

MOOCs and the Science of Learning #berkman

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A hypothesis:
We have terabytes of data about what students click,



but little understanding about what changes in their heads.

image from [Berklee School of Music](#)

Table 8. Use of Khan Academy at Site 1 by Lower than Predicted and Higher than Predicted Test Score Performance Groups (SY 2011-12)

	Lower than predicted		Higher than predicted		Percent Difference
	Mean	SD	Mean	SD	
Fifth grade					
Minutes***	951	767	1,683	2,042	+76%
Problem sets completed ***	67	39	93	48	+39%
Sixth grade					
Minutes**	866	654	1,032	698	+19%
Problem sets completed***	93	50	113	59	+22%

SD ■ standard deviation.

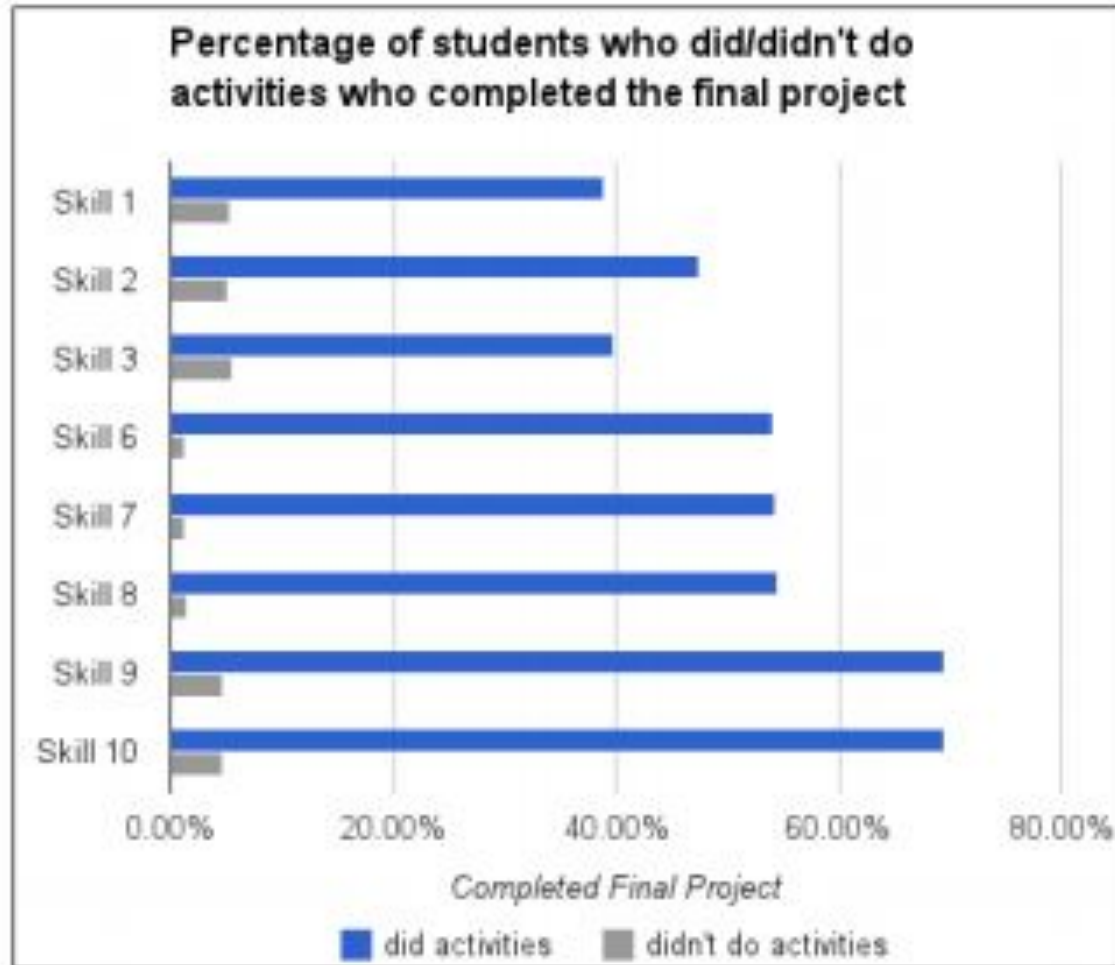
Sample sizes

Fifth grade: Lower than predicted group ■ 223 students; Higher than predicted group ■ 212 students.

Sixth grade: Lower than predicted group ■ 226 students; Higher than predicted group ■ 189 students.

