How do online videos and textbook reading engage students and affect exam performance?

Adventures in flipping a cell biology course
Dr. Katie Shannon
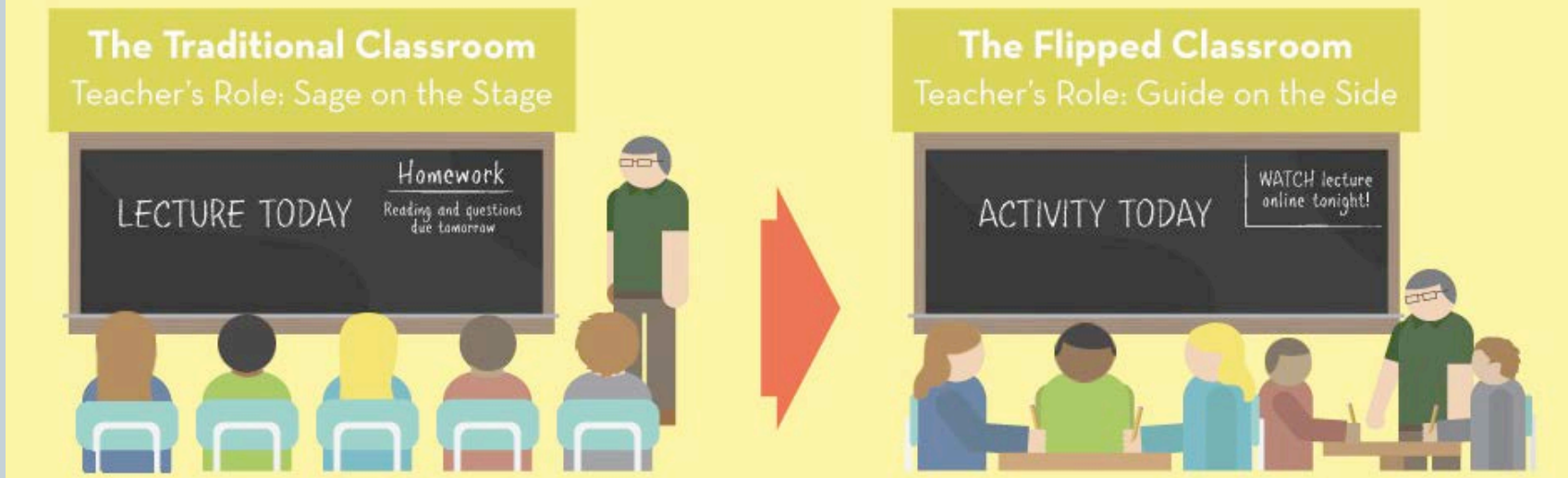**Biological Sciences**
Missouri S&T

What is flipping?

- Instruction delivered outside of class
- Class time focused on problem-solving

THE INVERSION

The Traditional Classroom
Teacher's Role: Sage on the Stage

LECTURE TODAY

Homework
Reading and questions
due tomorrow

The Flipped Classroom
Teacher's Role: Guide on the Side

ACTIVITY TODAY

WATCH lecture
online tonight!

http://www.knewton.com/flipped-classroom/

Cell Biology

- Required for Biological Sciences majors

- Required for Chemical Engineering with Biochemical Engineering Emphasis

- Required for Chemistry - Pre-medicine Emphasis

- Sophomore level

- Taught since 2007

- Meets for 50 min 3 days a week

Why Flip Cell Bio?

- Students need to be able to apply knowledge, not just memorize

How do we teach our students to think like scientists?

Flipped Friday Class

- I recorded and edited videos using Camtasia primarily in summer 2013
- Videos and quiz were posted on Blackboard
- Quiz due by class time Friday
- Students worked in groups on problem set in class
- I wander, listen, answer questions, assist students
- Clickers were used for students to collaborate on answers
- Similar problems are given in homework and on exams

Evaluation

- Student performance on exams was not significantly different between Spring 2013 and Fall 2013

- Scores on "overall effectiveness of instructor" on student evaluations did not change

- Three additional questions on student evaluations

- Opinion surveys to gauge student reaction
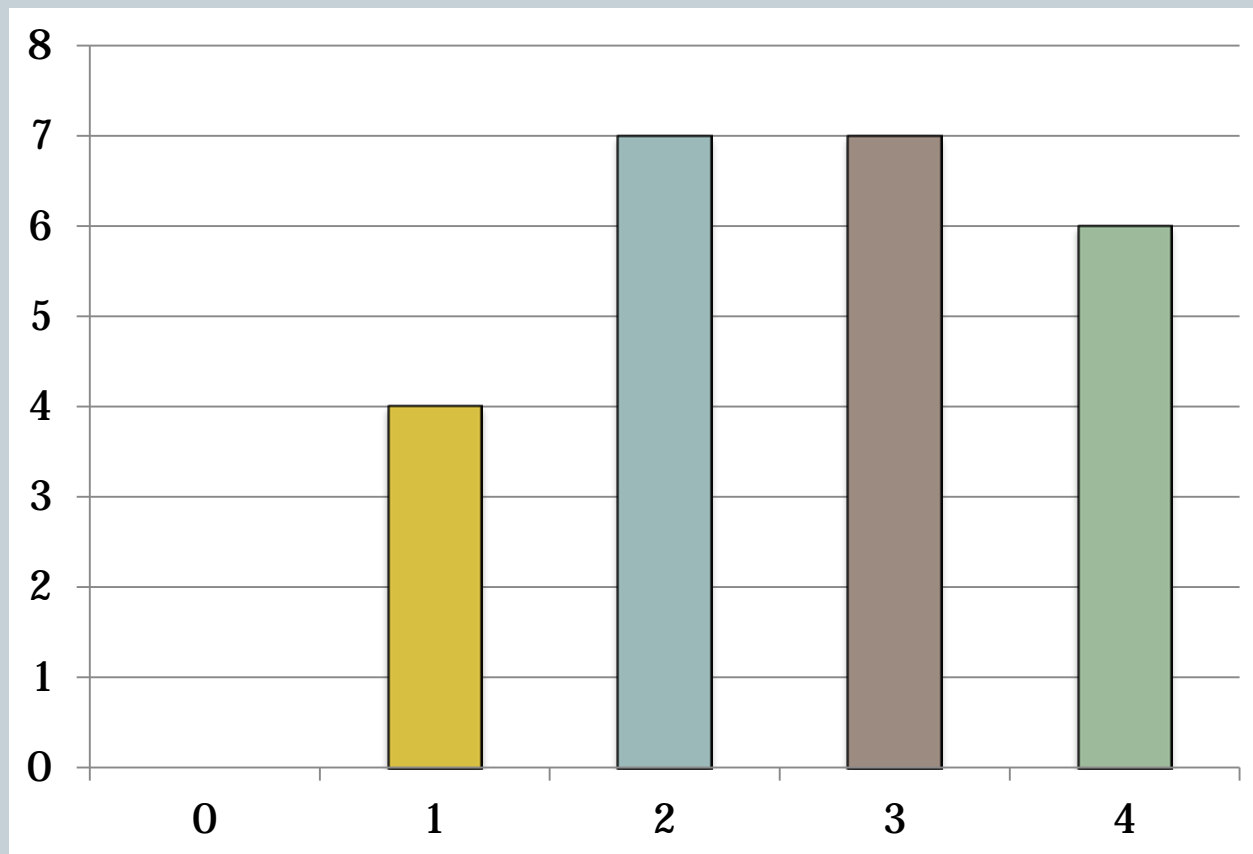
Student Evaluations

