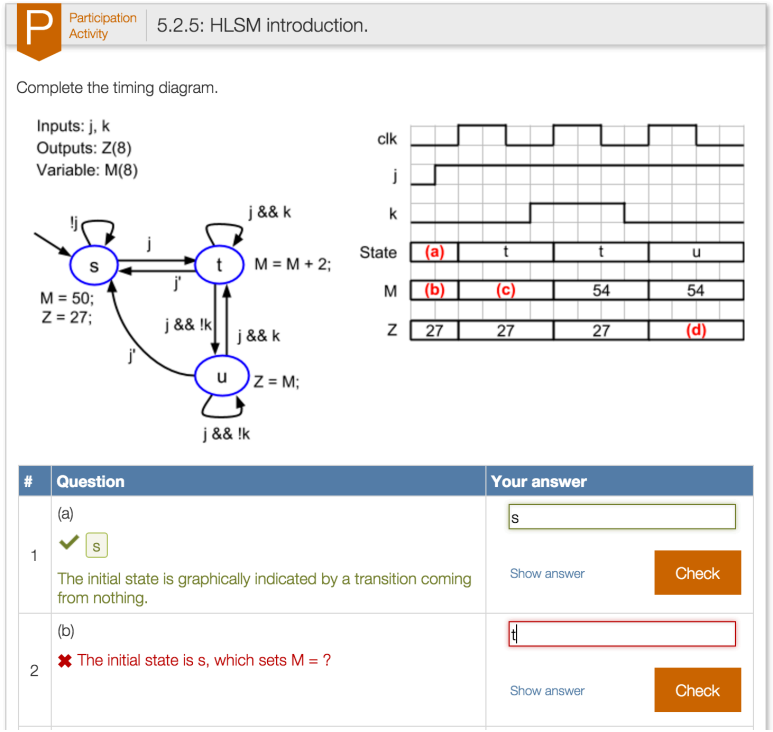
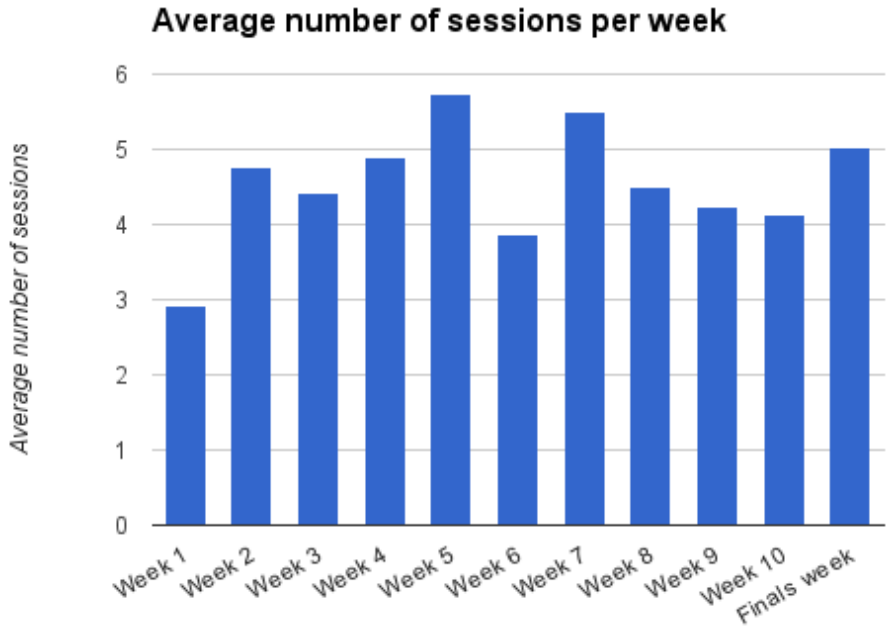
Student Usage and Behavioral Patterns with Online Interactive Textbook Materials





Alex Edgcomb[1,3], Daniel de Haas[3], Roman Lysecky[2,3], Frank Vahid[1,3]

[1]Dept. of Computer Science and Engineering, University of California, Riverside (USA)

[2]Dept. of Electrical and Computer Engineering, Univ. of Arizona

[3]zyBooks, Los Gatos, California

Interactive textbook – Less text

1.9 Equations to/from circuits

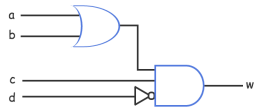
An equation is just one way to represent a Boolean function. Another way is using a circuit.

An equation can be converted to a circuit by converting each operation to a gate. Conversion is done first for items within parentheses. NOT is converted before AND or OR.

