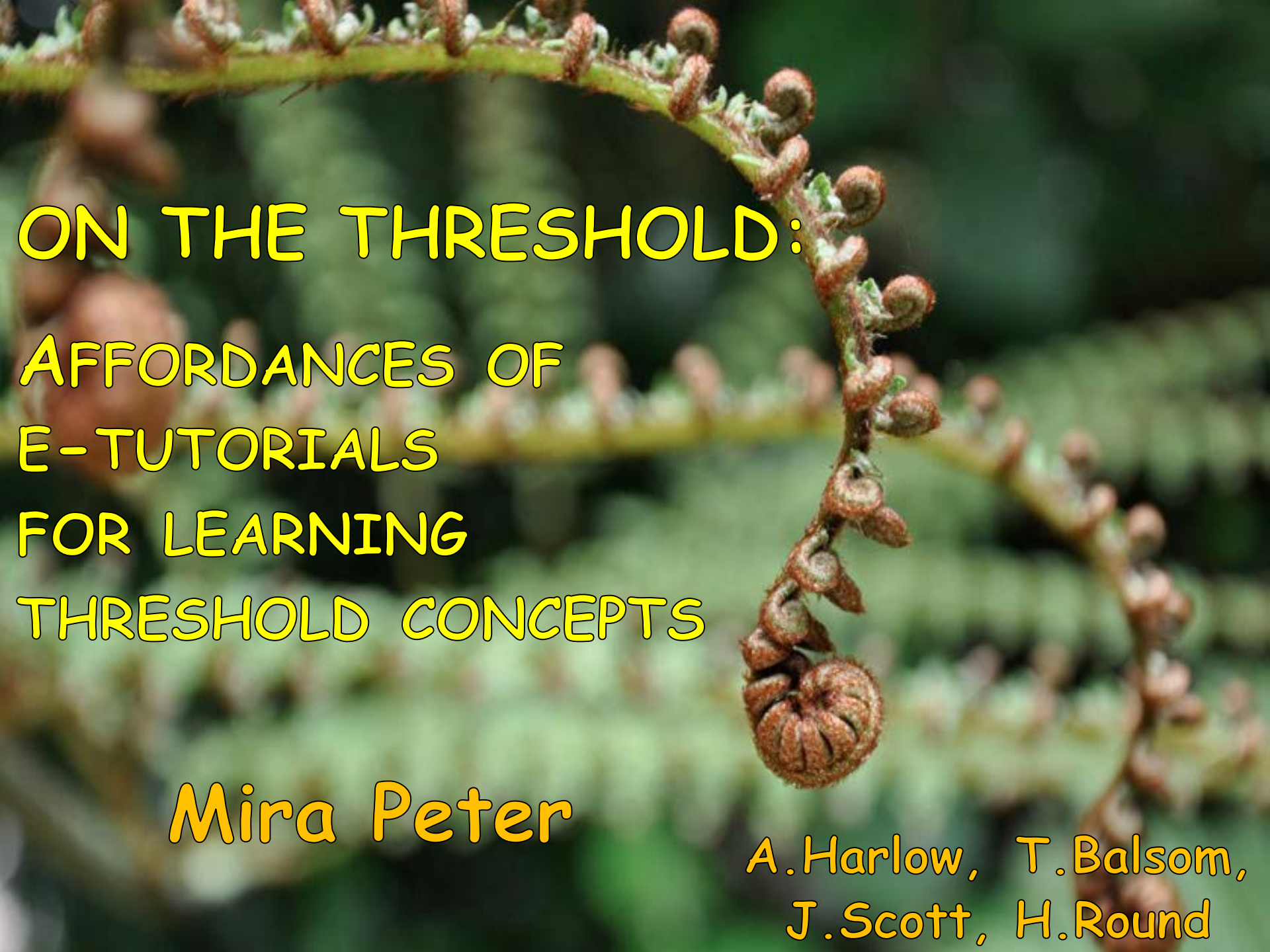




ON THE THRESHOLD:

AFFORDANCES OF
E-TUTORIALS
FOR LEARNING
THRESHOLD CONCEPTS

Mira Peter

A. Harlow, T. Balsom,
J. Scott, H. Round

THRESHOLD CONCEPT THEORY

"In each academic discipline,
there exist special concepts
- *threshold concepts* -
that once grasped, reveal new
and previously inaccessible ways
of thinking about a subject".

(Meyer & Land, 2003)

THRESHOLD CONCEPTS (TCs)

TRANSFORMATIVE: we are what we know

IRREVERSIBLE: difficult to unlearn

INTEGRATIVE: cohere key aspects of the subject

BOUNDED: serve a specific and limited purpose

BUT...

TROUBLESOME! counter-intuitive, difficult to learn,
and...

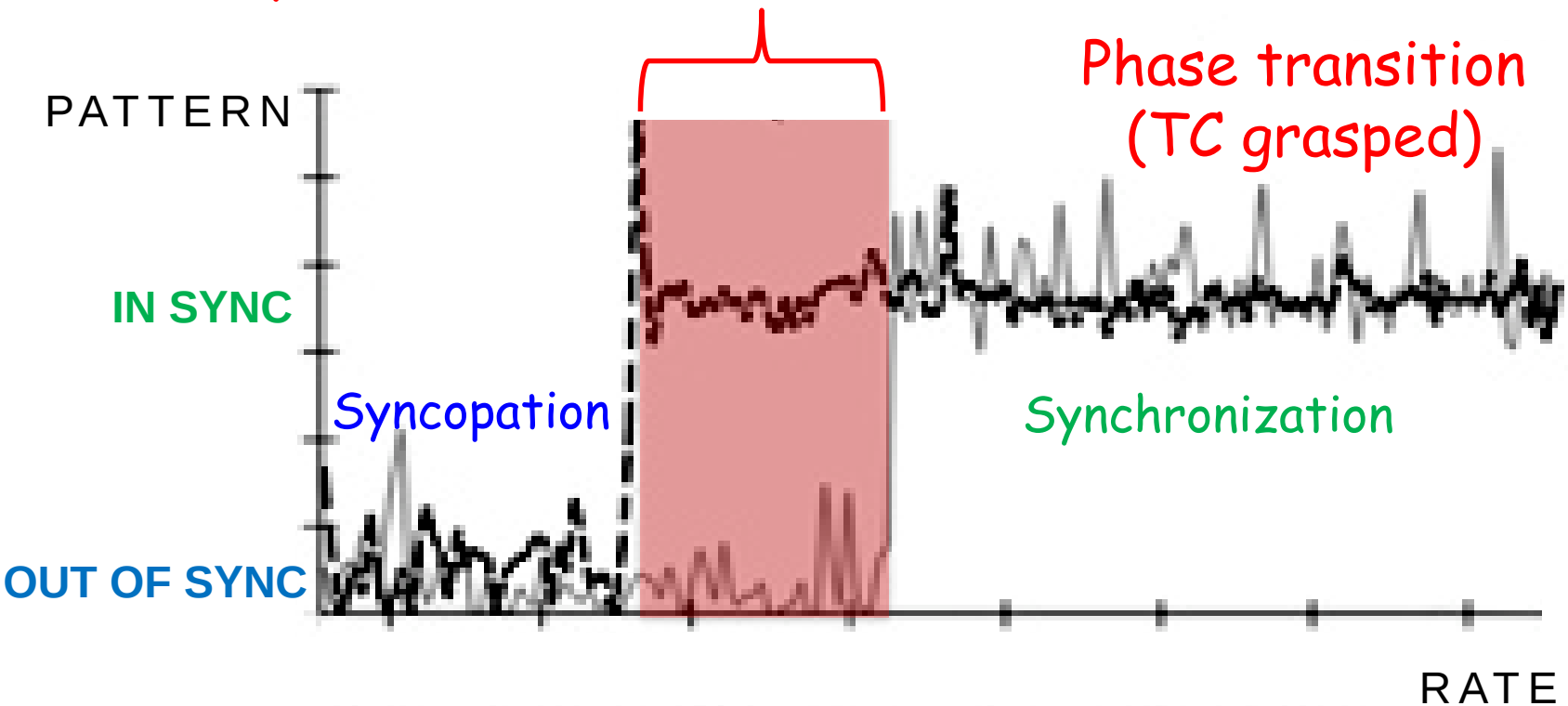
STUDENTS GET STUCK!