** $p < .01$, *** $p < .001$

from SRI (2014) Khan Academy Implementation Report

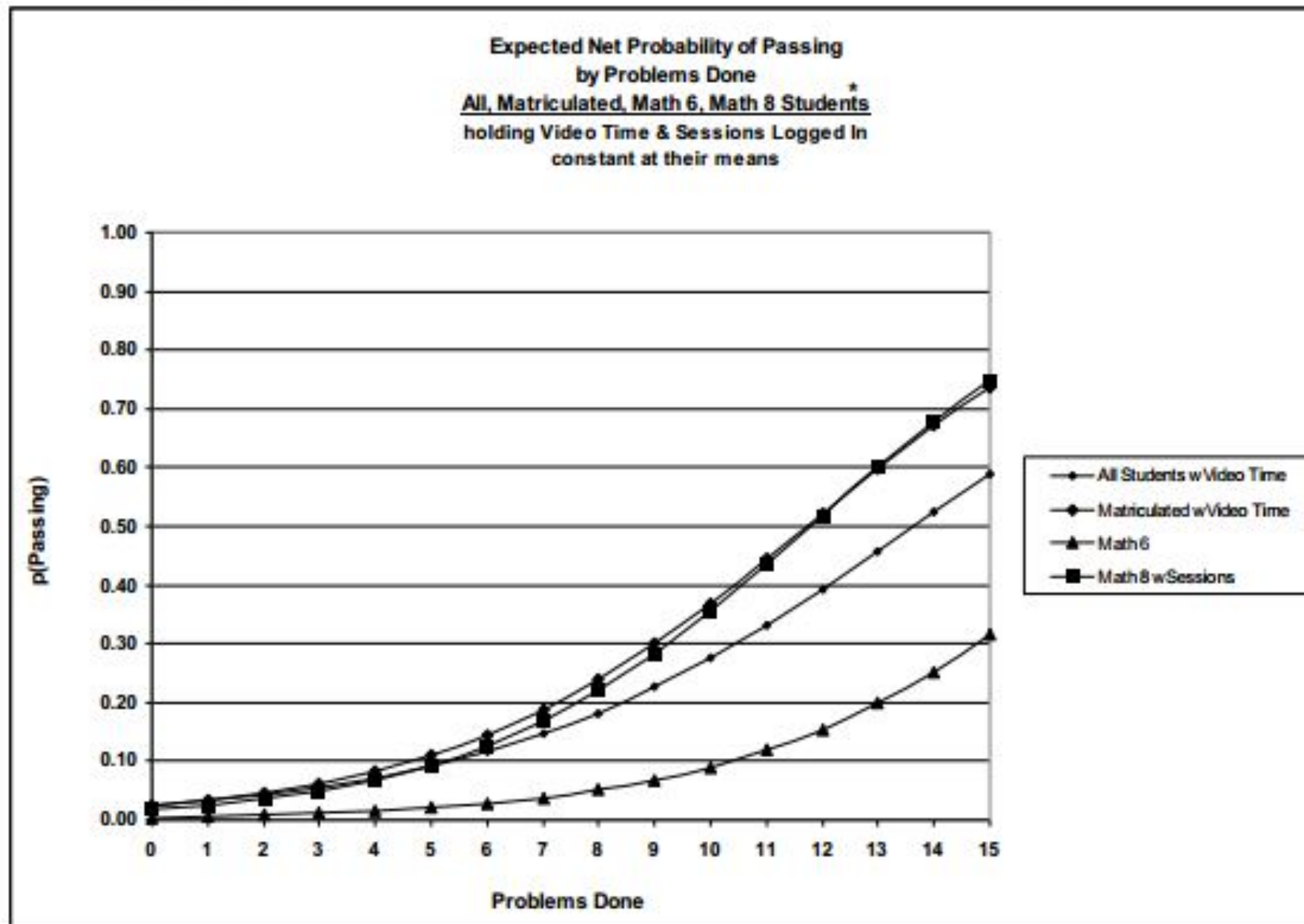


	Did Activities	Didn't Do Activities
Skill 1	39.01%	5.45%
Skill 2	47.53%	5%
Skill 3	39.83%	5.51%
Skill 6	54.07%	1%
Skill 7	54.29%	1%
Skill 8	54.50%	1%
Skill 9	69.58%	4.62%
Skill 10	69.58%	4.62%

Figure 3. Students who did activities and did not do activities who completed final projects

From Wilkowski, Deutsch, Russell, (2014) Student Skill and Goal Achievement in the Mapping with Google MOOC

Figure 4. Expected Net Increase in Probability of Passing with Increase in Problems Done



* All variables are listed by model in the appendix. The graphed variables show effect net of the other variables' effects. A model's significant variables not included in a graph are being held constant at their mean values for each student group.

The primary conclusion from the model, in terms of importance to passing the course, is that measures of student effort eclipse all other variables examined in the study, including demographic descriptions of the students, course subject matter and student use of support services. Although support services may be important, they are overshadowed in the current models by students' degree of effort devoted to their courses. This overall finding may indicate that accountable activity by students--problem sets for example--may be a key ingredient of student success in this environment.

Students who do things in class, pass.

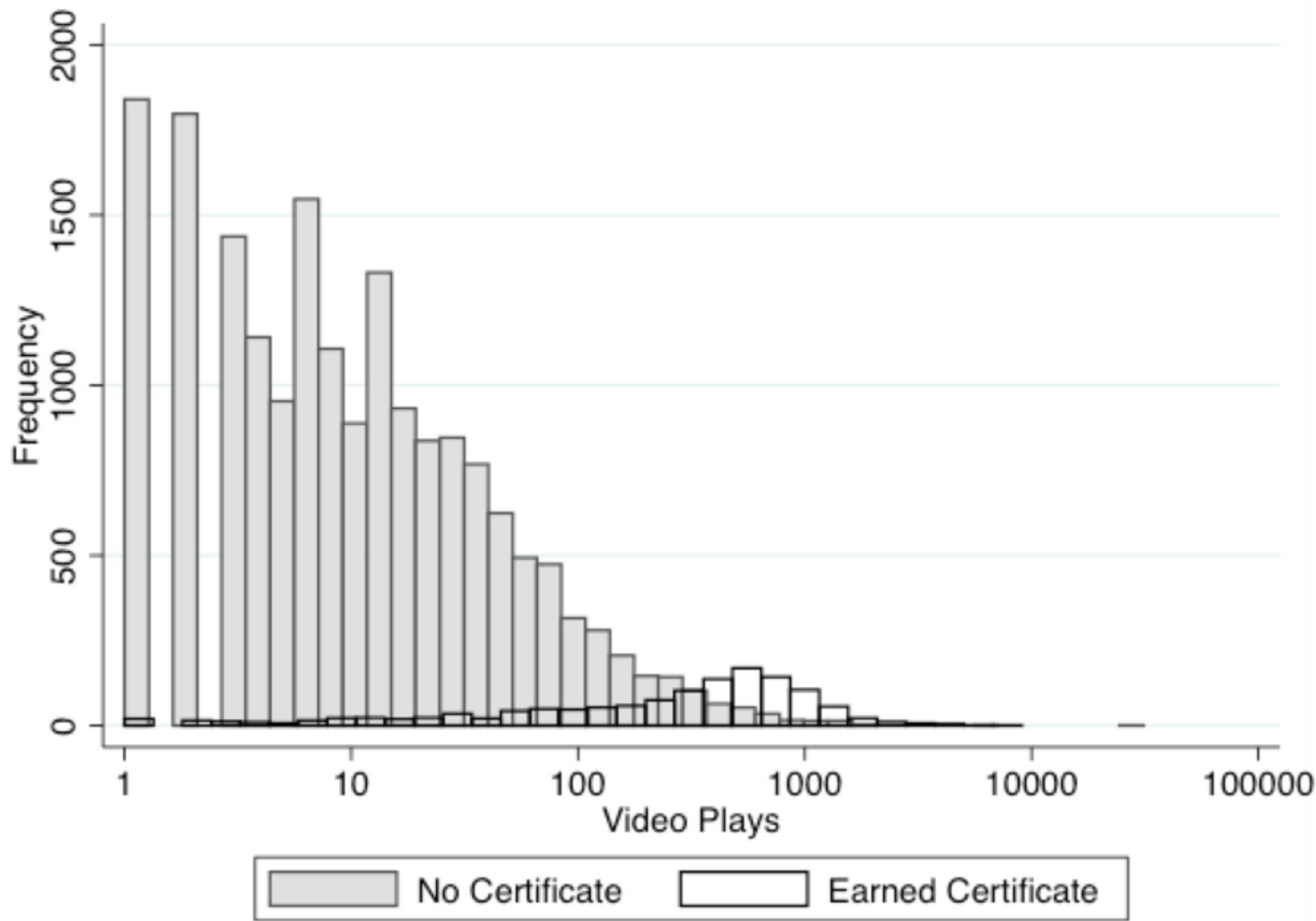


Figure 12: Video play events as captured by edX video player log data for 1,307 certificate earners and 15,008 non certificate-earners who viewed at least one video in the edX player.