Rate the ability of online Flipped Friday lectures to communicate the material effectively
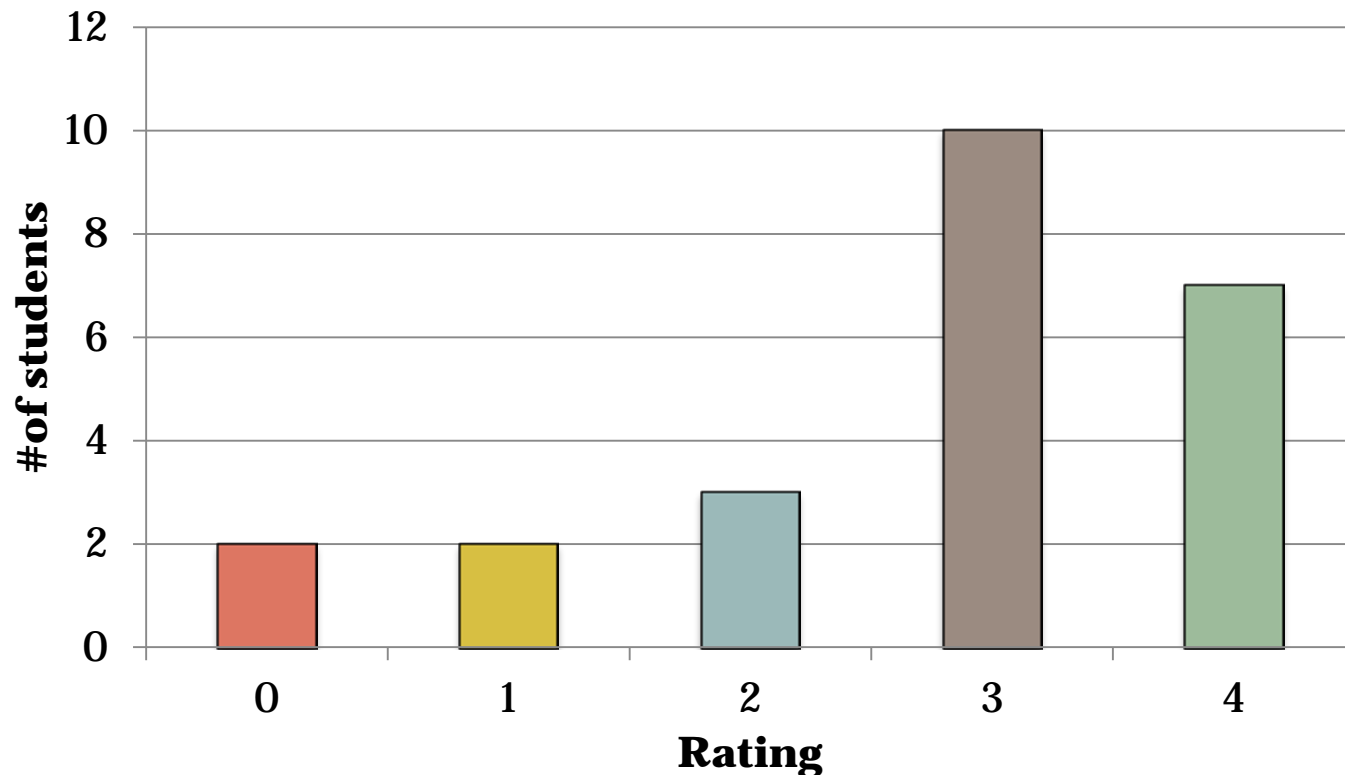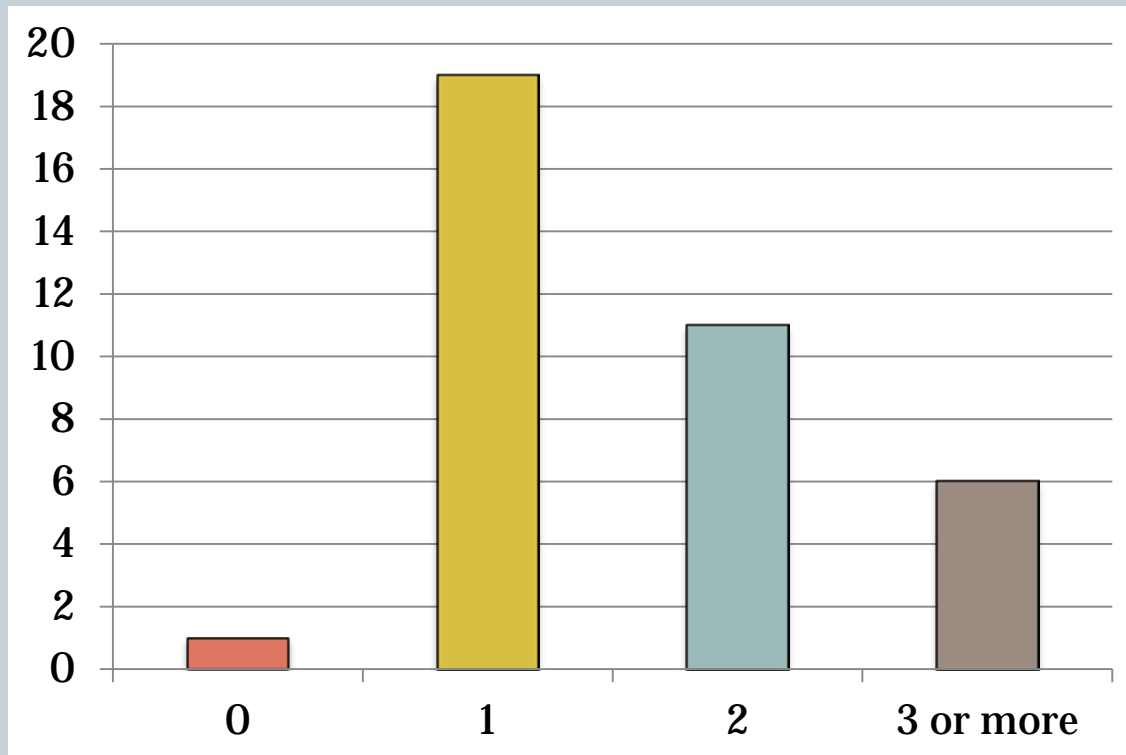
Student Evaluations