THRESHOLD CONCEPT THEORY COMPARE TO PHASE TRANSITION THEORY

Messy journeys back and forth across conceptual terrain
- *recursiveness and oscillation*

instability/uncertainty: "LIMINAL SPACE"



TEST CASE:

ELECTRICAL ENGINEERING STUDENTS

First-year students, analog electronics

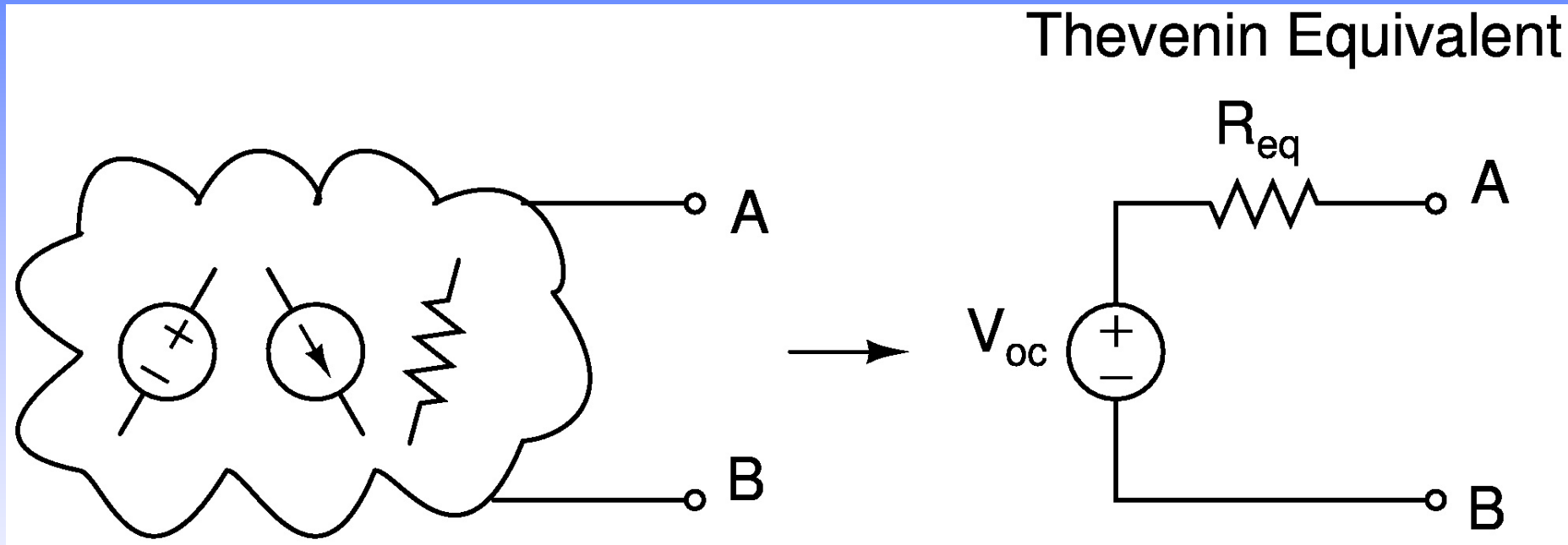
Challenge:

Students not grasping TC of...

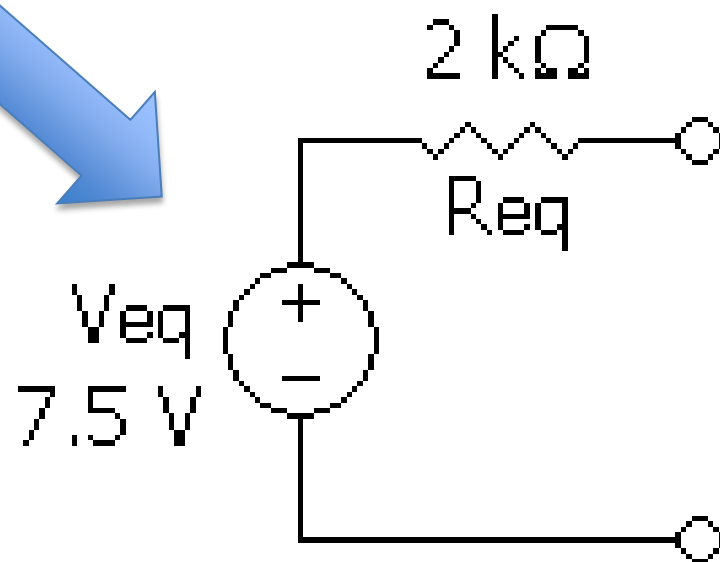
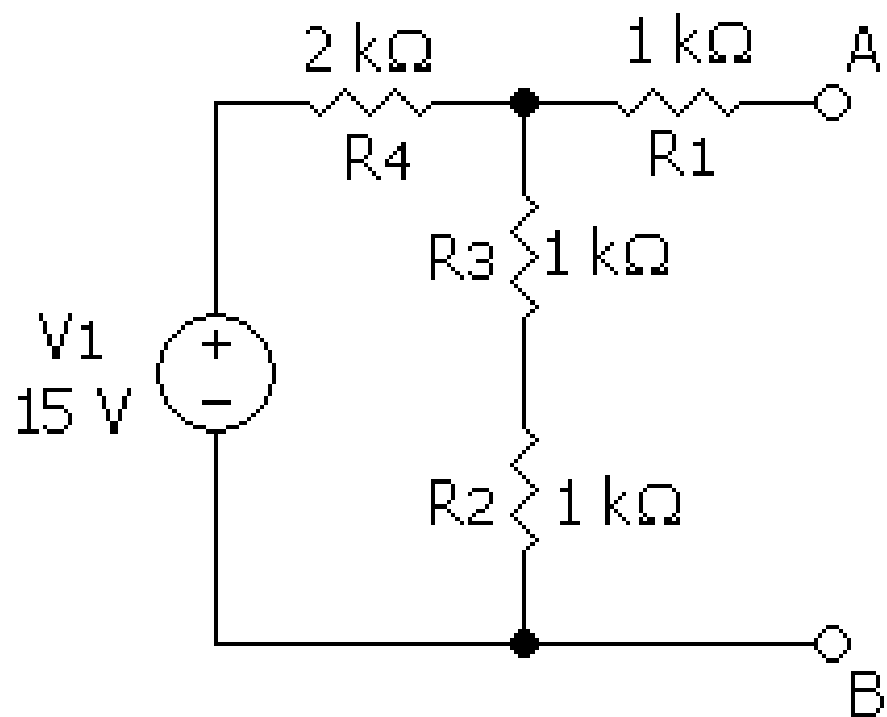
"Thevenin's theorem"

Thevenin's (equivalent voltage and resistance) theorem

THEVENIN'S THEOREM



Reduce a complex series and parallel circuit...
to a simple series circuit. For example...



Challenge was:

Students not grasping TCs (e.g., Thevenin's theorem)

Strategy:

Use novel affordances of technology (e-tutorials)
to enhance learning (metaffordances!)

Use novel (hands-on/perception-action)
assessment techniques for learning TCs - IFATs
(IFAT - Immediate Feedback Assessment Technique,
i.e., "scratchies")



IFAT

IMMEDIATE FEEDBACK ASSESSMENT TECHNIQUE (IF AT®)

Name _

Test #

Subject

Total 32

SCRATCH OFF COVERING TO EXPOSE ANSWER

	A	B	C	D	E	Score	
1.	☐	☐	☒	☐	☐	5	
2.	☒	☐	☐	☐	☐	5	
3.	☐	☐	☒	☐	☐	2	
4.	☐	☐	☐	☐	☒	2	
5.	☐	☒	☐	☐	☐	0	
6.	☐	☐	☒	☐	☐	5	
7.	☐	☐	☐	☒	☐	5	
8.	☒	☐	☐	☐	☐	1	
9.	☐	☐	☐	☒	☐	5	
10.	☐	☐	☐	☐	☒	2	32

e-Tutorials

Online tutorials

give students lots of examples!

Old...