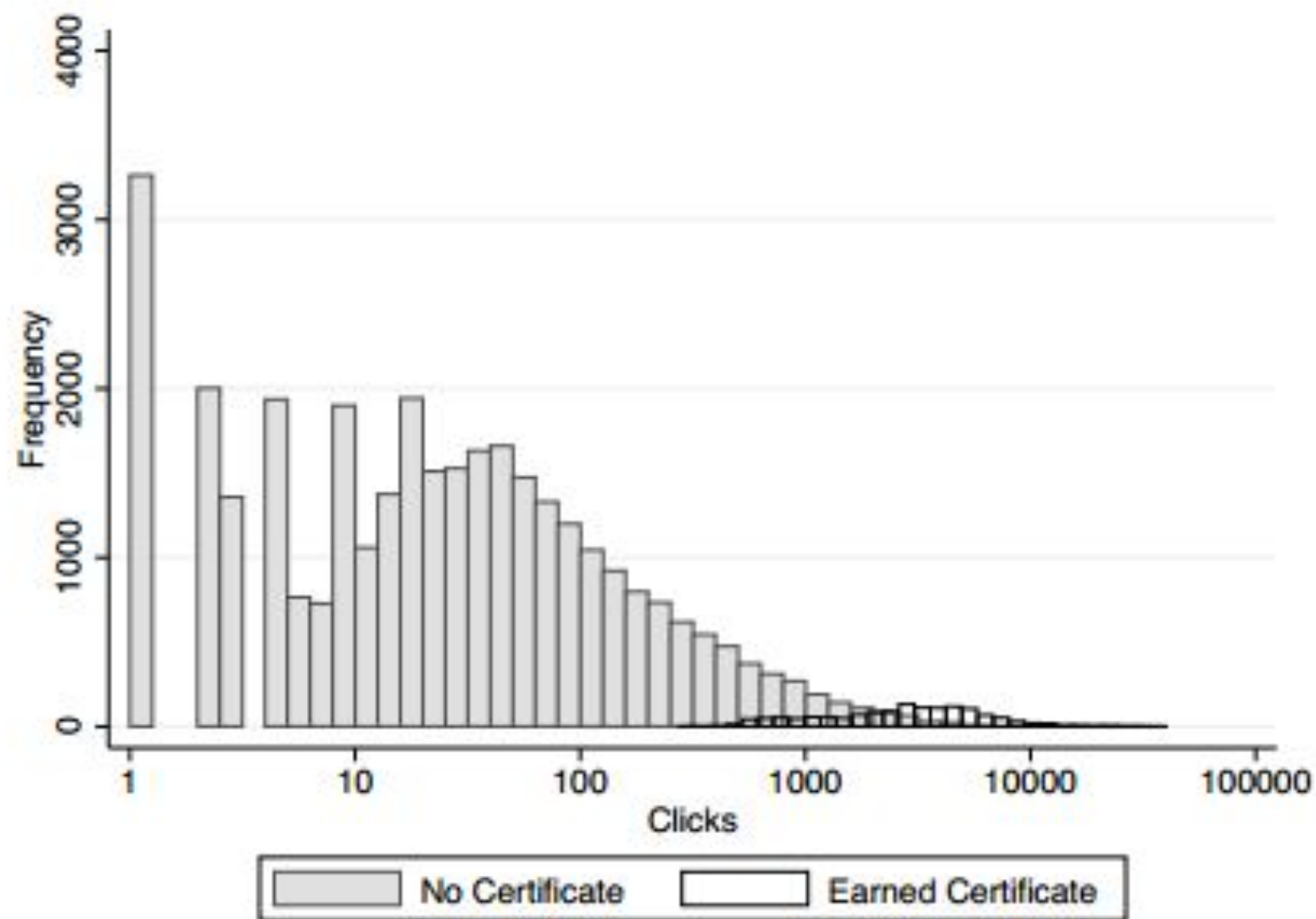


Figure 13: Number of participant clicks (i.e. recorded actions) plotted on a log scale for Heroes certificate earners ($n=1,400$) and non-certificate earners ($n=42,163$).

Reich's Law

- 1) Students who do stuff, do more stuff.
- 2) Students who do stuff,
do better than students who don't do stuff.

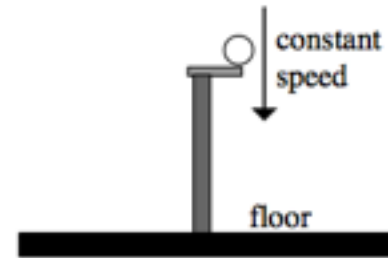


Just make student do more stuf!!!!

Figure 4-3a. Elevator problem that corresponds to several FCI questions from Steinberg and Sabella, "Performance on multiple-choice diagnostics and complementary exam problems," in *The Physics Teacher*.⁴⁷

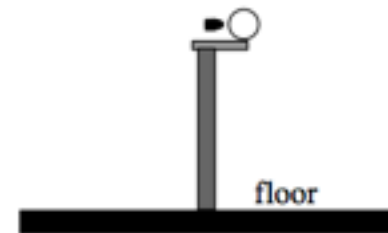
Exam problem 1: Ignore all friction and air resistance in this problem.

A. A steel ball resting on a small platform mounted to a hydraulic lift is being lowered at a constant speed, as shown in the figure at right.

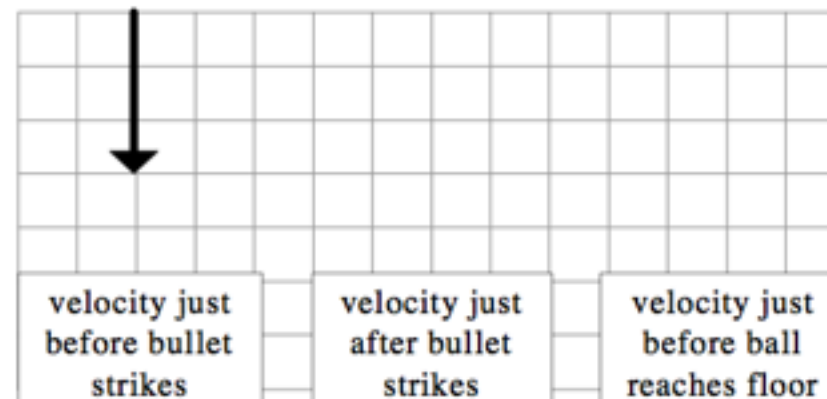


- i. Draw a free body diagram of the ball. Describe each type of force.
- ii. Compare the magnitudes of the forces you have drawn. Explain your reasoning.

B. As the ball is moving down, a bullet moving horizontally hits the exact center of the ball (see figure at right) and then ricochets straight back. This causes the ball to immediately fall off the platform.



- i. Draw a free body diagram of the ball after it is no longer in contact with the bullet or the platform. Describe each type of force.
- ii. A vector that represents the velocity of the ball just before the bullet hits is shown below. Draw vectors that could represent the velocity at each of the 2 other times indicated. The scales of the 3 vectors should be consistent with each other. Explain your reasoning.