Rate the usefulness of working on problems in class on Flipped Fridays as preparation for homework/test questions

Student Evaluations

How many times did you typically watch a videos, from the time it was posted until the exam?

Benefits of Flipped Classroom

- Active classroom on Fridays

- Self-directed learning

- Increased student-student interaction

- Increased student-faculty interaction

- Higher level questions introduced in setting where students can get help

- Students are able to practice the application of knowledge

Do lecture videos increase student engagement?

- Two days a week are lectures, students are assigned textbook pages to read before class
- Class begins with 5 "clicker" questions from reading
- For each day of course, students have incentivized out of class assignment to read or watch videos
- Do students prefer videos?
- Are students more likely to watch videos than read textbook?
- Would there be additional benefit to flipping whole course?
- Online videos have digital viewing data

How to measure out of class behaviors?

- Asked extra credit questions at the end of each exam

- Began Fall 2014

- Students were asked how often they read the assigned pages in the textbook

- They were asked how long they studied and to choose from a list of study methods used

- Questions asked about sleep

- IRB approved

How did you prepare for this exam?

A. I spent several days reviewing the material (3)

B. I spent two days reviewing the material (2)

C. I studied last night/this morning (1)

D. I did not study (0)

Study Time Sometimes Correlates with Exam Grade

Correlation between exam grades and reported study time

	Fall 2014 N=56	Spring 2015 N=36	Fall 2015 N=53
Exam 1	No	Yes	No
Exam 2	No	Yes	No
Exam 3	No	Yes	No
Exam 4	No	No	No

Correlation is based on the Spearman rank coefficient and p value of less than 0.05

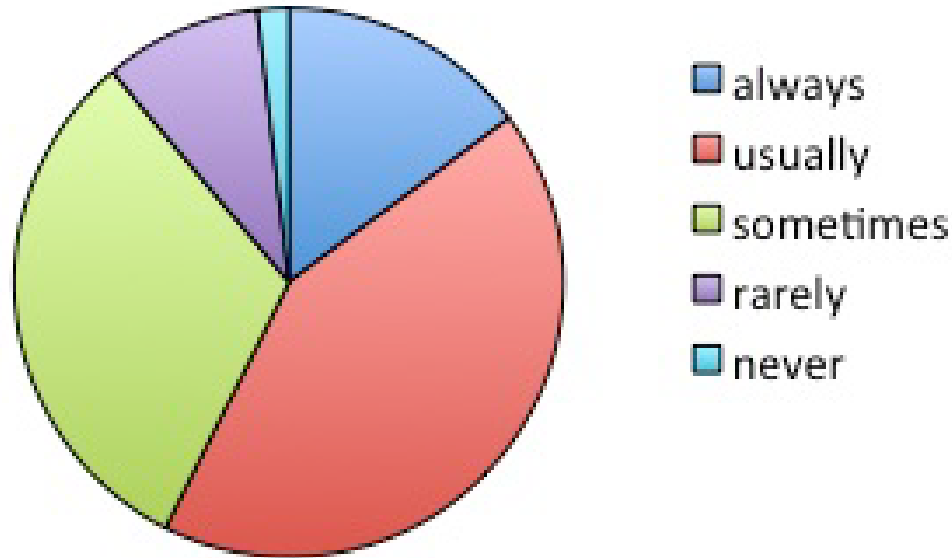# For the material on this exam, I read the assigned pages in the textbook before class

A. Always (4)

B. Usually (only missed one or two days total) (3)

C. Sometimes (did not read one assignment each week) (2)

D. Rarely (only read once or twice total) (1)

E. Never (0)

Do students read the textbook?

Reading Average for the Semester

- always
- usually
- sometimes
- rarely
- never

Pie chart shows results from final exam in Fall 2014, which were similar to results from the other four exams during the semester, except that "always" was highest for the first exam and declined during the semester as "sometimes" increased.