Participation Activity 1.9.1: Convert equation to circuit.

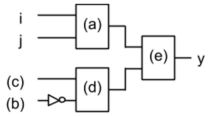
Start

w = (a + b)cd'



Feedback?

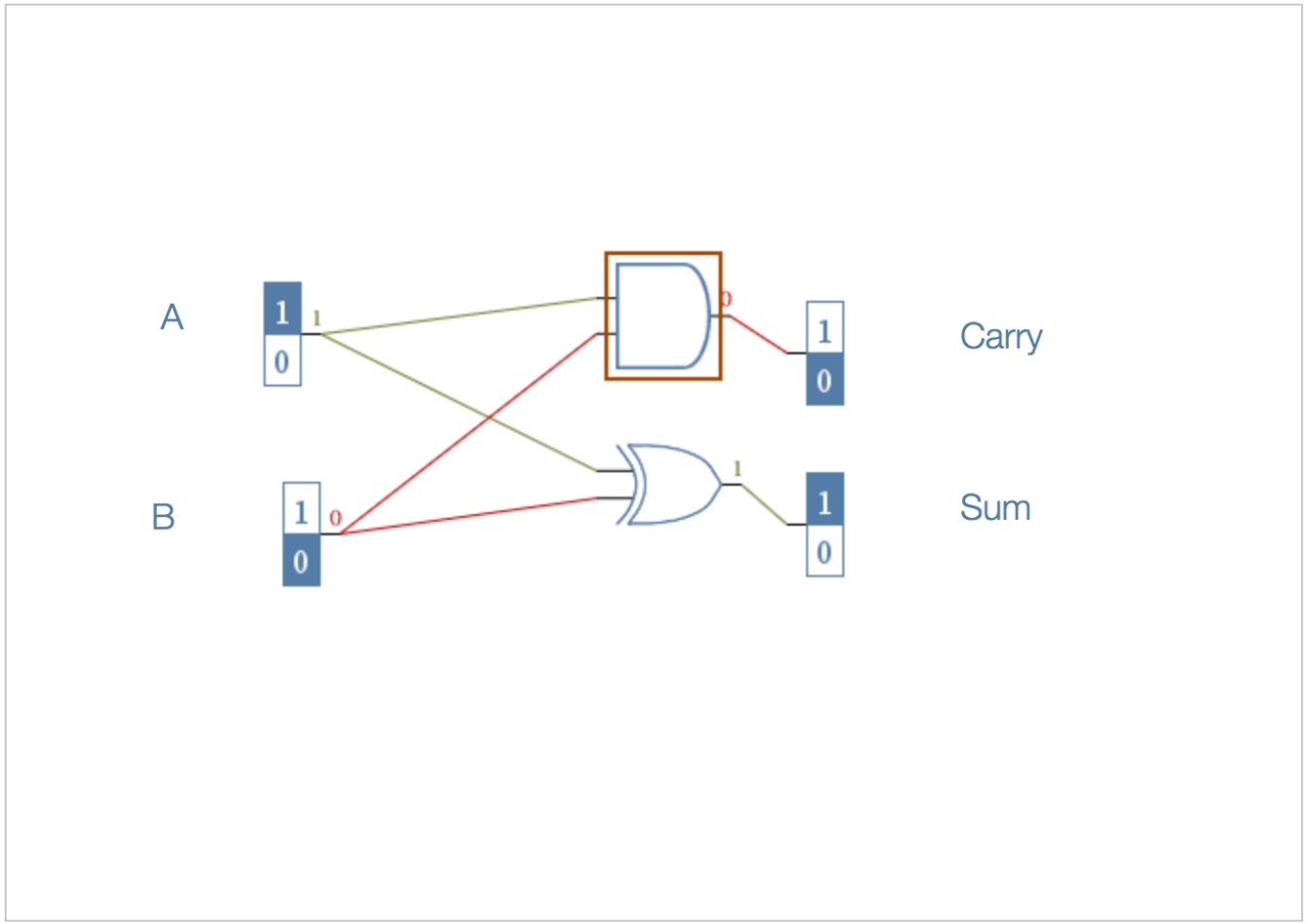
Participation Activity 1.9.2: Converting an equation to a circuit.