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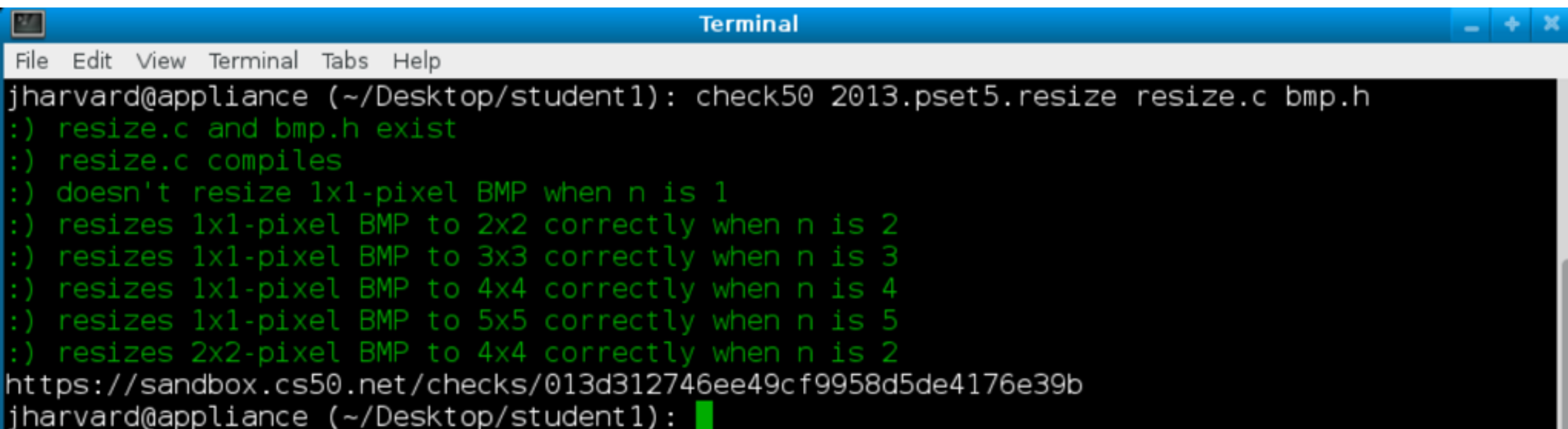
Just make student do more stuf!!!!

Three Ideas for MOOCs and the Science of Learning

- 1) Measure the Most Important Competencies
- 2) Measure Change in Competency over Time
- 3) Carefully Build Chains of Causal Reasoning of How Behavior Affects Learning


```
:( hello.c exists
  \ expected hello.c to exist
:| hello.c compiles
  \ can't check until a frown turns upside down
:| prints "hello, world\n"
  \ can't check until a frown turns upside down
```

```
:) hello.c exists
:) hello.c compiles
:( prints "hello, world\n"
  \ expected output, but not "hello, world"
```



```
Terminal
File Edit View Terminal Tabs Help
jharvard@appliance (~/Desktop/student1): check50 2013.pset5.resize resize.c bmp.h
:) resize.c and bmp.h exist
:) resize.c compiles
:) doesn't resize 1x1-pixel BMP when n is 1
:) resizes 1x1-pixel BMP to 2x2 correctly when n is 2
:) resizes 1x1-pixel BMP to 3x3 correctly when n is 3
:) resizes 1x1-pixel BMP to 4x4 correctly when n is 4
:) resizes 1x1-pixel BMP to 5x5 correctly when n is 5
:) resizes 2x2-pixel BMP to 4x4 correctly when n is 2
https://sandbox.cs50.net/checks/013d312746ee49cf9958d5de4176e39b
jharvard@appliance (~/Desktop/student1):
```

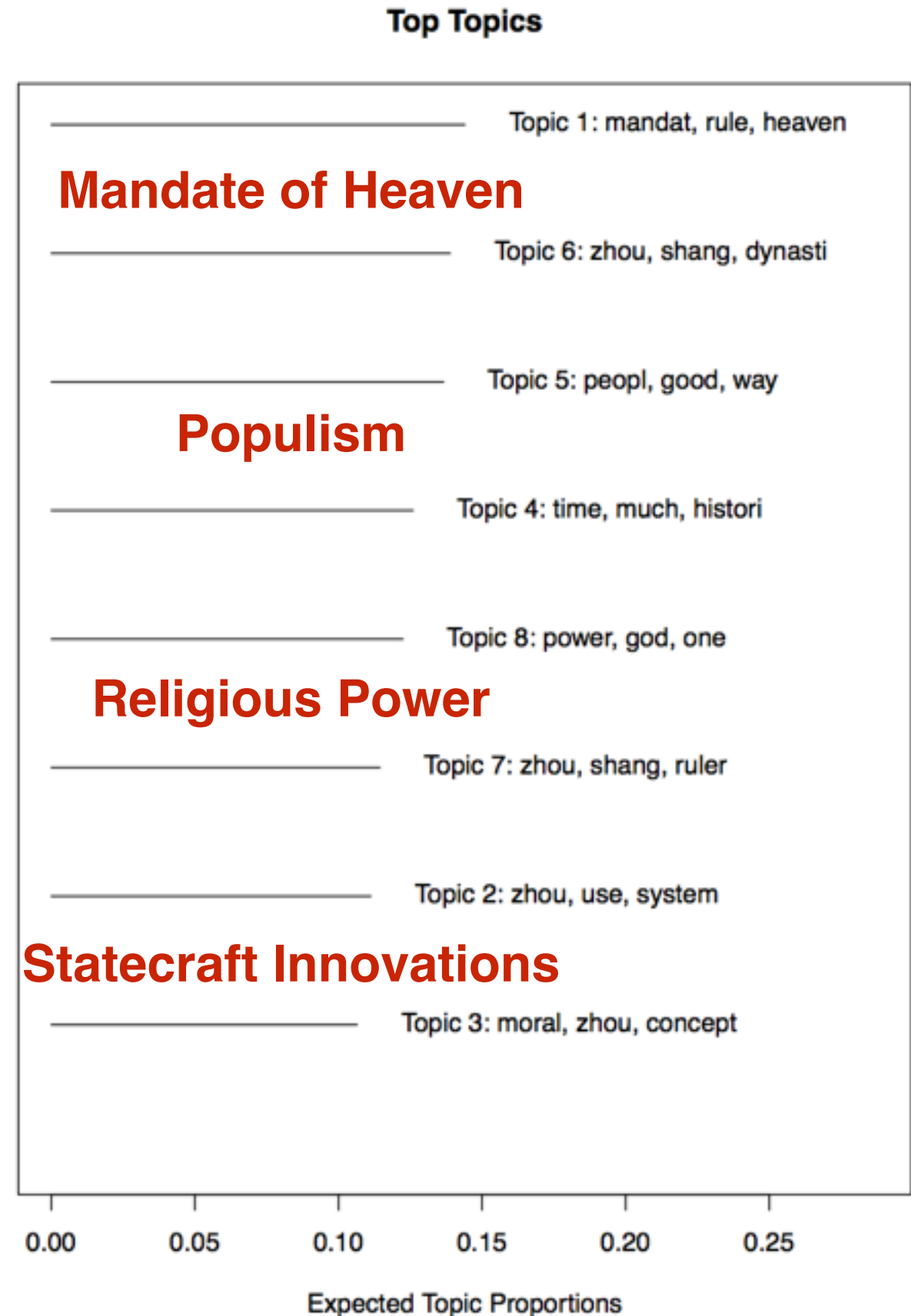
In your answer to this second question, do you see the word *mūthos* 'words' functioning as:

mūthos - a story made for heroes by the gods

mūthos - a story that heroes make for themselves

mūthos - a story that is both made for heroes by the gods and re-made by heroes whenever they tell the story