Correlation between self reported reading and clicker points Fall 2014
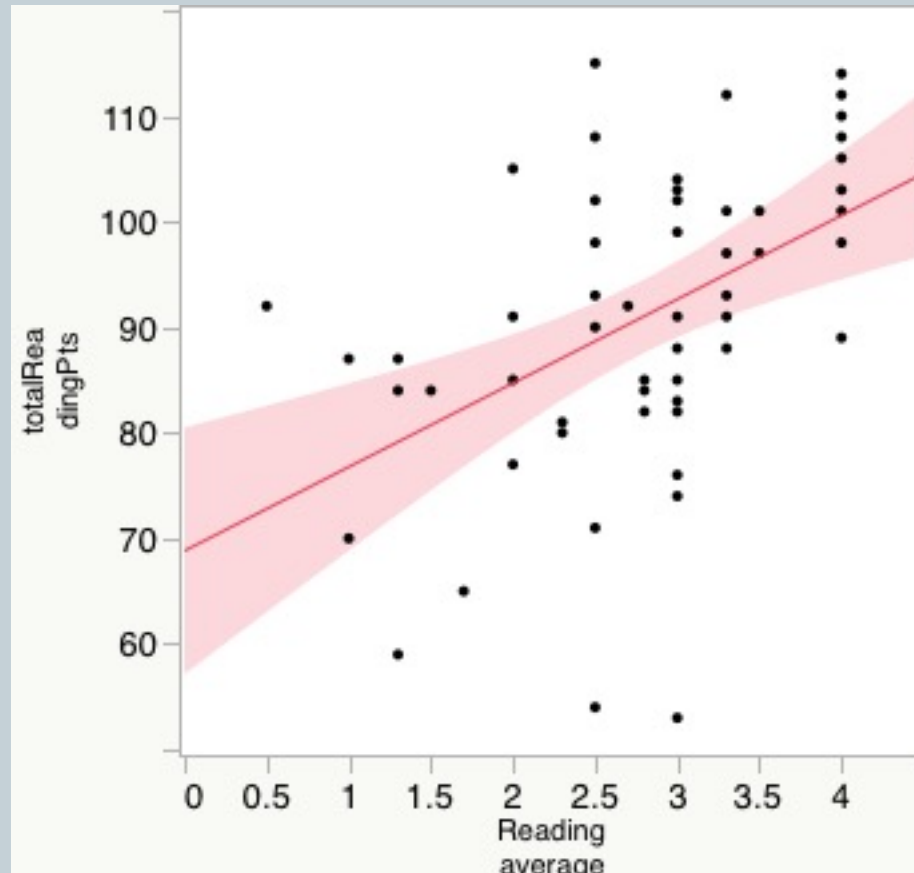
Total Reading Clicker Pts Predicted P=0.0002 RSq=0.22 regression analysis in JMP
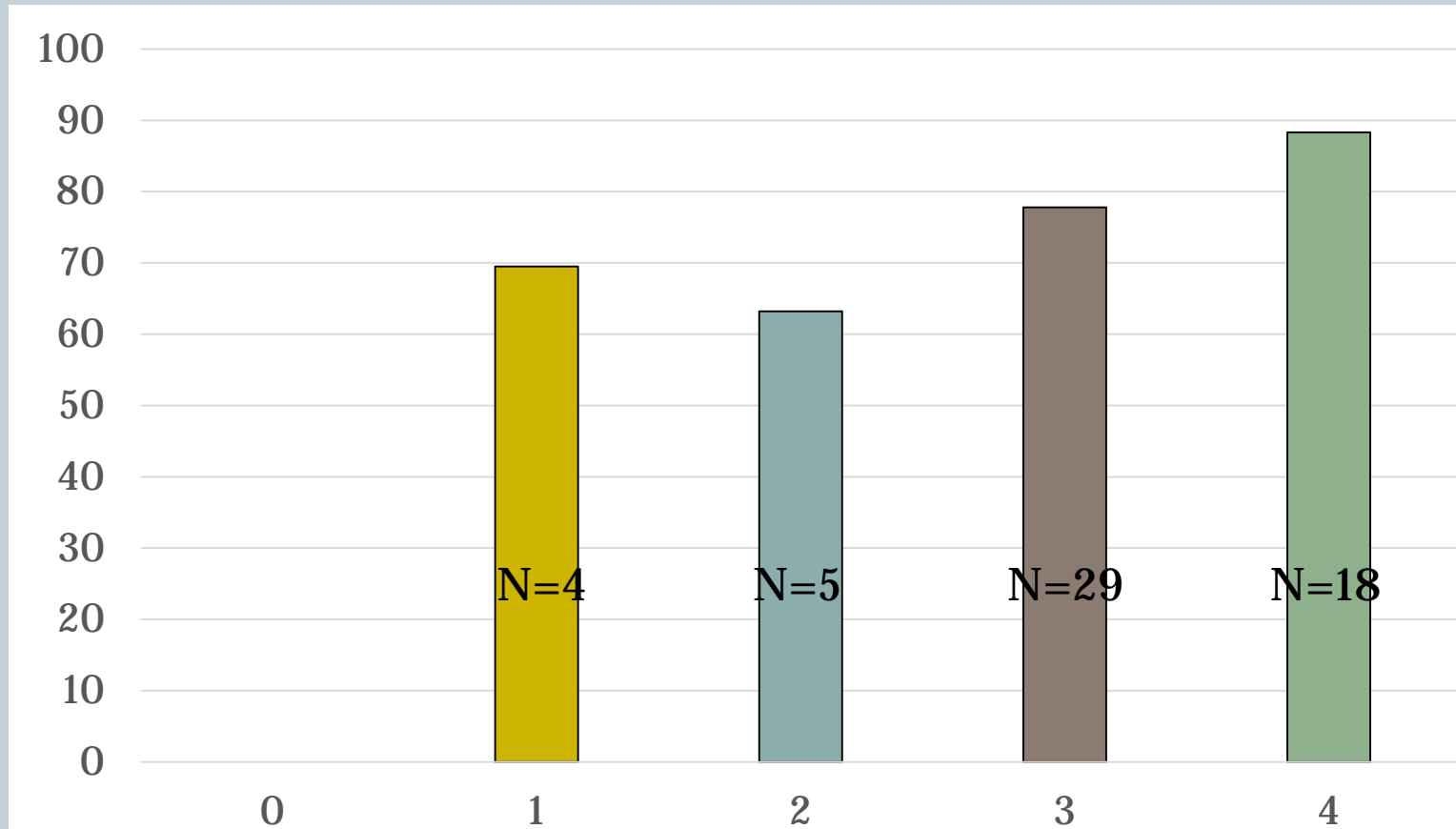
Textbook Reading Sometimes Correlates with Exam Grade