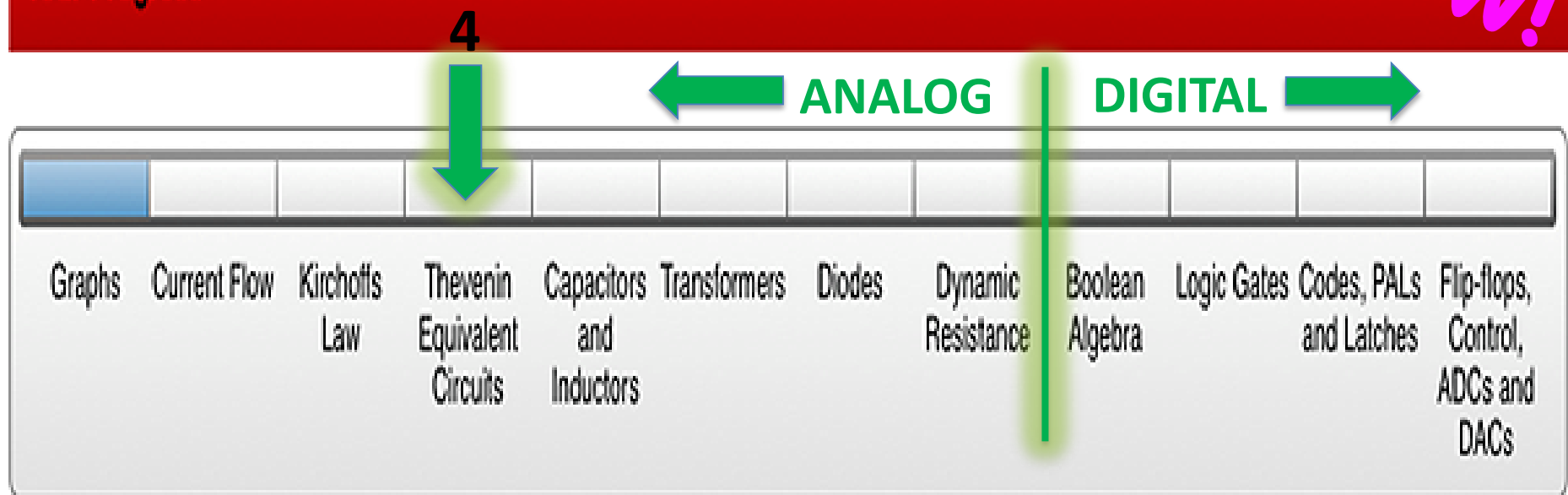
ENEL111 Tutorial 2

ENEL111 Tutorial 2

DOOR EXIT

Your Progress

New!



For the current section, **Current Flow**, you have answered correctly 0 of 5 in a row.

Tutorials

[Start Weekly Tutorials for ENEL111](#)

[View my progress in detail](#)

[Practice Tutorial Questions](#)

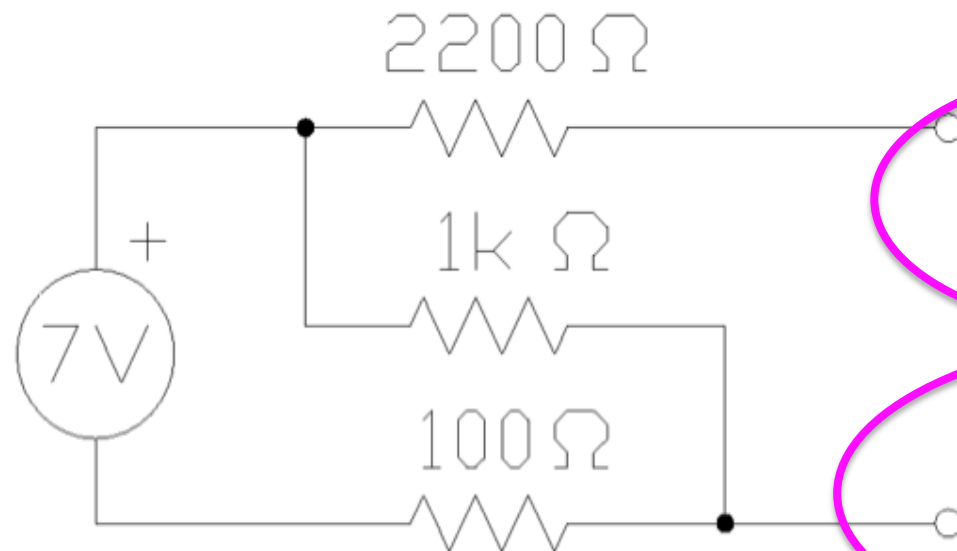


e-tutorials

Analog sections:

- 1 Graphs
- 2 Current Flow
- 3 Kirchoff's Law
- 4 Thevenin Equivalent Circuits
- 5 Capacitors and Inductors
- 6 Transformers
- 7 Diodes
- 8 Dynamic Resistance

107. Thévenin 4b



What is the Thévenin equivalent resistance of this circuit?

Select an Answer

- ☐ 2290 Ohms
- ☐ 2300 Ohms
- ☐ 3200 Ohms
- ☐ 3300 Ohms

Reason for your Answer

Please give a reason for your answer...

Submit

Resource Links

Need some help? Try these links...

Section Links

[Hyperphysics - Current Law](#)

General Links

[Hyperphysics](#)

[Electronic-Tutorials.ws](#)

[All About Circuits](#)

[Electronics Club](#)

[MIT Electronics Videos](#)

Affordances of e-tutorials?

Multiple examples ("explore infinite information")

Random questions ("chaotic/uncertain environment")

Must pass a section to move forward ("goal directed")

(pass = 5 **consecutive** correct answers)

Must give reason for answer ("no free lunches")

No limit or penalty on where, when, whom they collaborate with, or on number of errors/mistakes ("freedom to act, freedom to perceive")

Affordances of e-tutorials?

Students **can get help** during hands-on labs

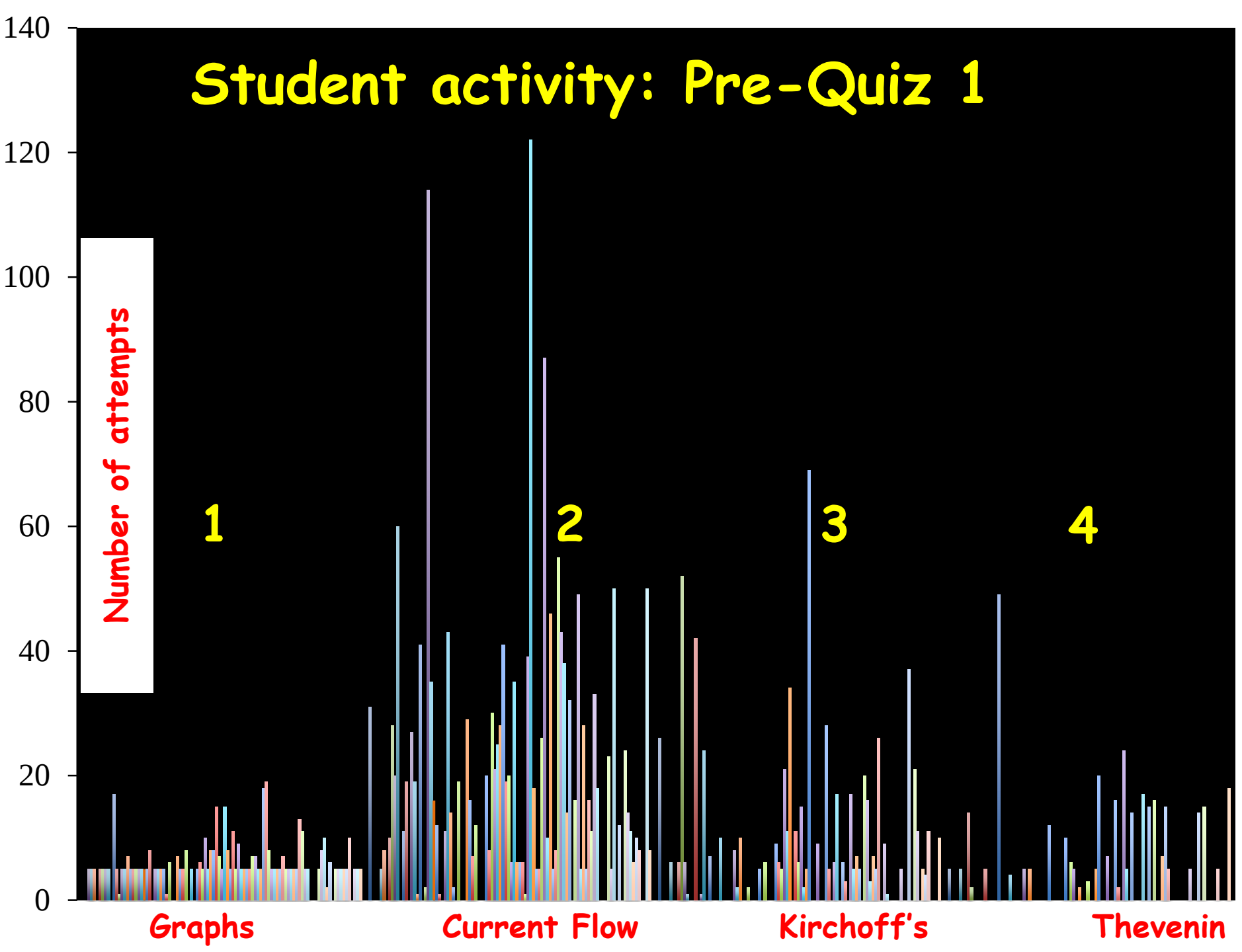
Student **discussion** group (*Moodle intranet*)