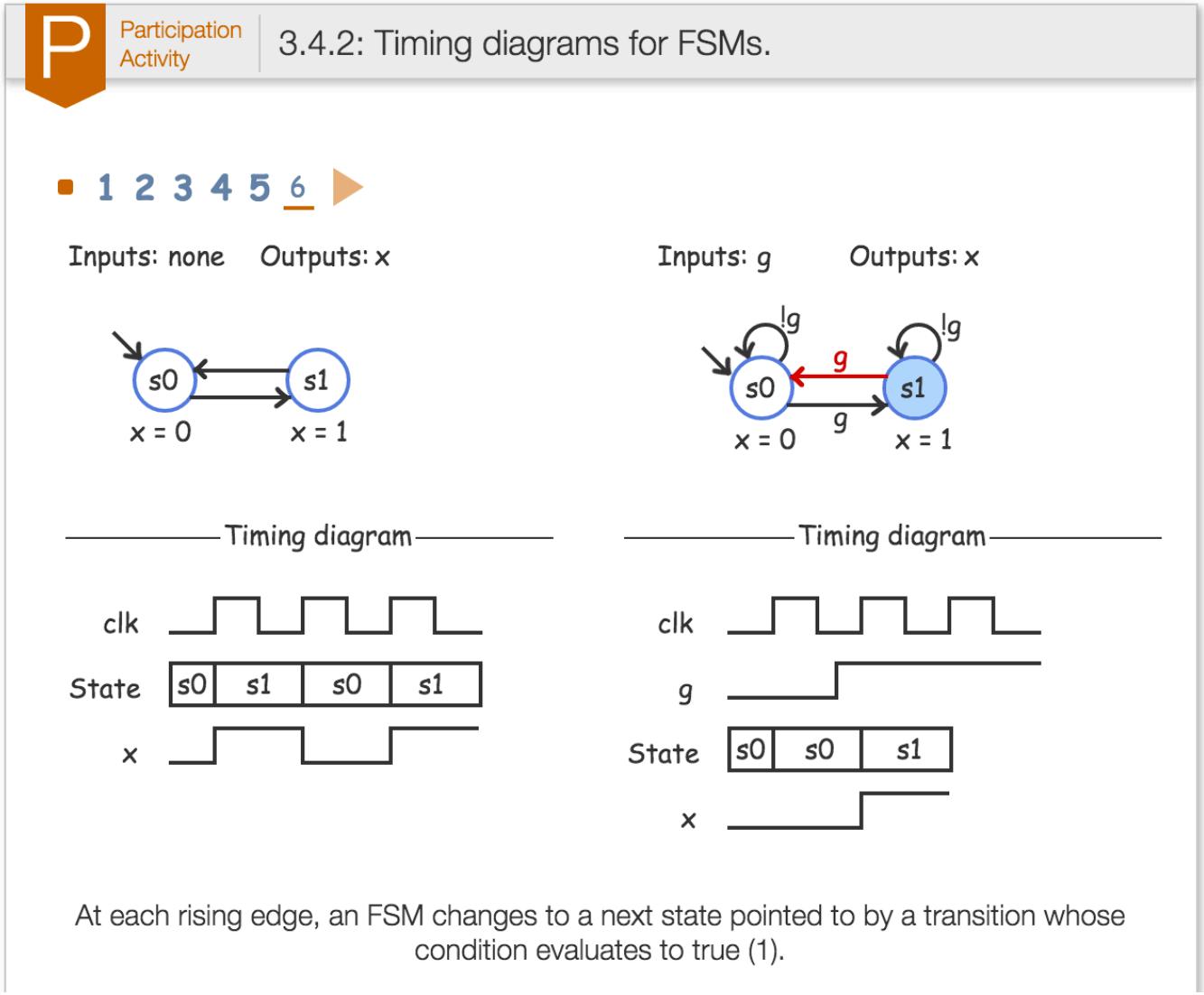
Use the figure above to determine the missing value.
Original equation: y = ij + mn'

#	Question	Your answer
1	(a)	AND
		OR
		NOT
2	(b)	m
		n
		mn'
		i
	(c)	m
		n

Interactive textbook – Simulators



Interactive textbook – Animations

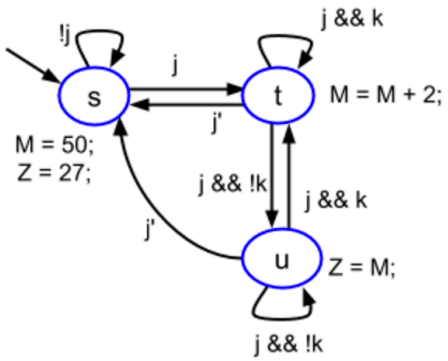


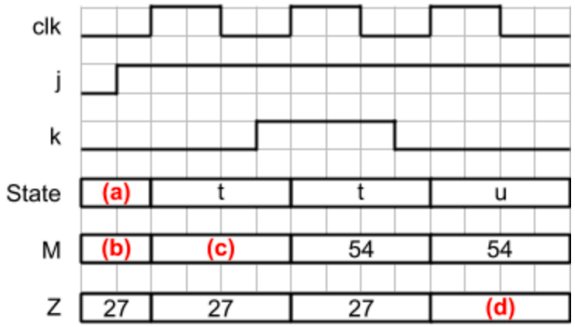
Interactive textbook – Learning questions

Participation Activity | 5.2.5: HLSM introduction.