Correlation between self reported reading and exam grade

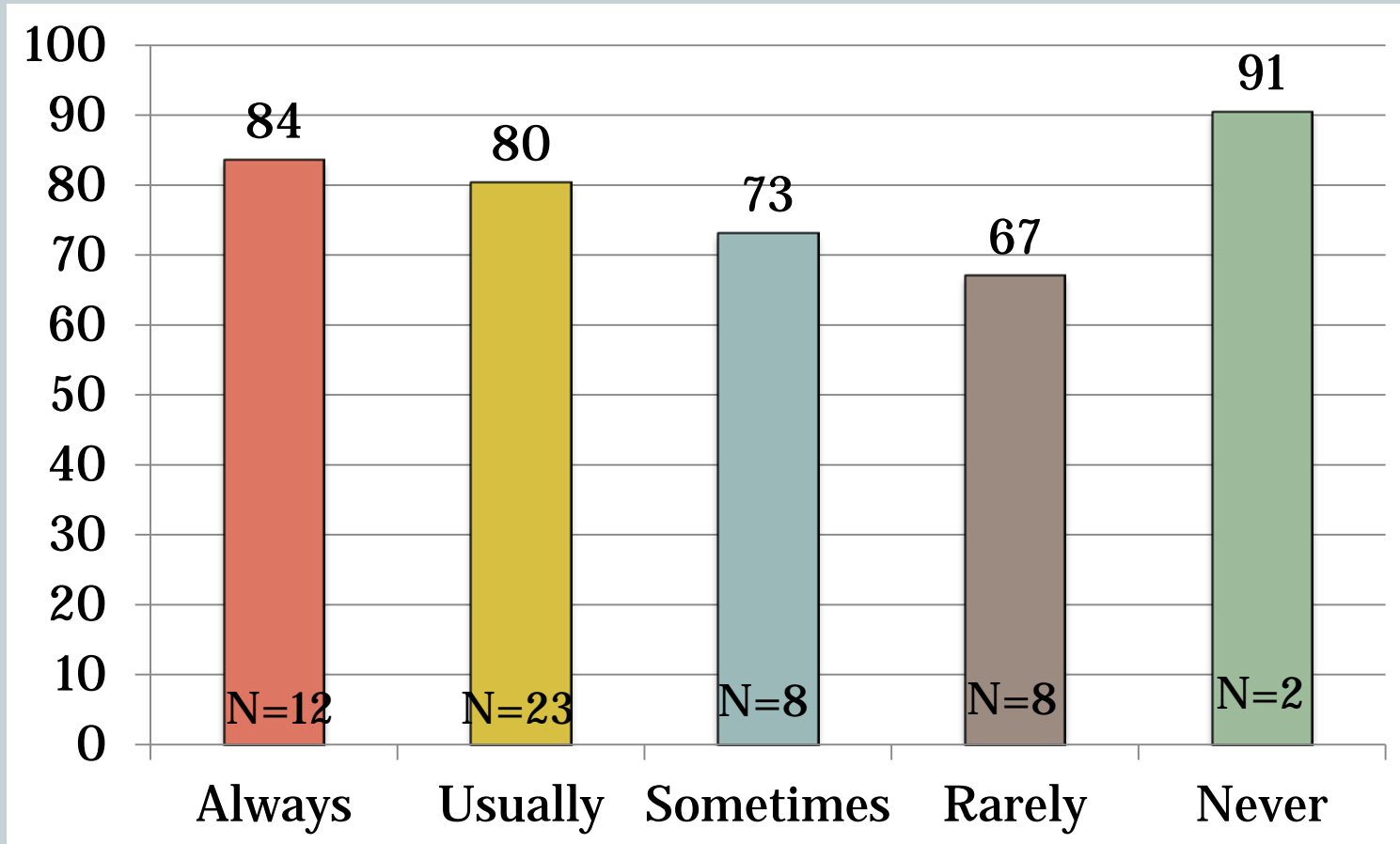|	Fall 2014 N=56	Spring 2015 N=36	Fall 2015 N=53
Exam 1	Yes	No	No
Exam 2	Yes	No	No
Exam 3	Yes	No	No
Exam 4	No	No	Yes

Correlation is based on the Spearman rank coefficient and p value of less than 0.05

Fall 2014 Exam 1 grade correlates with reading

# Exam 1 Average did not correlate with reading Fall 2015

Percent of total videos watched sometimes correlates with exam grades

	Fall 2014 N=56	Spring 2015 N=36	Fall 2015 N=53
Exam 1	Yes	No	Yes
Exam 2	No	Yes	No
Exam 3	Yes	No	No
Exam 4	No	Yes	No

Correlation based on the Spearman rank coefficient and p value of less than 0.05

Fall 2014 Exam 1 correlation between video watching and exam grades
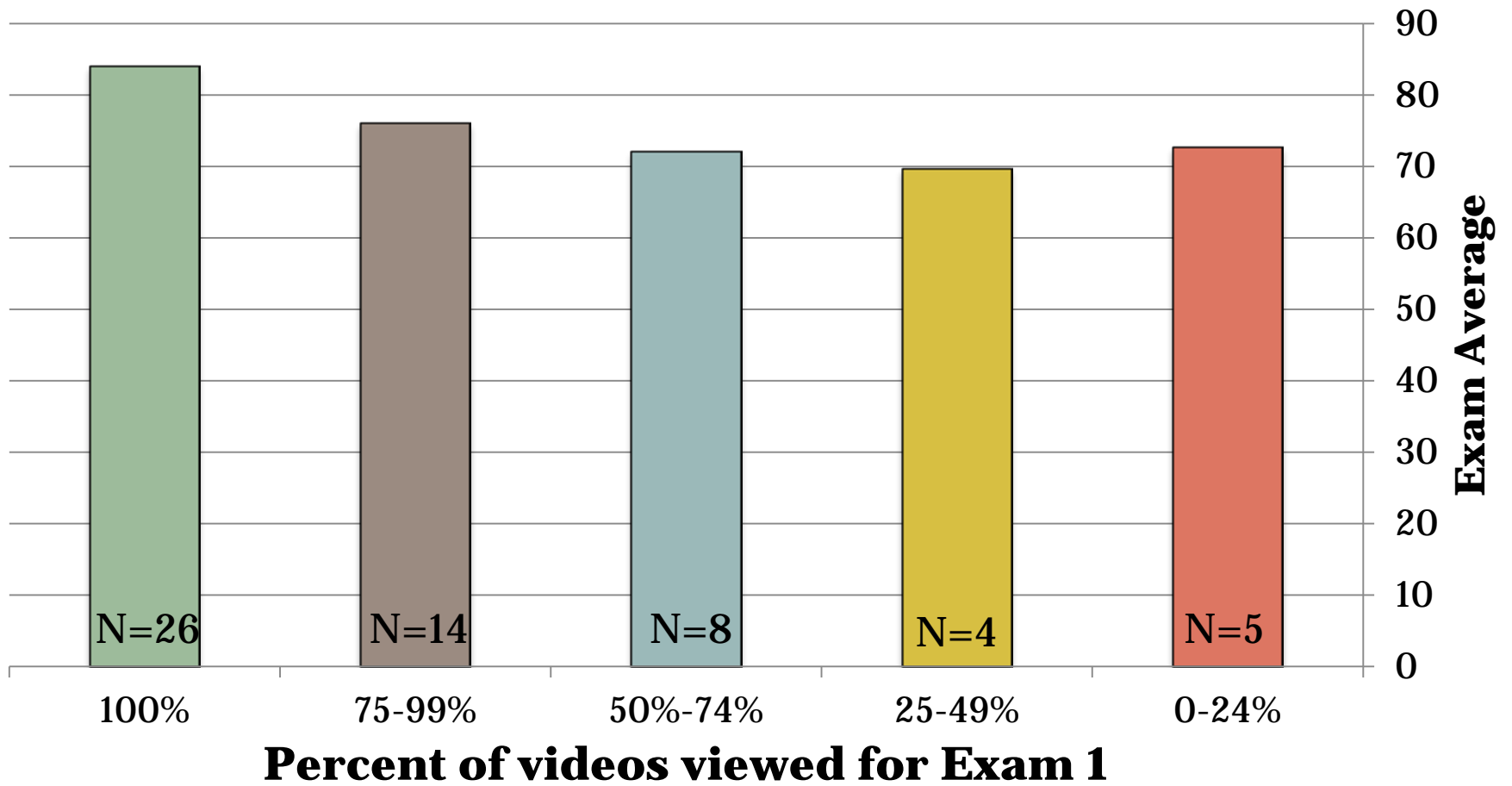
Do students watch videos more than they read the textbook?