Can **review** questions after a section

Marks for **passing** a section (up to 10% of final mark)

Freedom to opt-out on research data

Student activity: Pre-Quiz 1



Student performance: Pre-Quiz 1

Percent correct (#correct/# attempts)

Graphs

Current Flow

Kirchoff's

Thevenin

QUIZ 1 (SECTIONS 1-4)

IMMEDIATE FEEDBACK ASSESSMENT TECHNIQUE (IF AT®)

Name _____ Test # _____
Subject _____ Total 32

SCRATCH OFF COVERING TO EXPOSE ANSWER

	A	B	C	D	E	Score
1.			★			5
2.	★					5
3.			★			2
4.					★	2
5.		★				0
6.			★			5
7.				★		5
8.	★					1
9.				★		5
10.					★	2

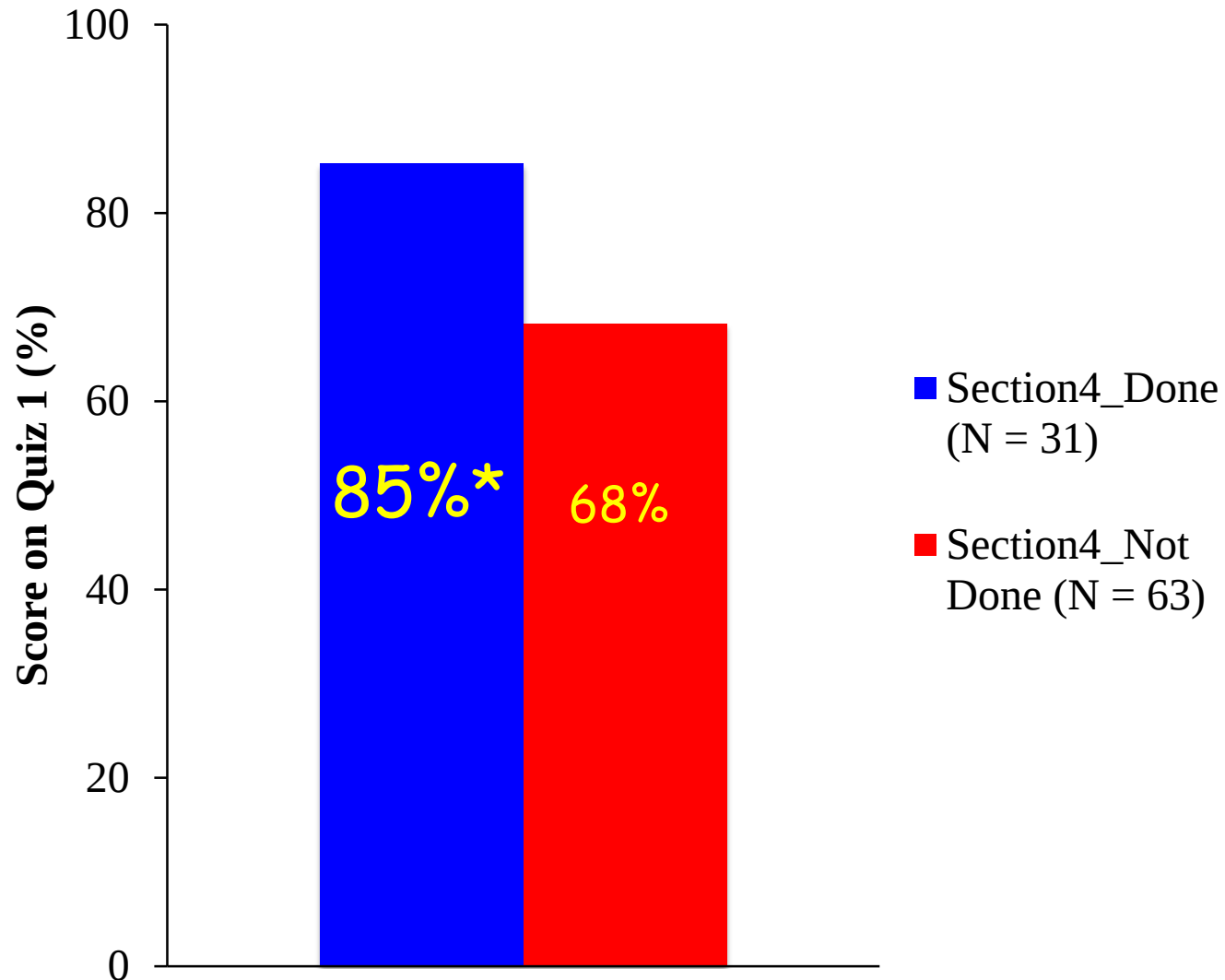
© 2008 M.L. & B.B. Epstein Form#E013

10 questions

Each question =
5 marks max

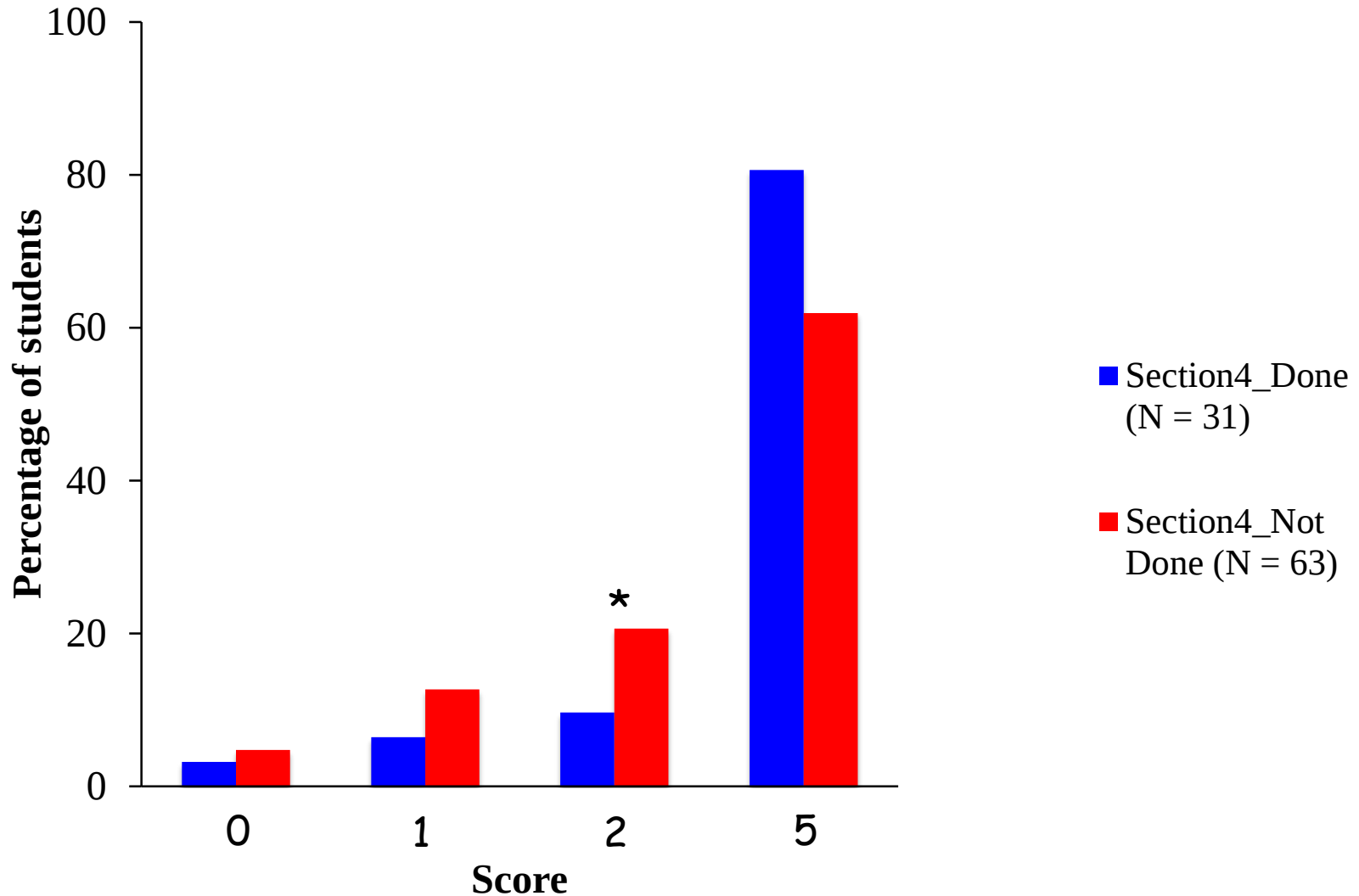
Q5, 9 & 10 = Thevenin

STUDENT PERFORMANCE QUIZ 1

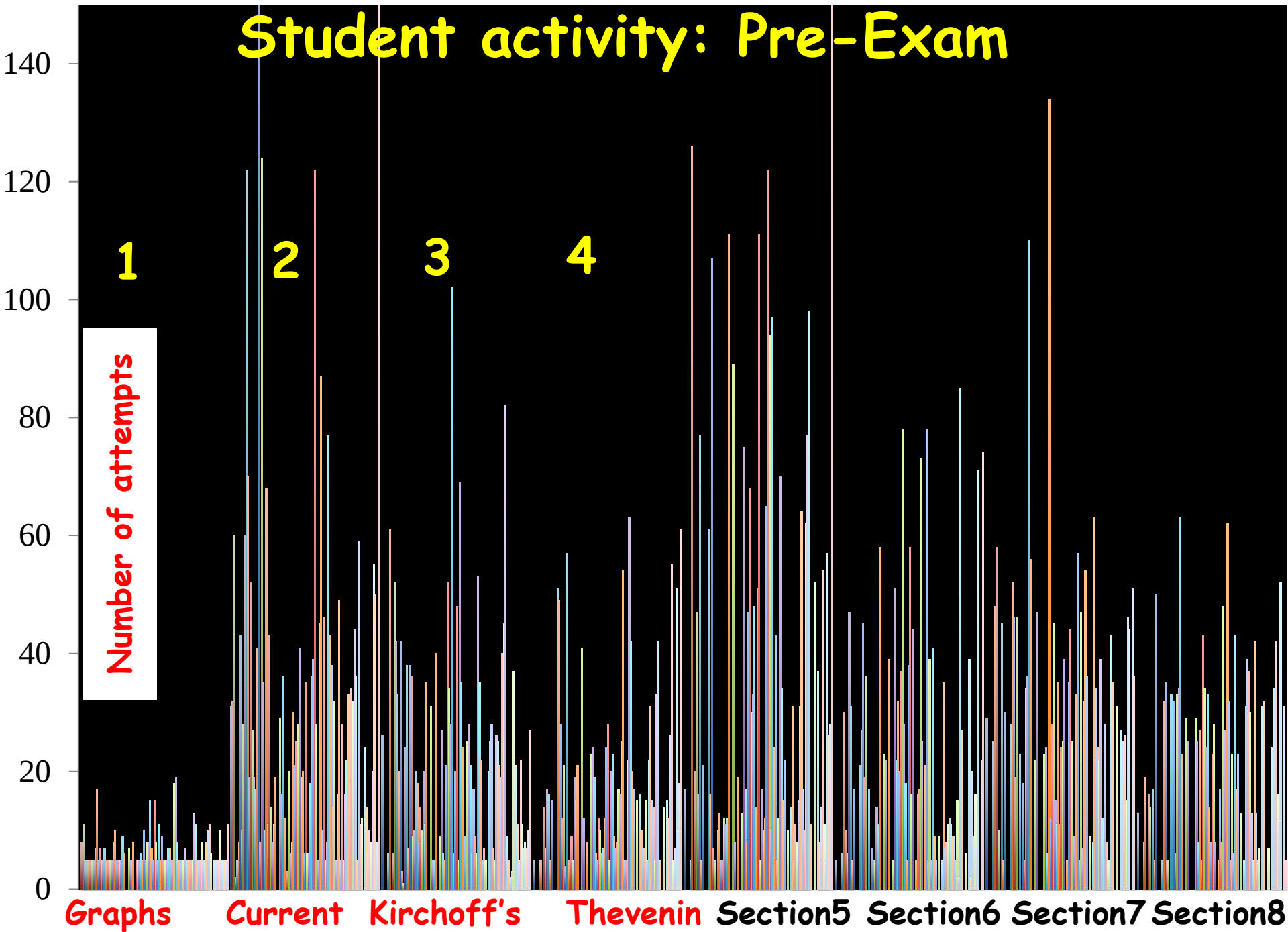


STUDENT PERFORMANCE

QUIZ 1, QUESTION 5



Student activity: Pre-Exam



Student performance: Pre-Exam

Percent correct (#correct/# attempts)