<p>Topic 1 : mandat, rule, heaven, legitim, zhou, ruler, shang, subject, also, given, continu, justifi, base, power, virtu, away, rather, prefer, idea, sens</p>
<p>Topic 2 : zhou, use, system, write, new, creat, polit, societi, choos, ritual, civil, develop, shang, base, bronz, form, human, religi, today, religion</p>
<p>Topic 3 : moral, zhou, concept, seem, idea, govern, agre, legitimaci, well, zhous, rule, mandat, heaven, also, introduc, peopl, standard, support, respons, act</p>
<p>Topic 4 : time, much, histori, even, look, chines, know, like, mani, china, think, zhou, period, interest, still, actual, see, probabl, one, someth</p>
<p>Topic 5 : peopl, good, way, think, make, live, better, govern, king, zhou, import, need, thing, believ, also, countri, leader, life, care, choos</p>
<p>Topic 6 : zhou, shang, dynasti, king, god, mandat, heaven, use, also, divin, better, last, legitim, believ, propaganda, made, corrupt, bone, model, becam</p>
<p>Topic 7 : zhou, shang, ruler, system, model, peopl, rule, state, right, offer, pick, might, give, later, reason, found, object, heaven, accord, account</p>
<p>Topic 8 : power, god, one, can, ancestor, will, shang, just, rule, want, control, keep, differ, like, communic, howev, peopl, famili, chang, come</p>



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Computing Readiness Pre-Test

In a counting system used by intelligent apes,

A banana = 1;

6 is represented by an orange and 2 bananas;

An orange is worth half a mango.

What is the value of two mangos, an orange and a banana?

Gerhard Sonnert, Philip Sadler



HARVARD-SMITHSONIAN
CENTER FOR ASTROPHYSICS

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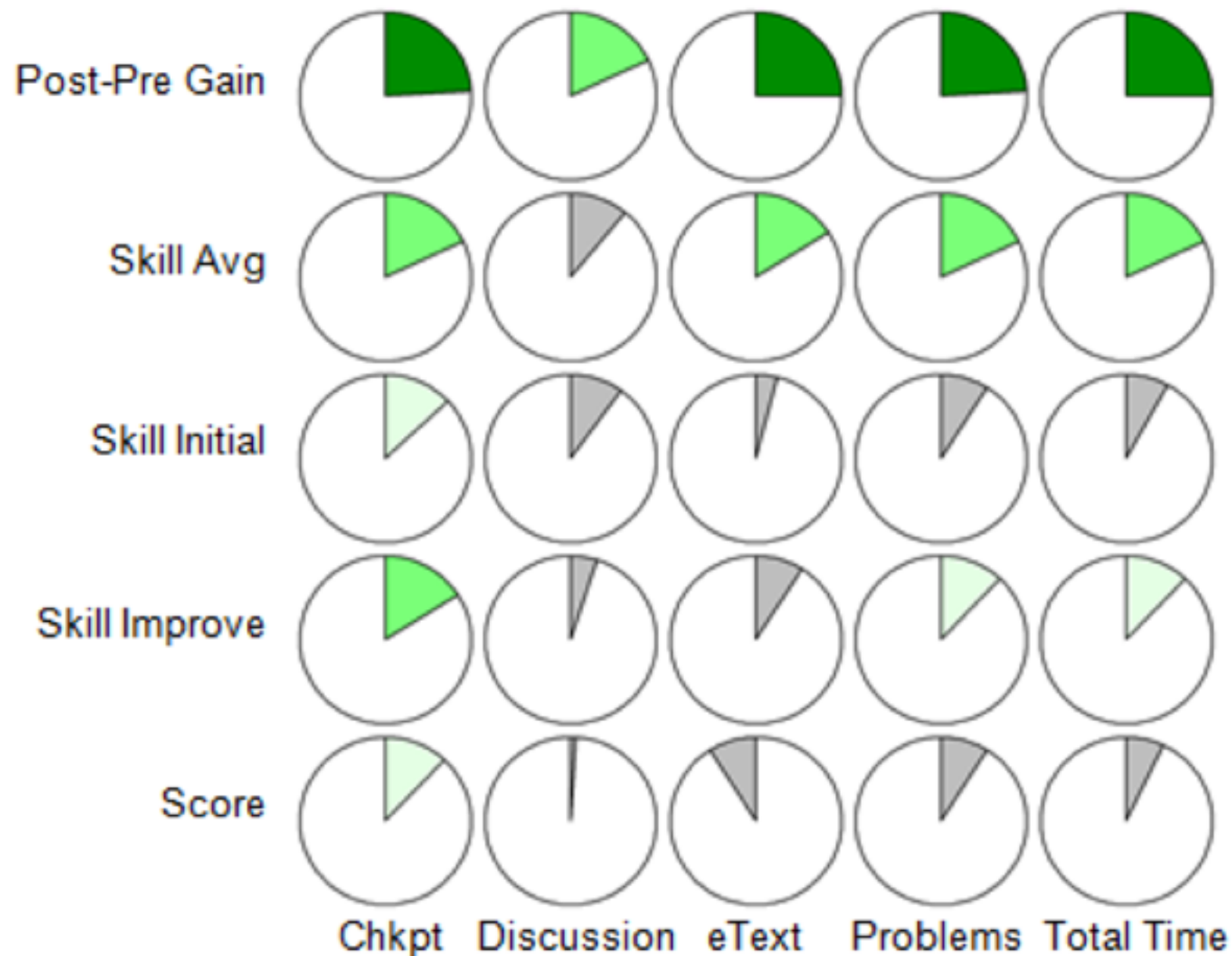


Figure 4: 8.MReV Correlations of Measures of Skill and Log of Time on Tasks (n=292)

Correlating Skill and Improvement in 2 MOOCs
 with a Student's Time on Tasks
 Champaign, et al (2014)