Divided students into those who watched videos more or read textbook more.
Watch more was defined as students who watched 2/3 or more of the videos but read Sometimes, Rarely, or Never
Read more was defined as students who read Always or Usually but watched 50% or less of videos

	Fall 2014		Spring 2015	
	Watch More	Read More	Watch More	Read More
Exam 1	5	8	11	6
Exam 2	12	5	7	6
Exam 3	7	9	4	10
Exam 4	15	3	5	8

Why do reading score and video watching only sometimes correlate with exam scores?

- Limited sample size

- Little spread in student responses

- Analysis performed for each exam

- Reading score is ordinal data, not continuous

- Other variables may have effect (GPA, ACT, prior courses in high school or college biology)

- Additional analysis needed

What now?

- Survey questions revised this year to determine how much time spent reading and strategies used while reading
- Continue to collect data Spring 2016
- Attitude survey to determine student preference for reading or watching videos
- Advanced analysis using fit modeling of multiple variables that affect exam performance: GPA, reading, video watching

GPA always significantly correlated with exam grade
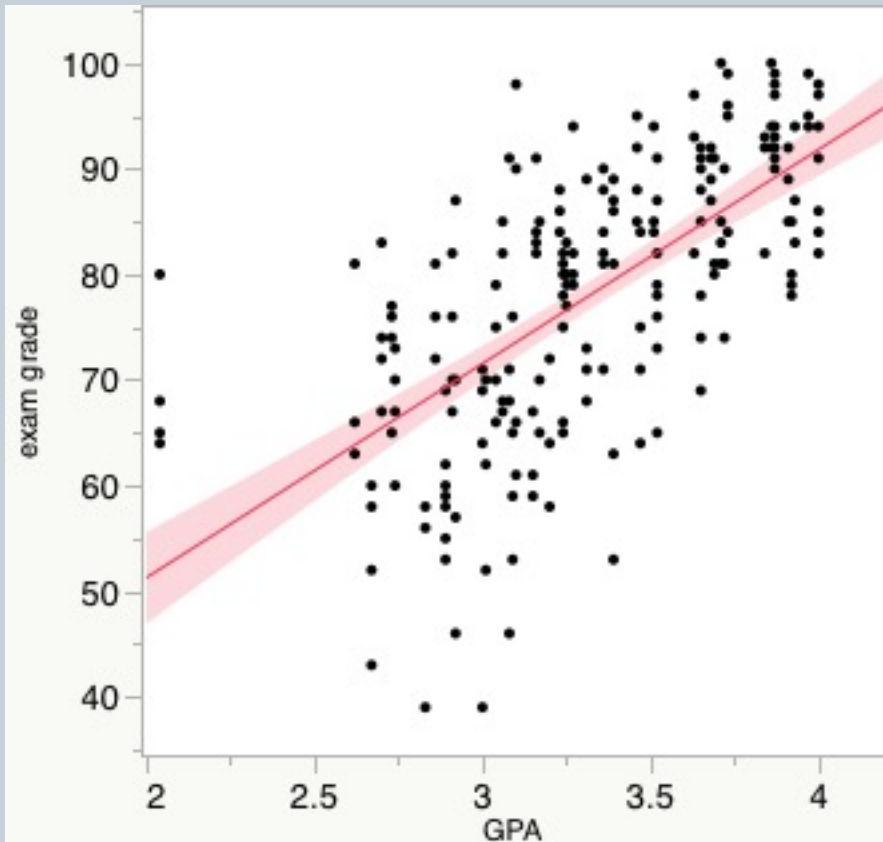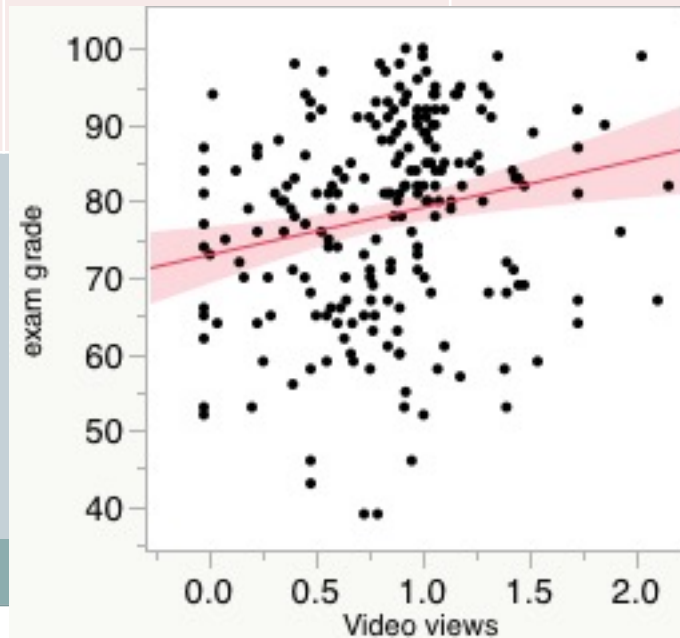