Graphs

Current

Kirchoff's

Thevenin

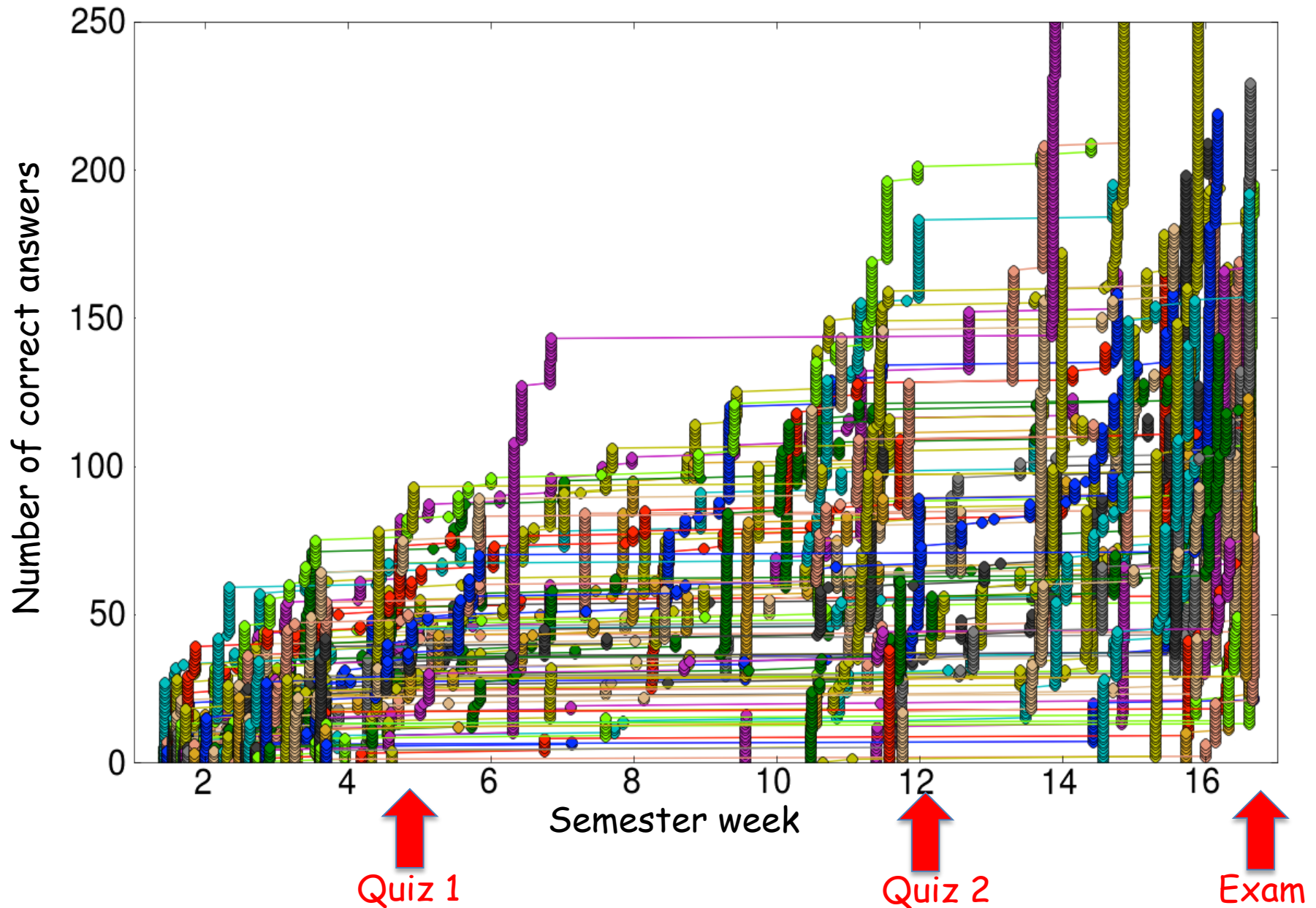
Section5

Section6

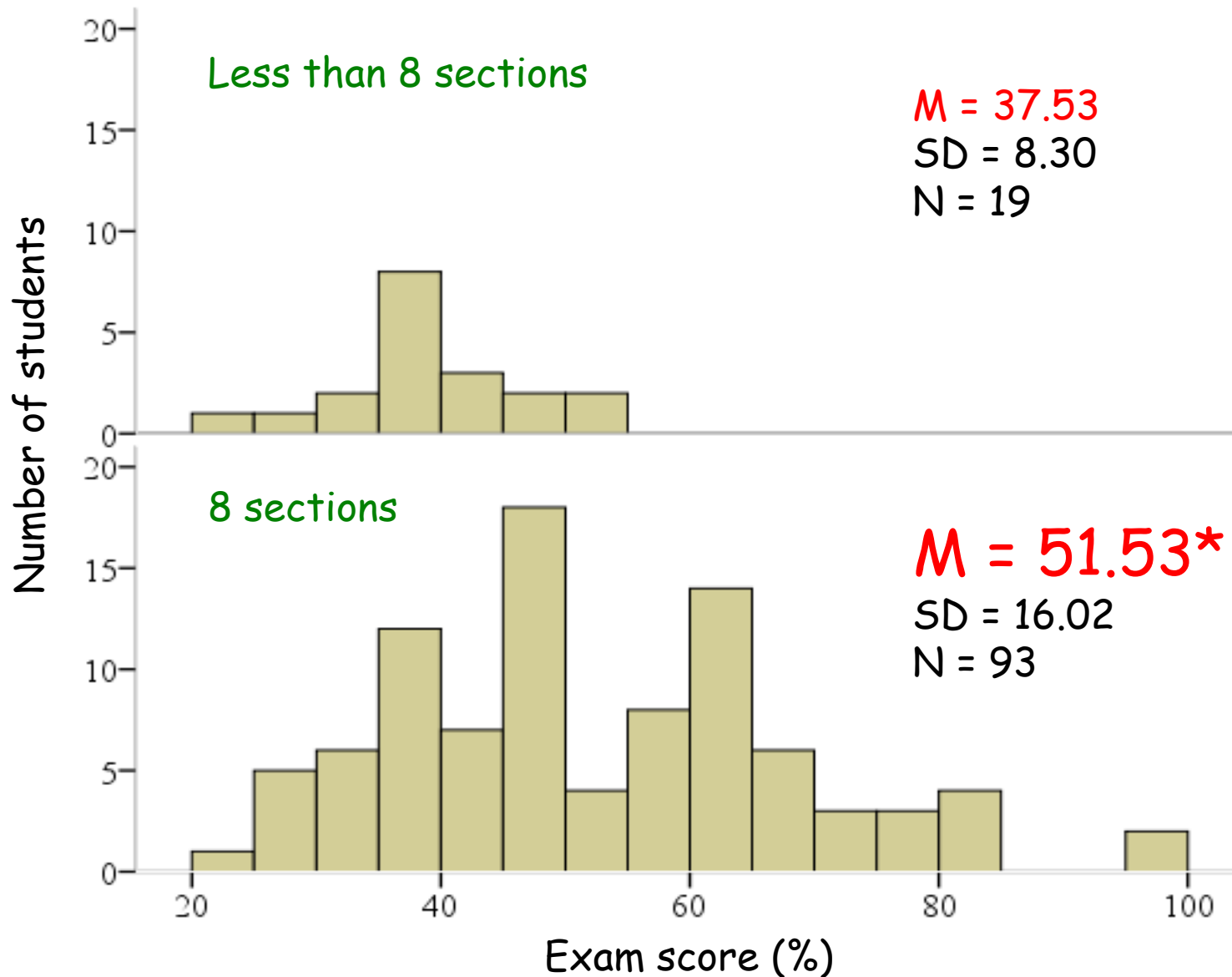
Section7

Section8

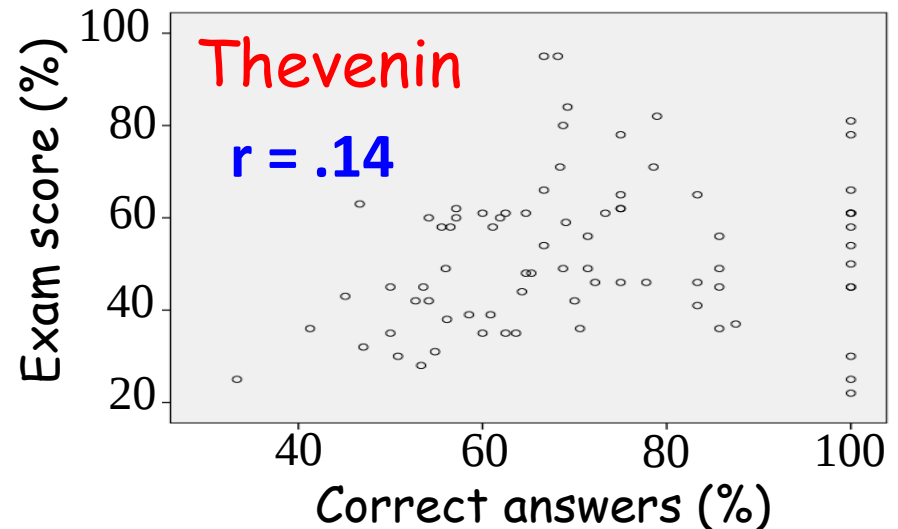