Complete the timing diagram.

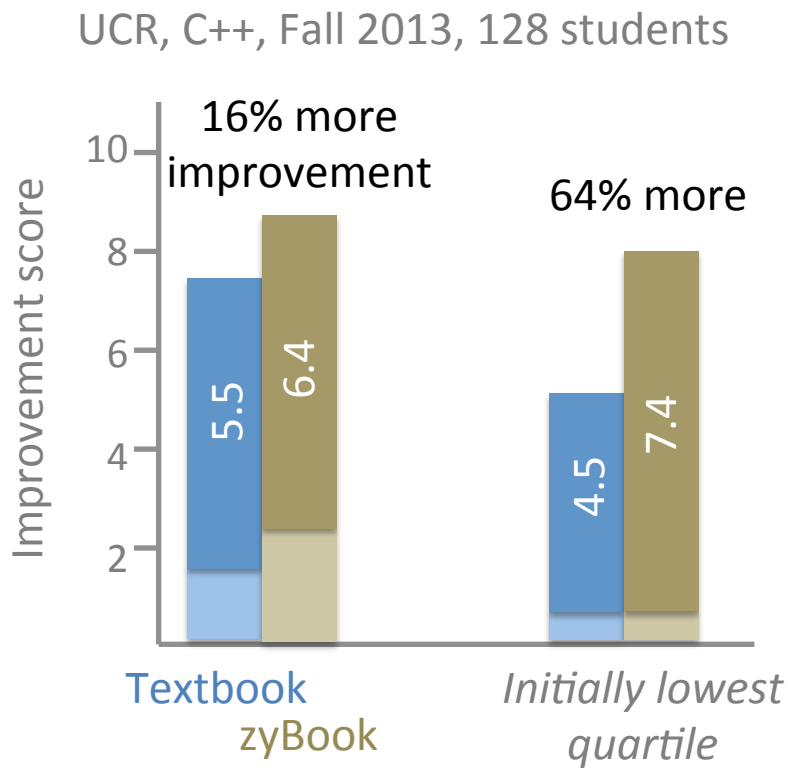
Inputs: j, k
Outputs: Z(8)
Variable: M(8)





#	Question	Your answer
1	(a) ✔ s The initial state is graphically indicated by a transition coming from nothing.	s Show answer Check
2	(b) ✖ The initial state is s, which sets M = ?	t Show answer Check

Research: Online textbook vs. zyBook [1]



86%
More time voluntarily spent

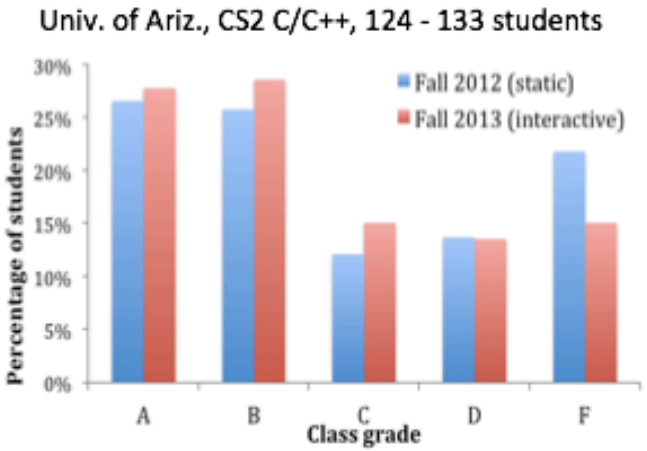
2014 Best Paper Award

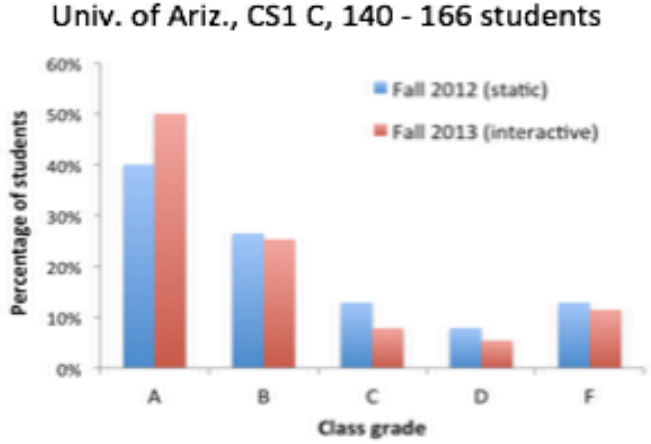
Students randomly assigned zyBook/textbook
Improvement score = post-test minus pre-test