Fall 2014 pooled data regression
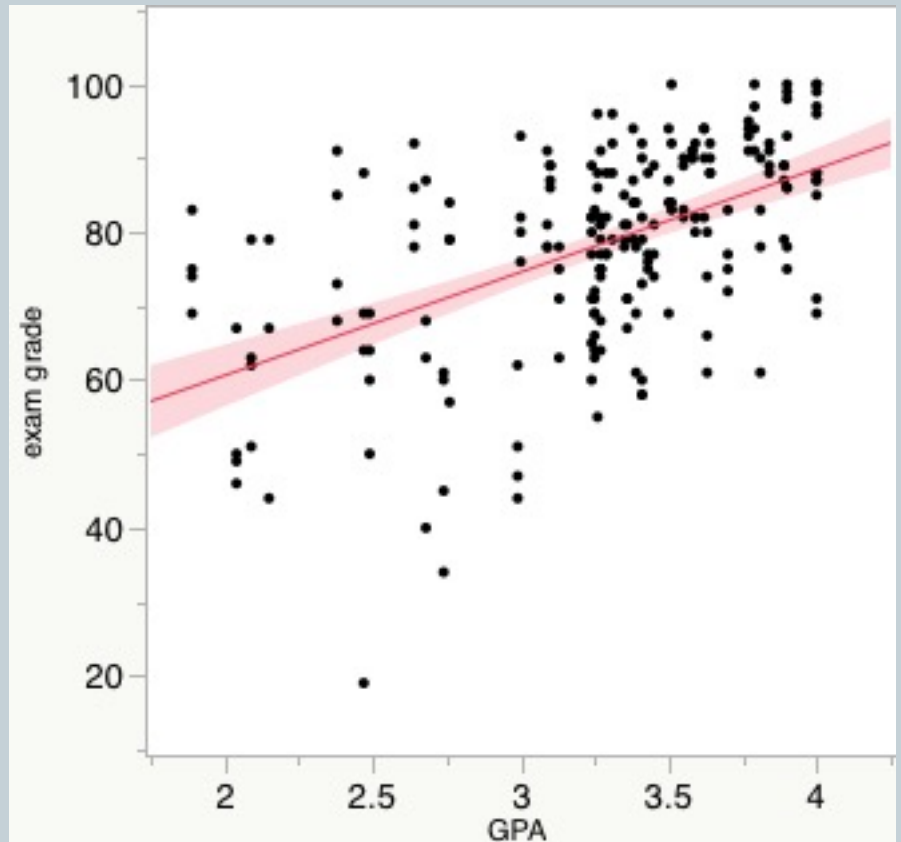
Fall 2015 pooled data regression

Pooled data for all four exams in one semester paired with reading score or video viewing
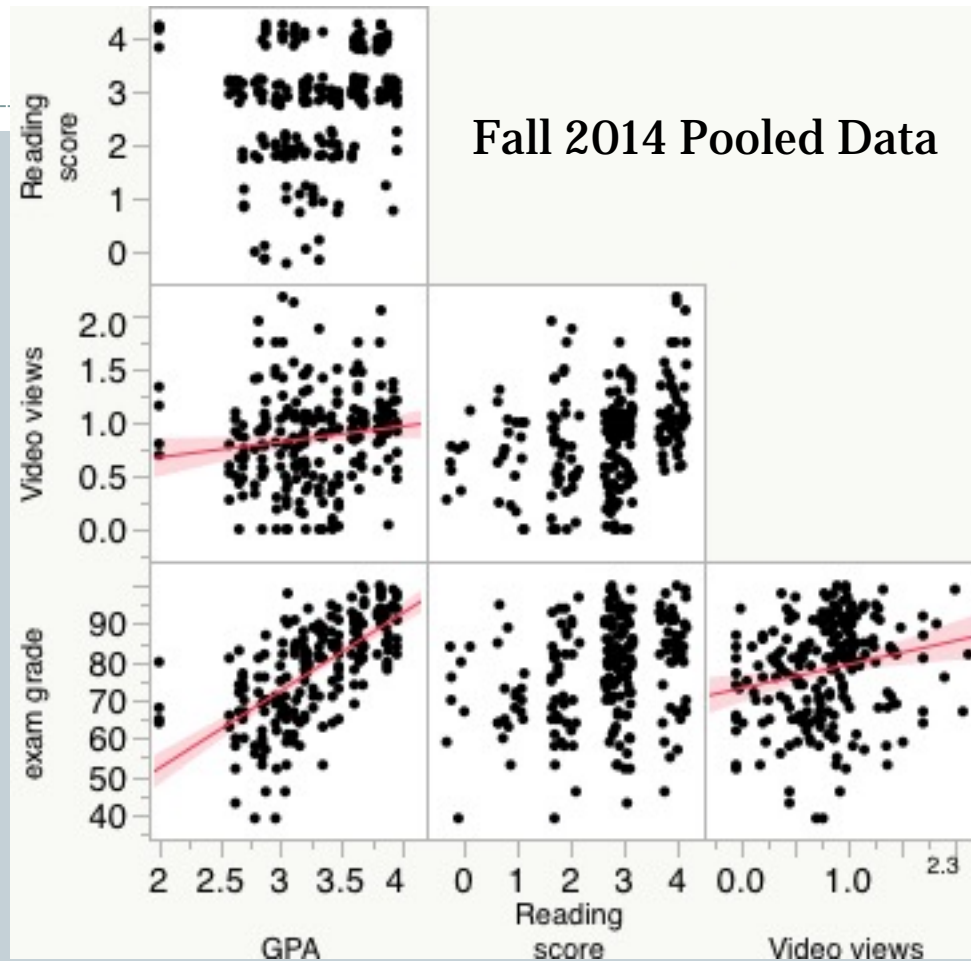
|	Fall 2014 N=224	Spring 2015 N=140	Fall 2015 N=213
Correlation between all exam grades and reading scores	Yes	Yes	Yes
Correlation between all exam grades and video viewing percentage	Yes	Yes	Yes