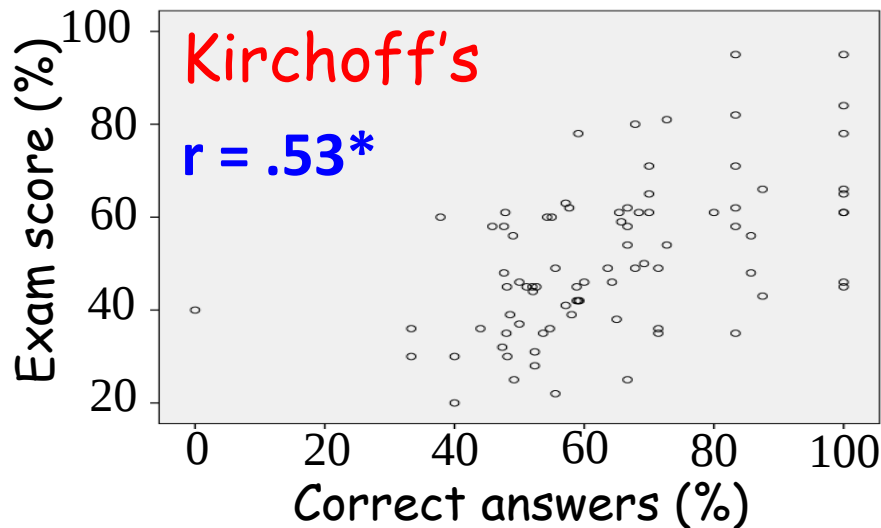
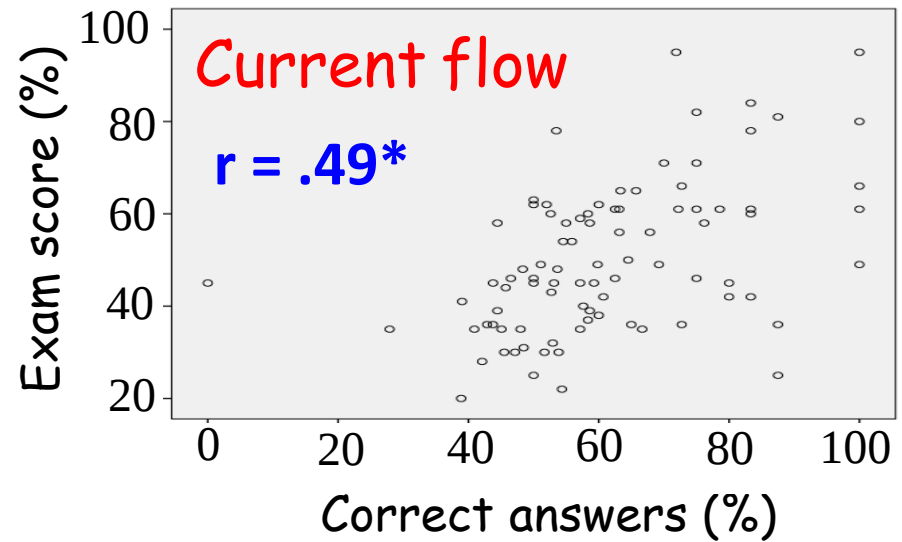
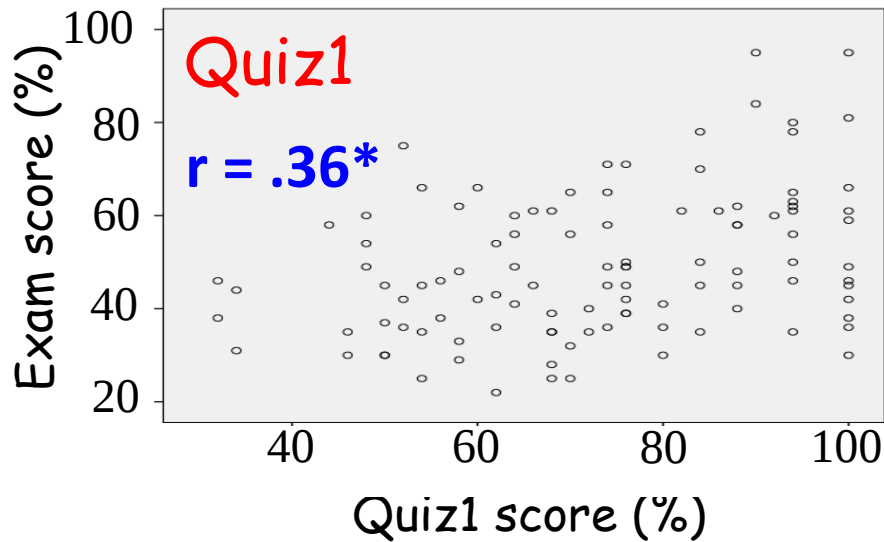
Student e-activity during semester



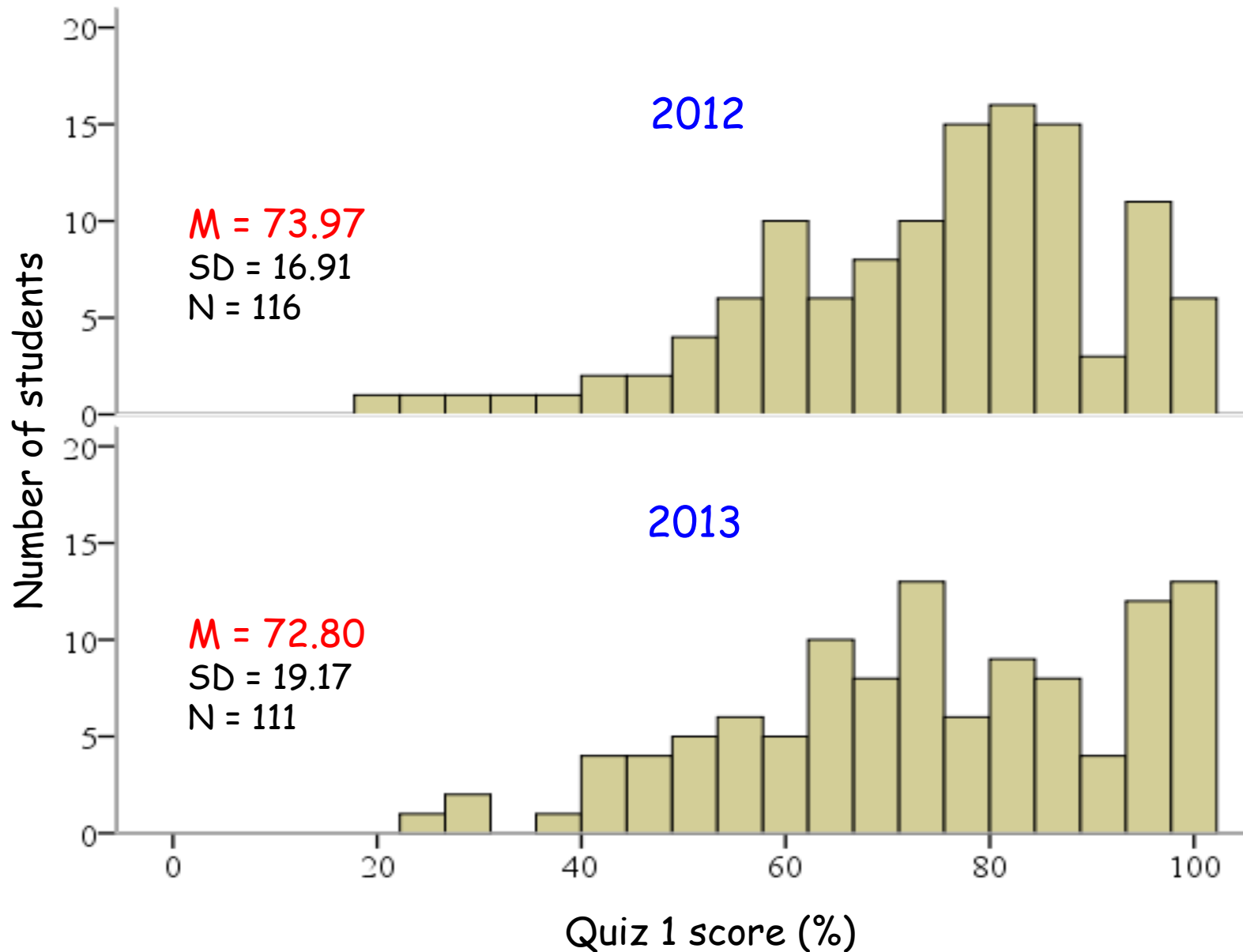
Final exam (analog)