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Fishing in the Exhaust



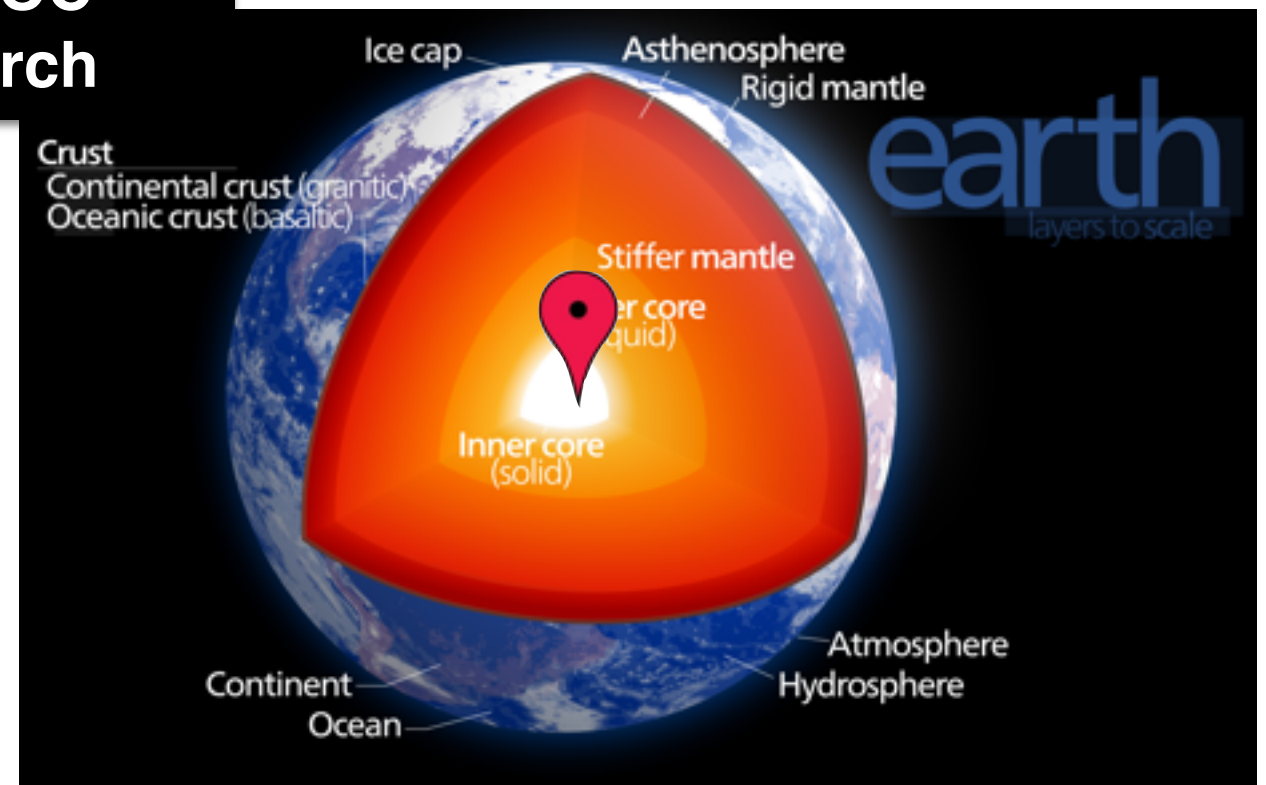
Experiments in the Periphery



Four Kinds of MOOC Research



Observations in the Field



Design Research in the Core

EdTech RESEARCHER



[The State of MOOCs: An EdTech Researcher Retrospective](#)

[Summarizing all MOOCs on One Slide](#)

[MOOCs as Three Kinds of LMS](#)

[MOOC: Textbook or Course](#)

[MOOC Killer Apps: Autograder vs. Syndication Engine](#)

[On our cMOOC inspired site for the Future of Learning Institute](#)

[Research Questions for HarvardX](#)

[Will Free Benefit the Rich?](#)

[MOOCs and High Education's Non-Consumers](#)

[Four Types of MOOC Research](#)

[The Learning of a MOOC Dropout](#)

[Dear Discourse, Let's Start Over, Love MOOCs](#)

[Picture Pages: The Original Toddler ProtoMOOC](#)