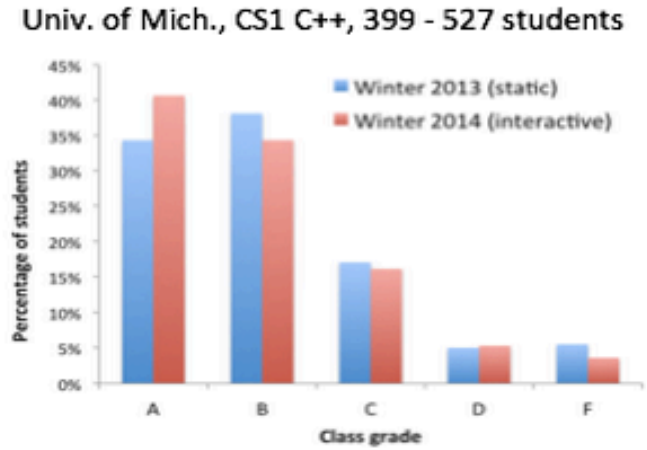
[1] Edgcomb, A., F. Vahid. Effectiveness of Online Textbooks vs. Interactive Web-Native Content, Proceedings of ASEE Annual Conference, 2014.

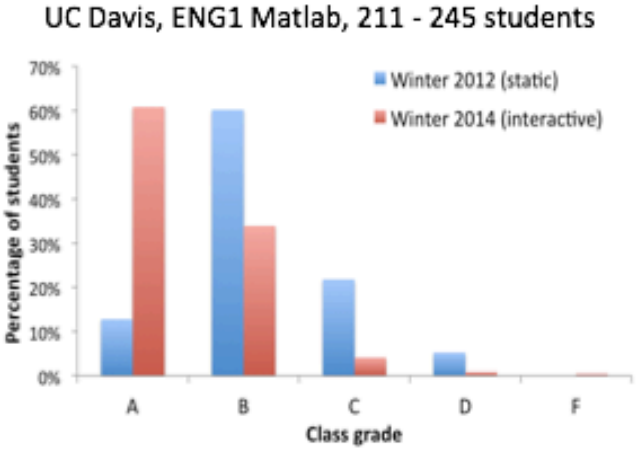
Research: Switching from textbook to zyBook (no other change)

2,000 students, 3 universities, 4 classes [2]









14% ↑
Letter grade (4.0 scale)

14% ↑
Exams

8% ↑
Projects

2015 Best Paper Award

[2] Edgcomb, A., F. Vahid, R. Lysecky, A. Knoesen, R. Amirtharajah, and M.L. Dorf. Student Performance Improvement using Interactive Textbooks: A Three-University Cross-Semester Analysis, Proceedings of ASEE Annual Conference, 2015.

Student usage/behavior patterns?