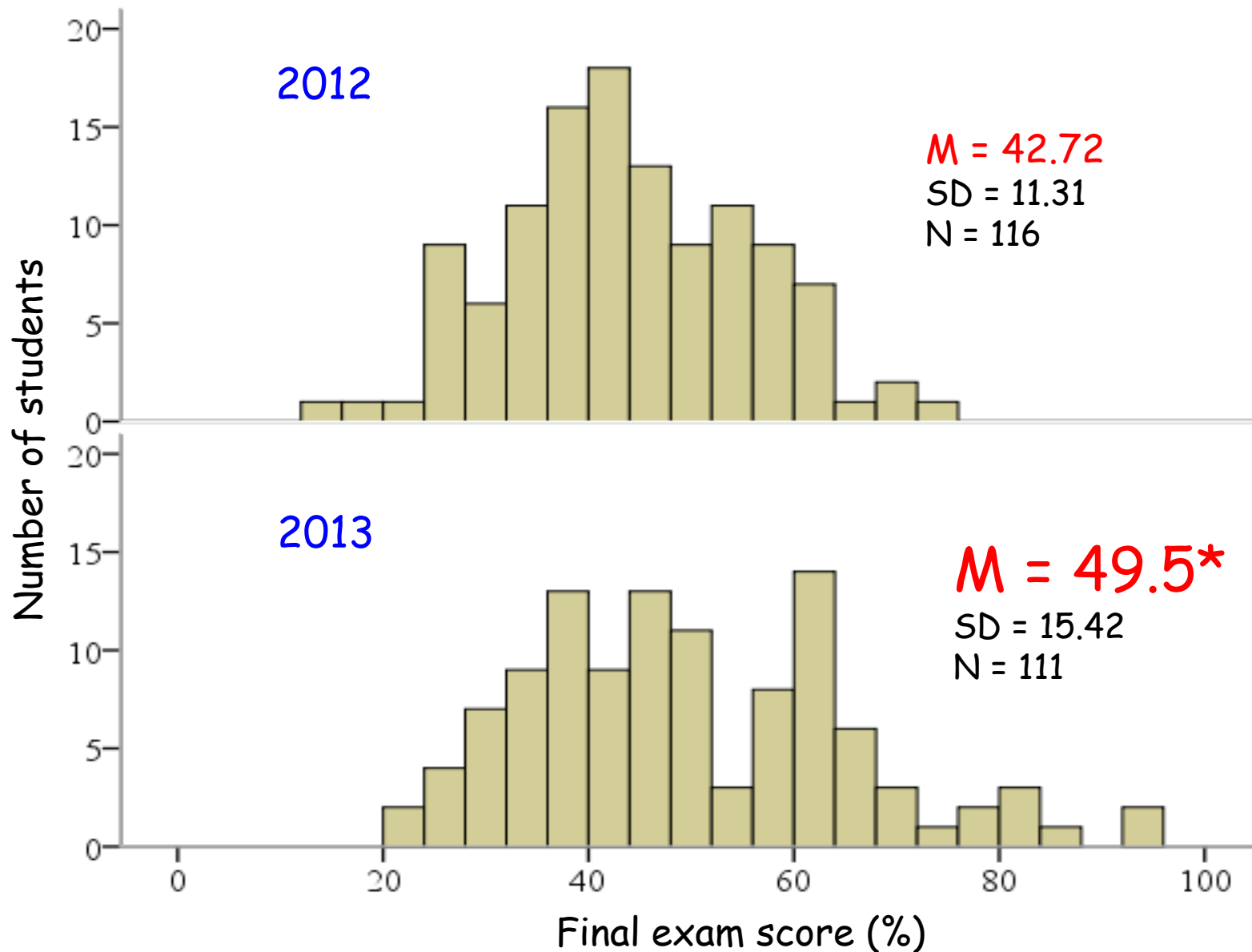
Correlation of Final Exam with...



Quiz 1 (analog): 2012 vs. 2013

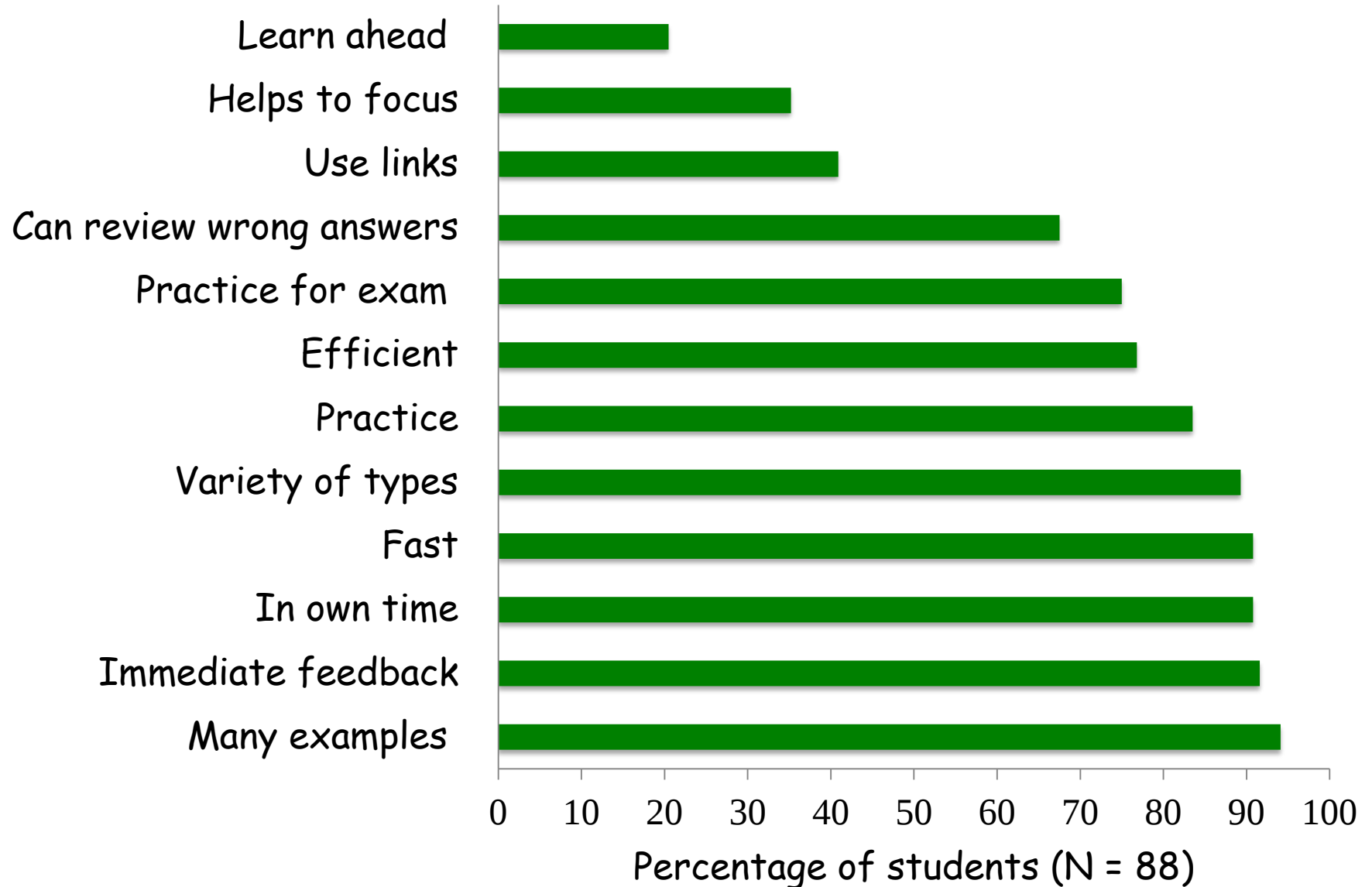


Final exam (analog): 2012 vs. 2013





Student perceptions: Survey



Practical lessons for lecturer:

Create **specific links** to online resources

Include **hints** if one is stuck

More questions in the database

Better organised **discussion forum**

Better use of **answer explanations**

Affordances and e-tutorials

LEARNT SO FAR:

Mastering TCs = event; periods of **instability/uncertainty**

e-tutorials = **real opportunities** for exploration & learning

Affordances of e-tutorials can be perceived and acted upon

e-tutorials = well suited to individual learning style &
previous knowledge

e-tutorials can provide for **shifts** in students' understanding

Find out:

Self-organisation of conceptual system (global order)



Thank you



Wilf Malcolm Institute
of Educational Research

Te Pūtahi Rangahau Mātauranga o Wilf Malcolm

THE UNIVERSITY OF WAIKATO



TEACHING & LEARNING
RESEARCH INITIATIVE

NĀU I WHATU TE KĀKAHU, HE TĀNIKO TAKU