Four Ideas for MOOCs and the Science of Learning

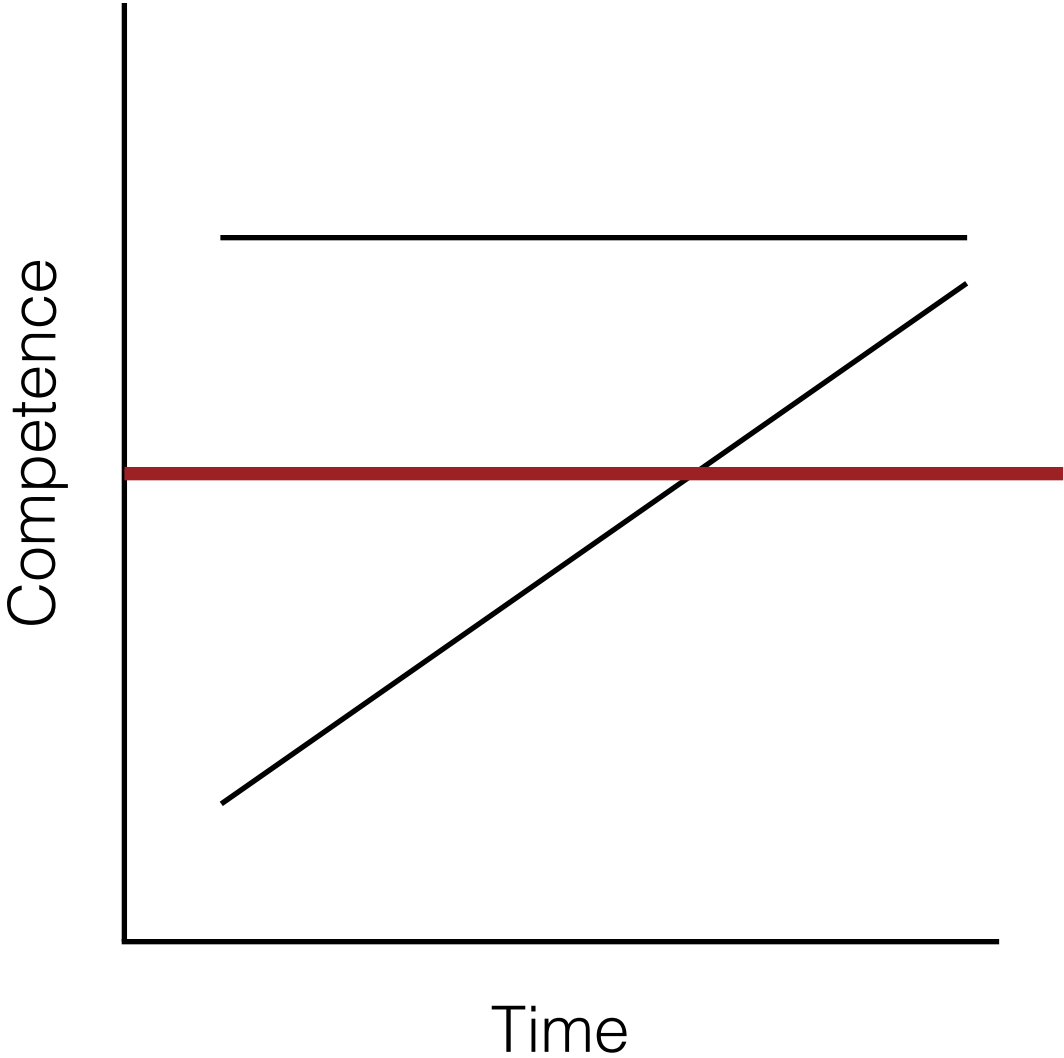
1) Define Learning Capaciously

2) Measure the Most Important Competencies

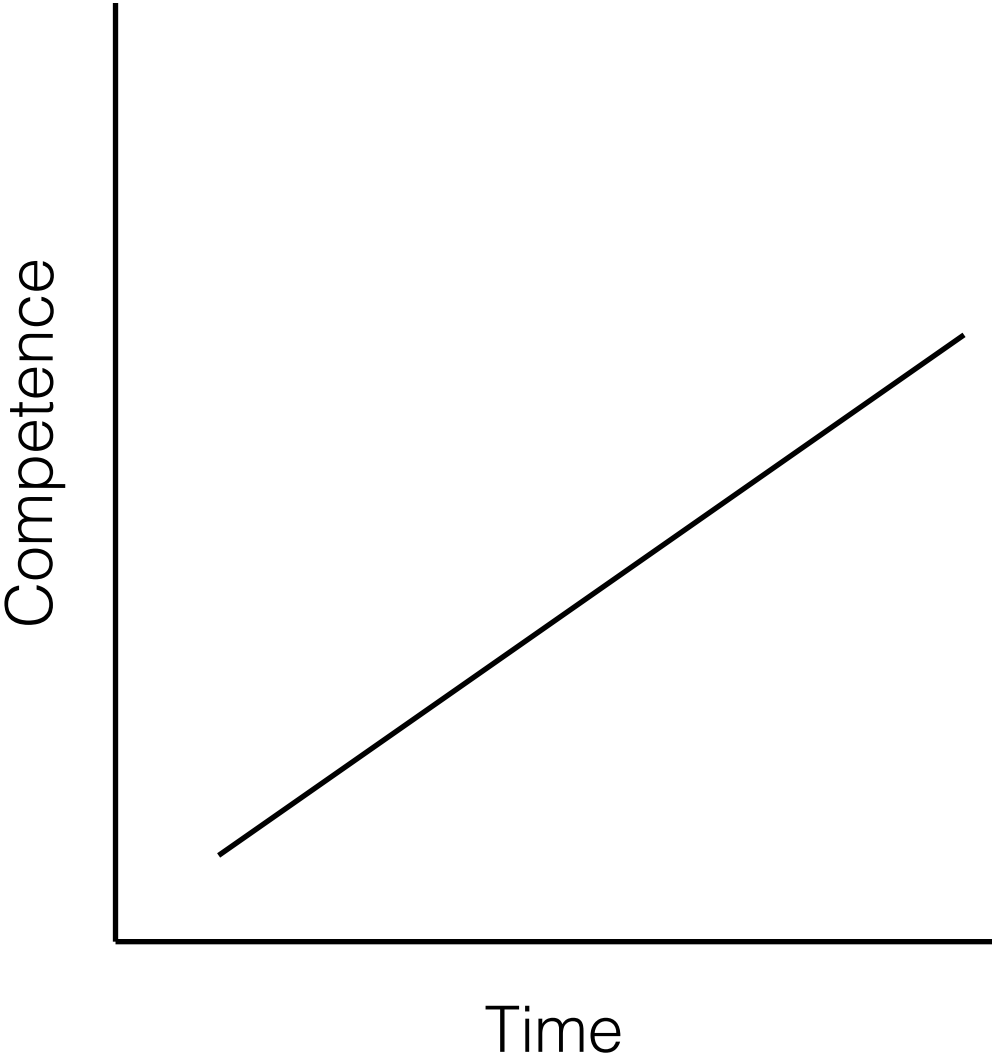
3) Measure Change in Competency over Time

4) Carefully Build Chains of Causal Reasoning

Evidence of learning is a change in level of competence.

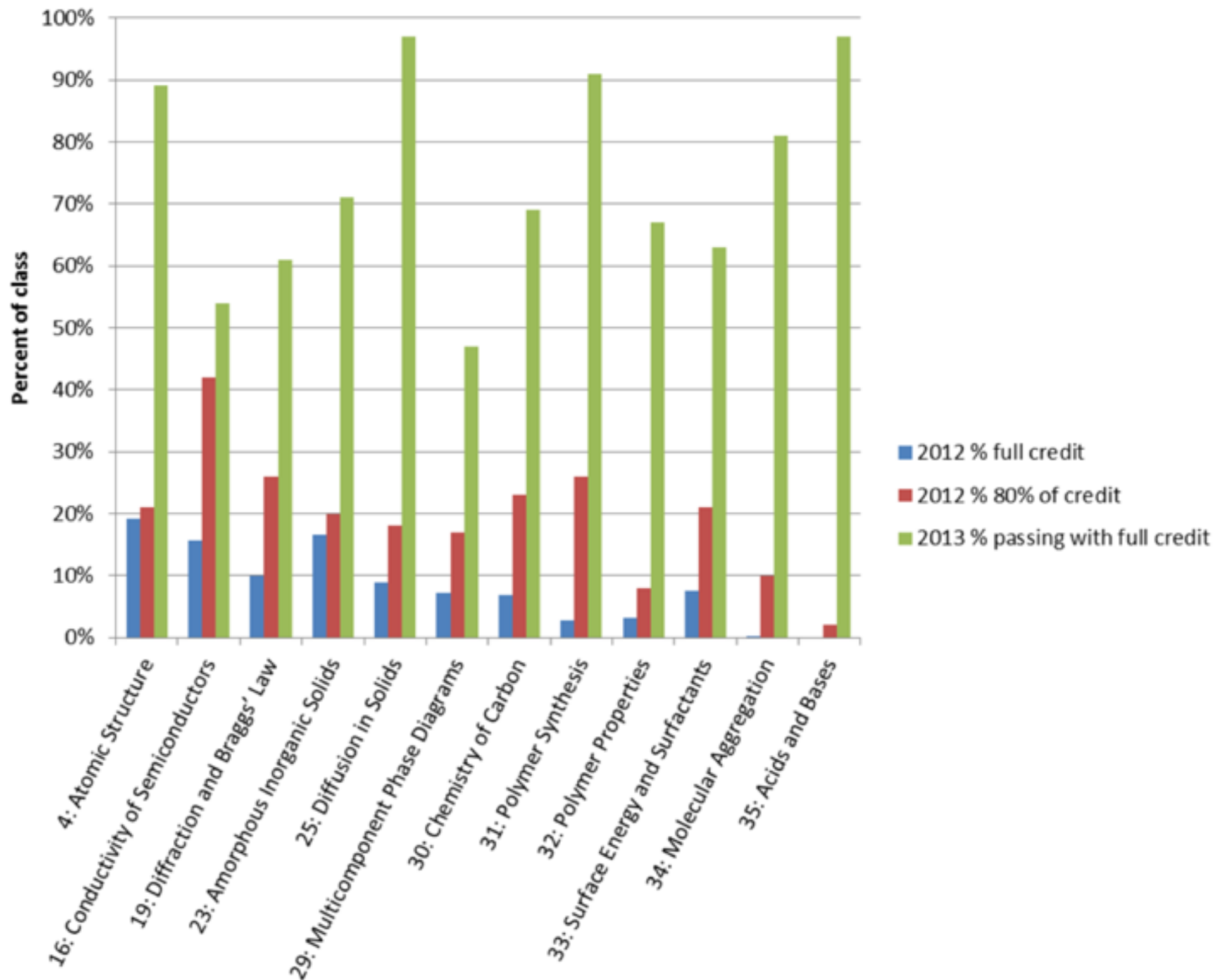


Certifying Competence



Maximizing Learning

Outcomes: 2012 versus 2013



Direct comparison of the 2012 outcomes with corresponding outcomes for 2013.