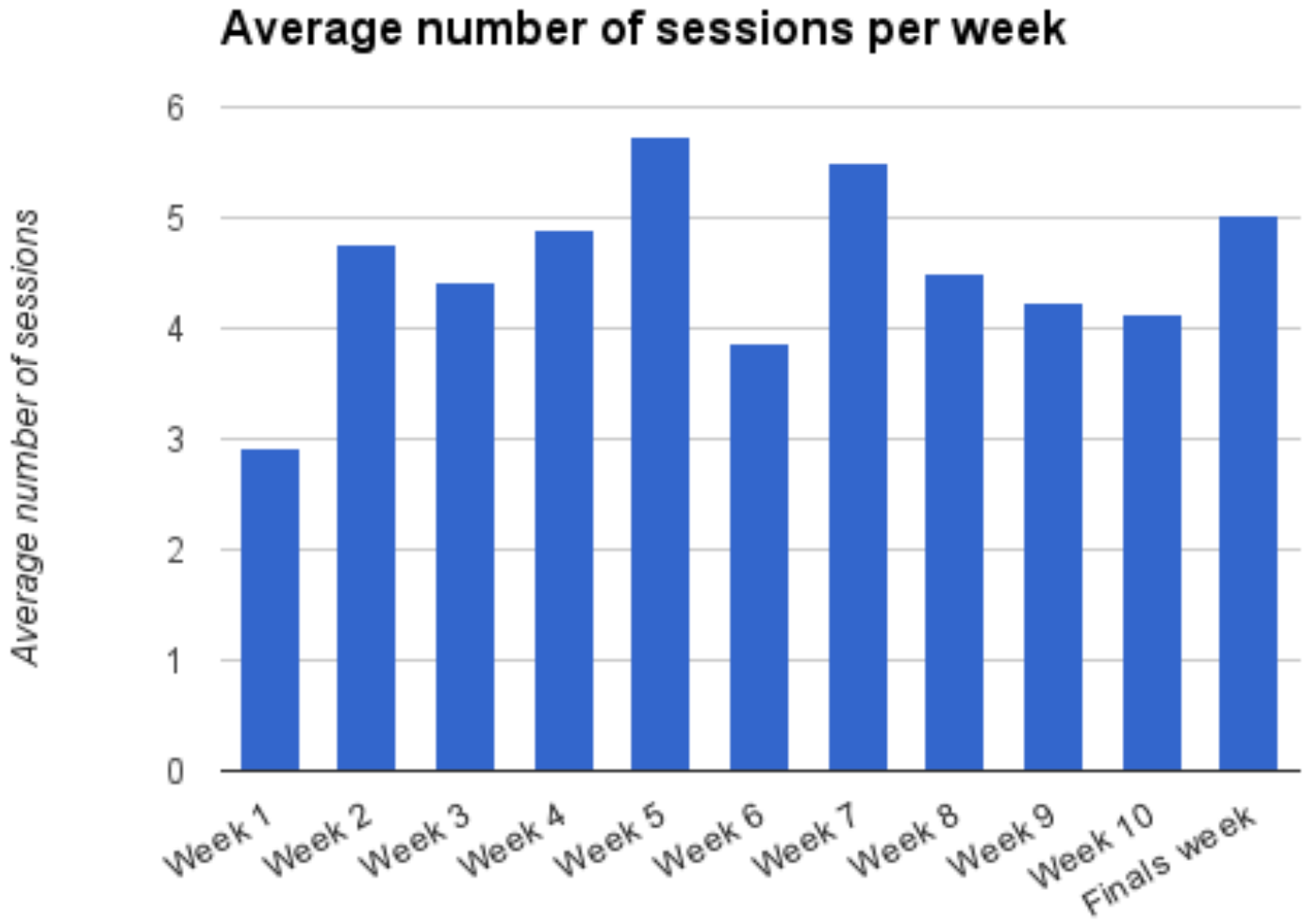
- Good study behavior?
  - How often do students use the books?
  - How much time per study session?
  - How is time spent?

- 581 students across two research universities
  - 282 in intro to computer science (CS1)
    - Included interactive homework
  - 299 in intro to discrete math (DM1)

- Assigned-reading completion: 90% interactive
- Acquisition: 99.8% interactive vs. 70% traditional [3]

