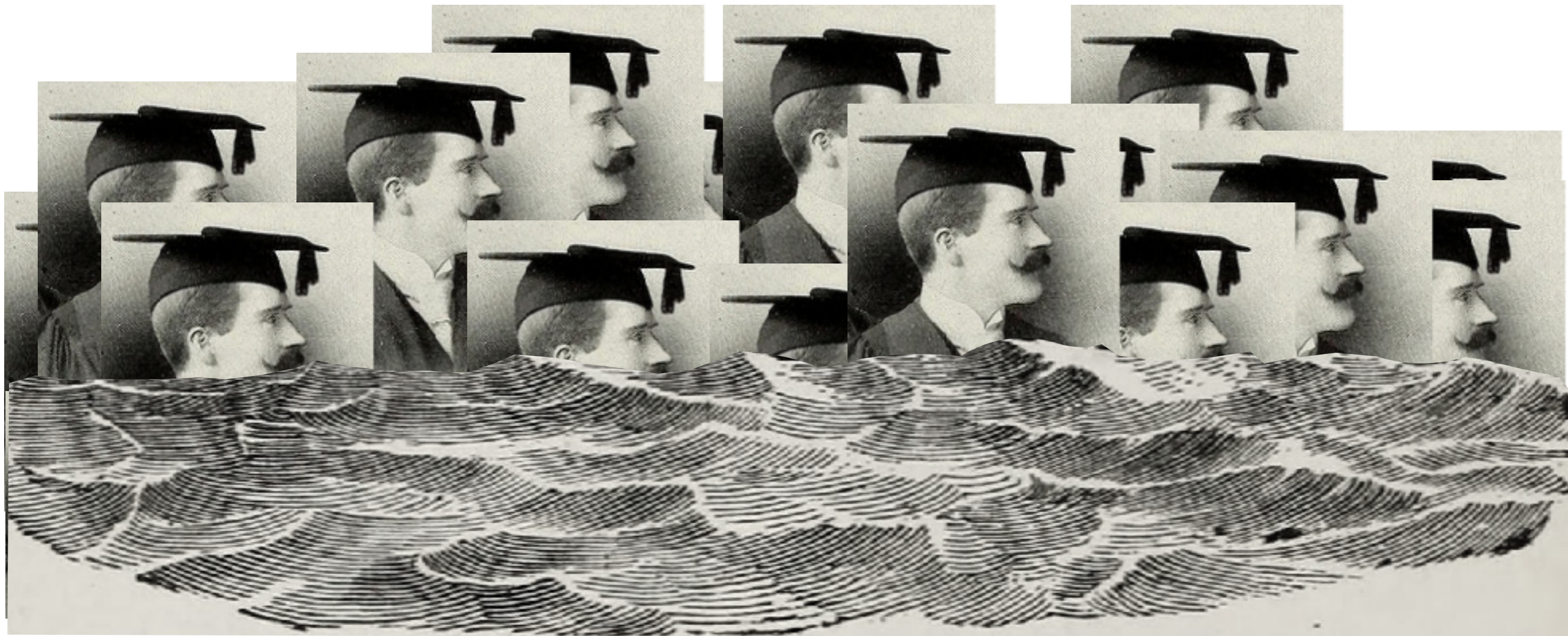
# a dance





# distributed





Online, we are swimming  
in a sea of teachers

# thank you

Landing: [\*https://landing.athabascau.ca/profile/jond\*](https://landing.athabascau.ca/profile/jond)

Home page: [\*http://jondron.org\*](http://jondron.org)

email: [\*jond@athabascau.ca\*](mailto:jond@athabascau.ca)

Twitter: [\*@jondron\*](https://twitter.com/jondron)