MIT 3.091 Data Courtesy of Michael Cima



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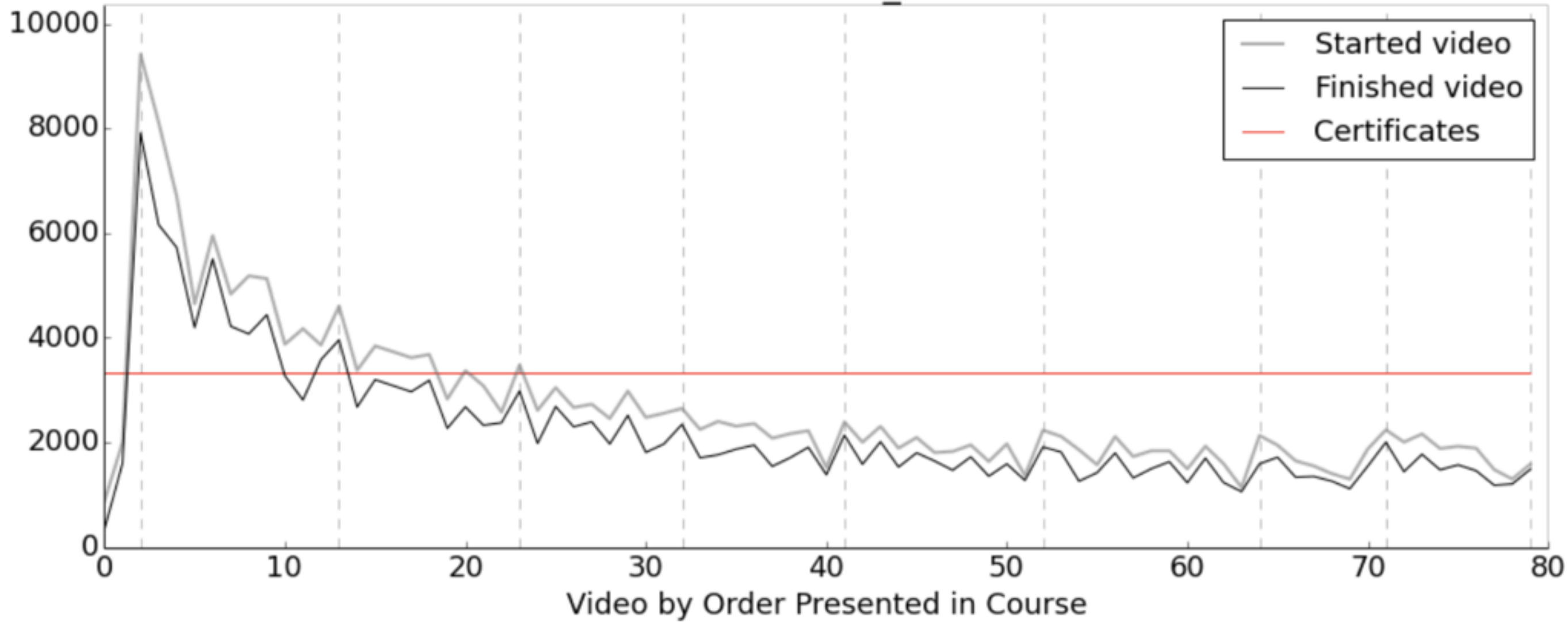
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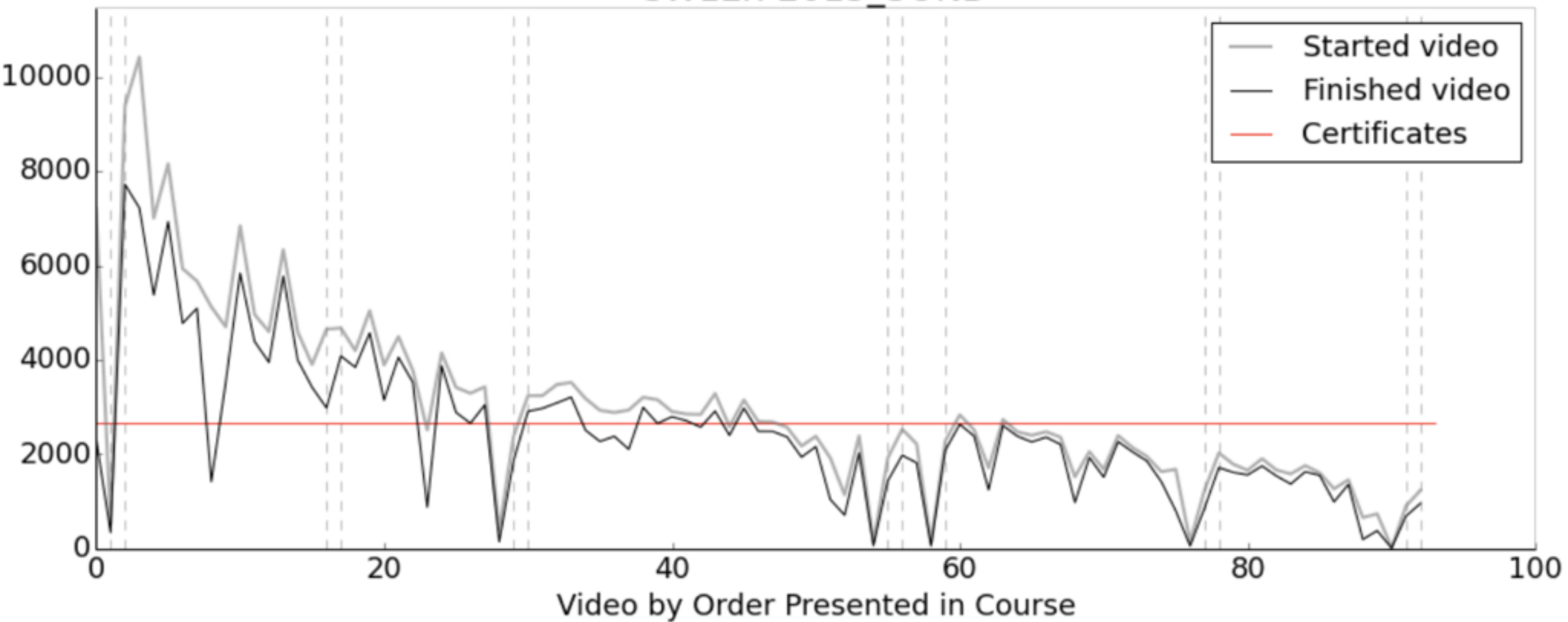
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PH201x-2013_SOND



SW12x-2013_SOND



CB22x-2013_Spring