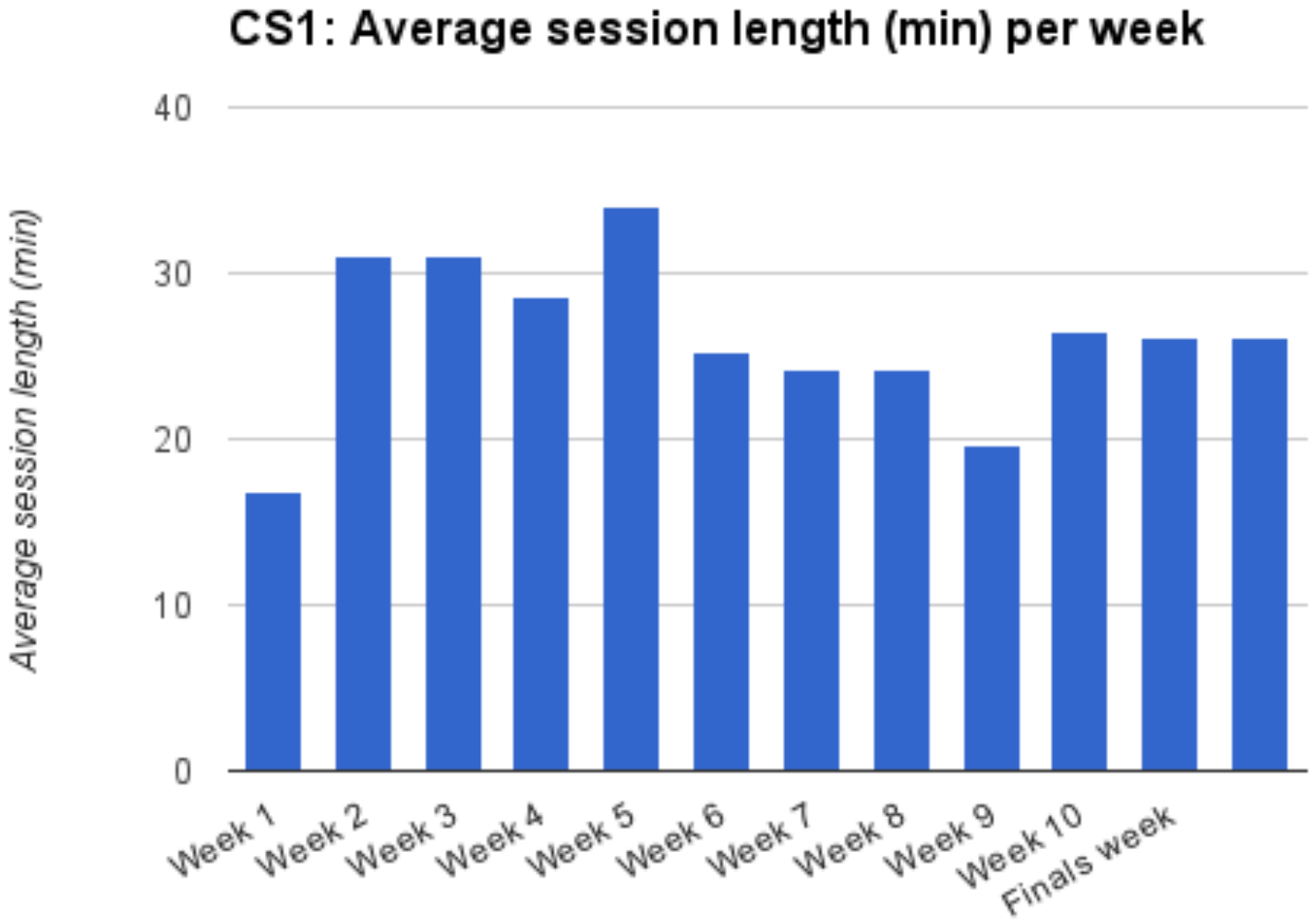
[3] Hobson, E.H. Getting students to read: Fourteen tips. Idea Paper 40: 1-10, 2004.

How often do students use the book?