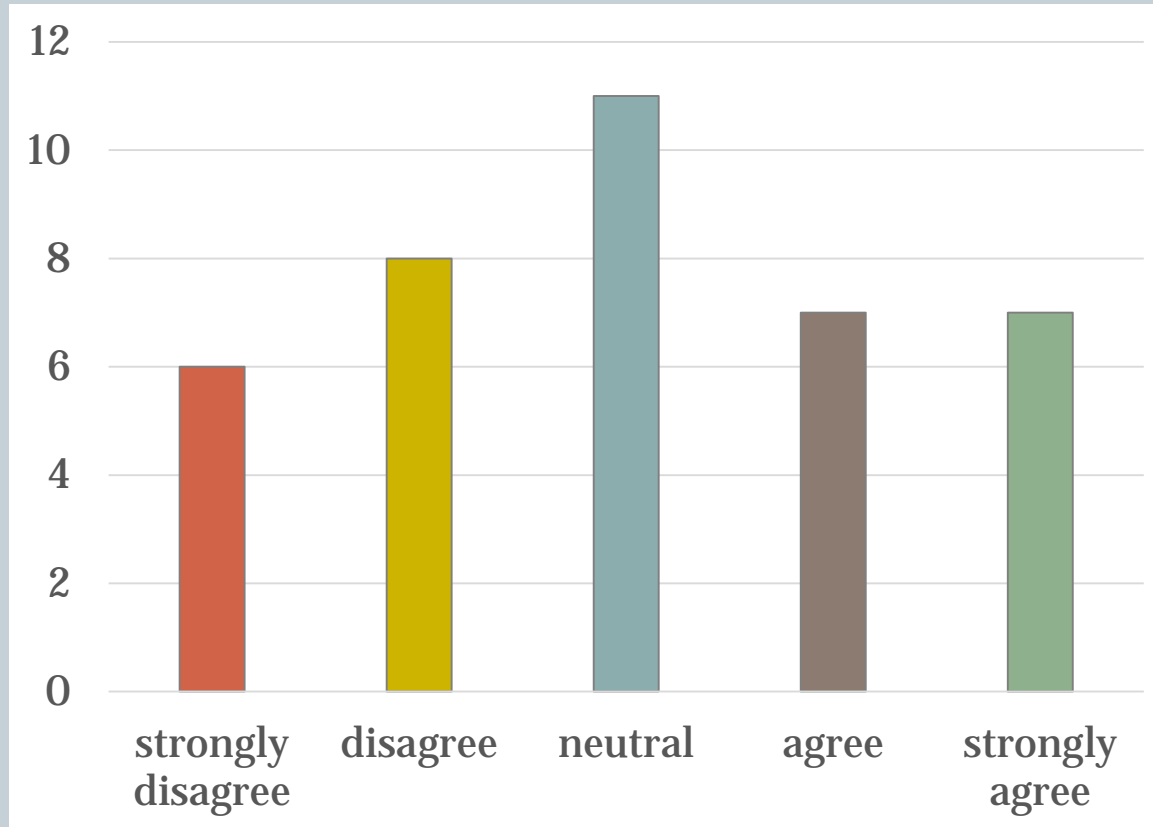Fall 2014 pooled video viewing Regression plot JMP

Mixed multivariate model

Fall 2014 Pooled Data

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
GPA	1	1	13708.310	146.0819	<.0001*
Reading score	4	4	1079.924	2.8770	0.0238*
Video views	1	1	216.958	2.3120	0.1299

I prefer watching videos to reading the textbook
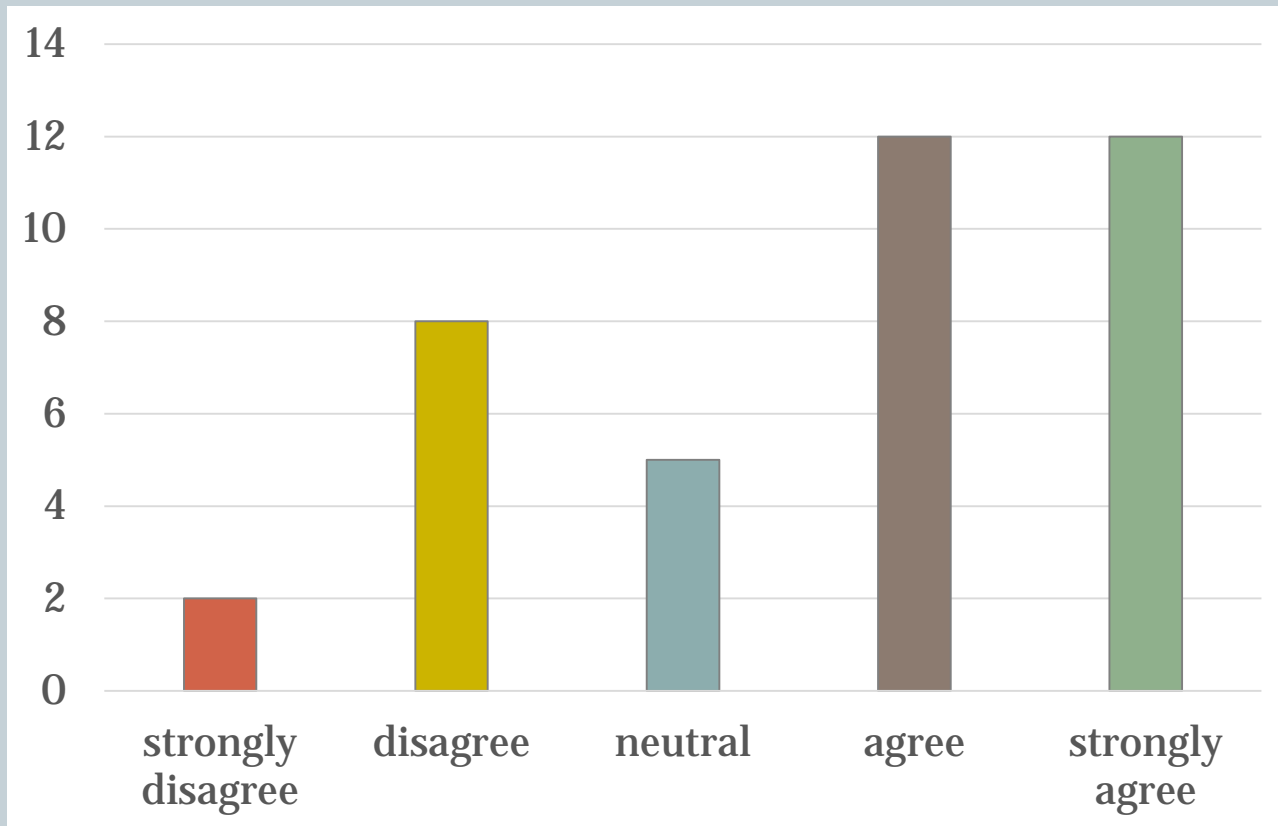
I would like to have more classes that use flipping

Acknowledgements

- Missouri S&T EdTech for assistance with closed captioning of videos and Kaltura data

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- Kaleb Bassett for assistance entering student survey data

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