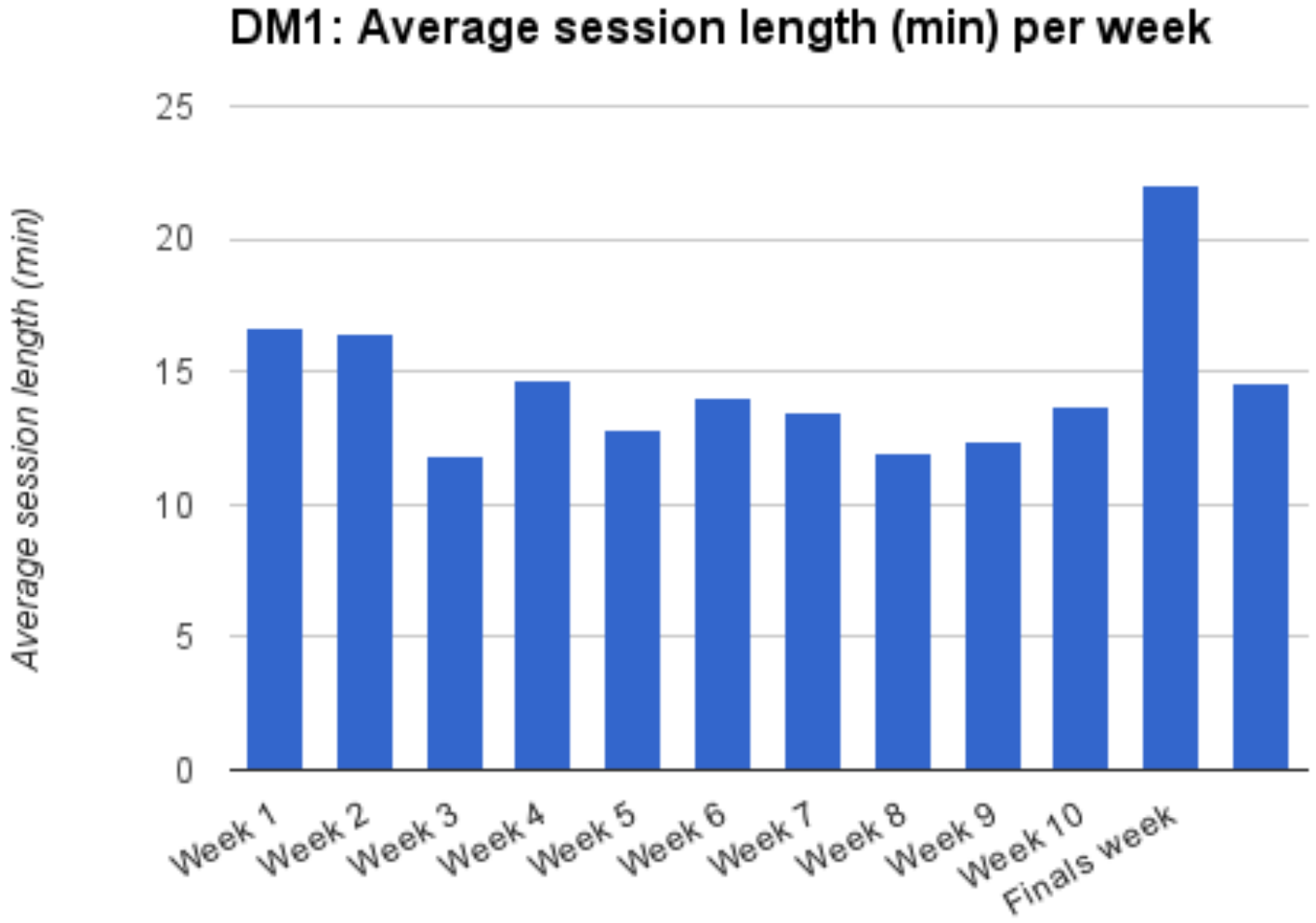


How much time per study session?

(with interactive homeworks)



How much time per study session?
(without interactive homeworks)

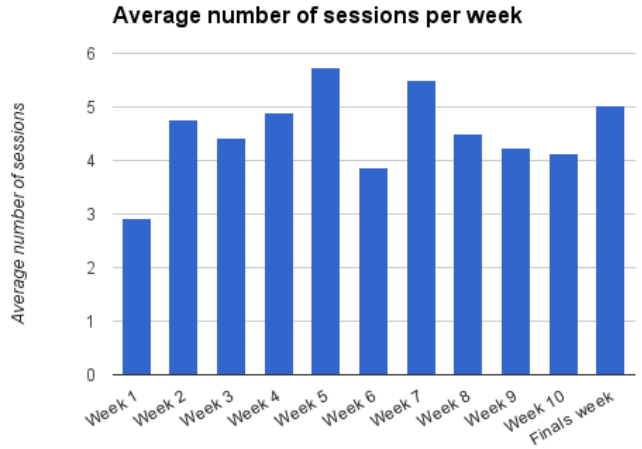


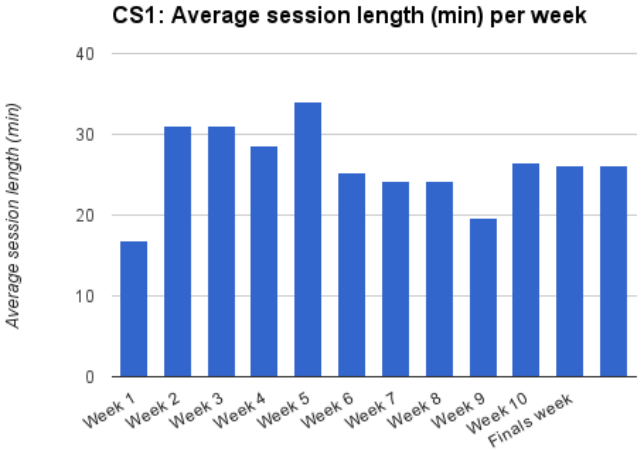
How is time spent?

- Categories: Activities, or reading (text/figures)
  - Reading includes time away from computer
- CS1: 31% activities / 69% reading
  - Activities included homework
- DM1: 17% activities / 83% reading

Conclusion

- 99.8% acquisition
- 90% reading completion
- 4.5 accesses / week
- 20 mins / access
- Future work: Improve usage patterns, measure impact of each interactive element type (ex: animation) compared to a static element (ex: multi-part figure)





We are grateful for support of this research by the NSF and Google.

Questions?