Using the Readiness Assurance Process and Metacognition in an Operating Systems Course

Michael S. Kirkpatrick
Samantha Prins

Motivation and challenges

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Student preparation

- Accountability for completing reading assignments

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More active learning in systems courses

- Use contact hours for activities beyond low-level Bloom's

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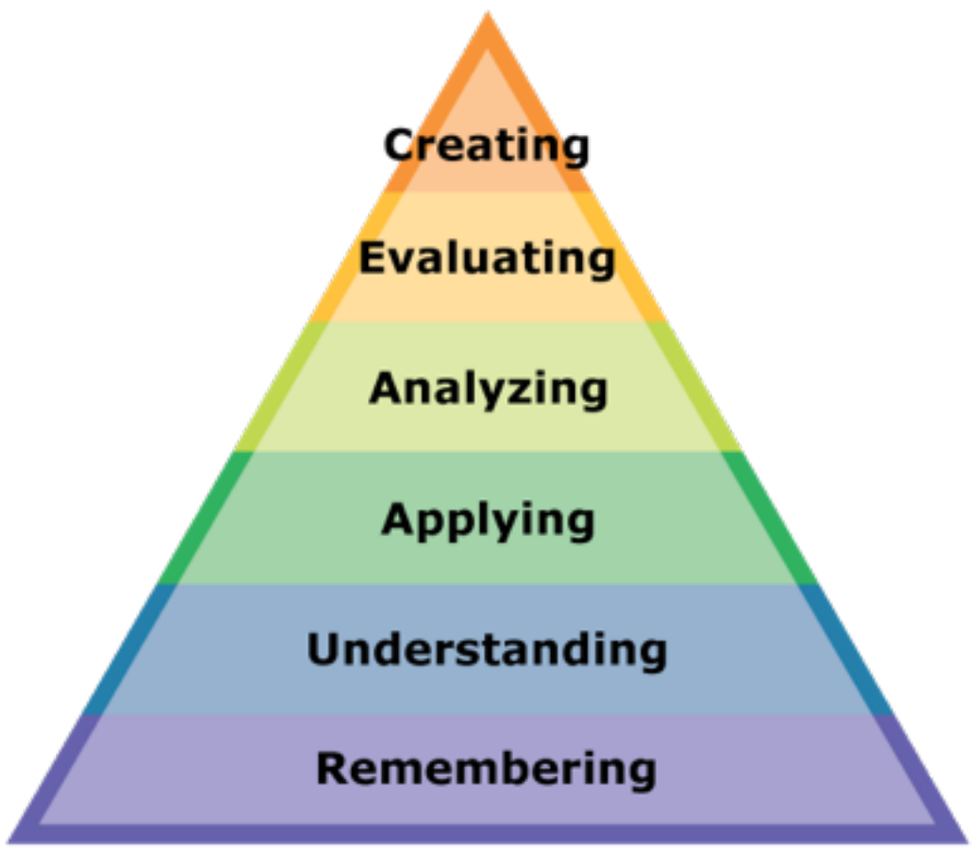

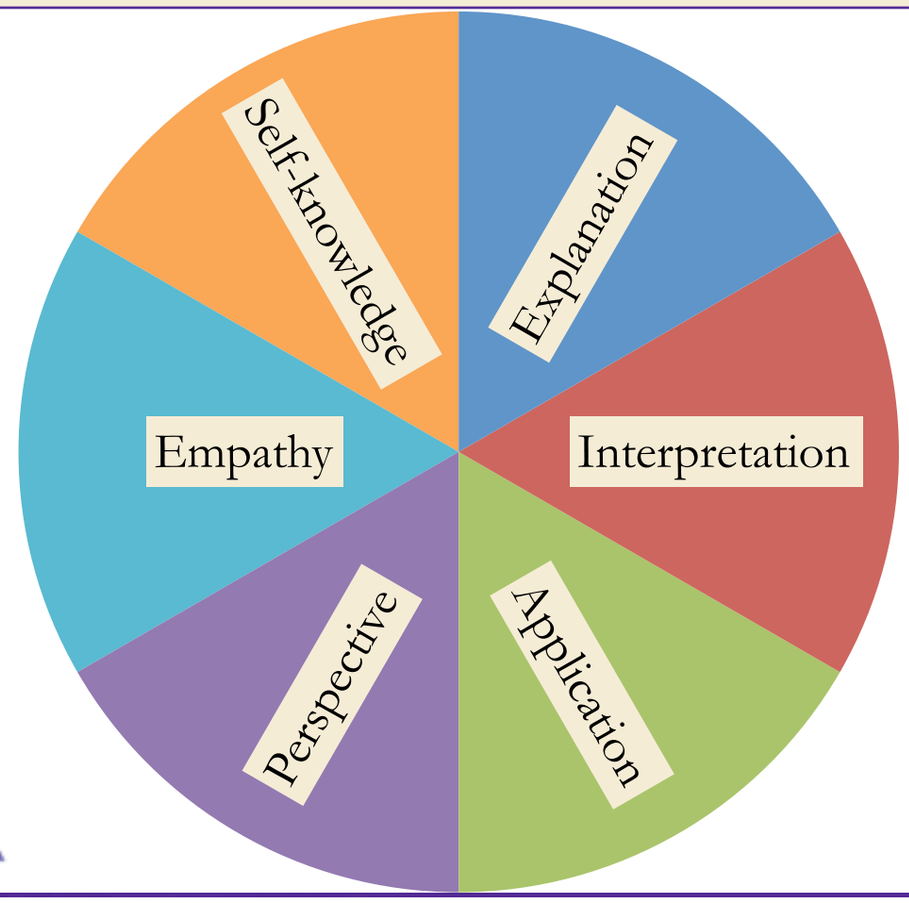

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Increase project motivation
- Pintos kernel projects are hard and time consuming

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Increase project motivation
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Move from strategic to deep learning
- Inspire and train students to become self-motivated, self-guided learners

Readiness Assurance Process

Team-based Learning (TBL)

- Flipped pedagogy developed by Larry Michaelsen
- Course divided into 5-7 modules
- Founded on constructivism and group process dynamics

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Preparation (Pre-Class)	Readiness Assurance Diagnostic - Feedback	Application of Course Concepts
	45-75 minutes class time	1-4 hours class time

1 Individual Study

2 Individual Test

3 Team Test

4 Written Appeals

5 Instructor Feedback

6 Application Oriented Activities

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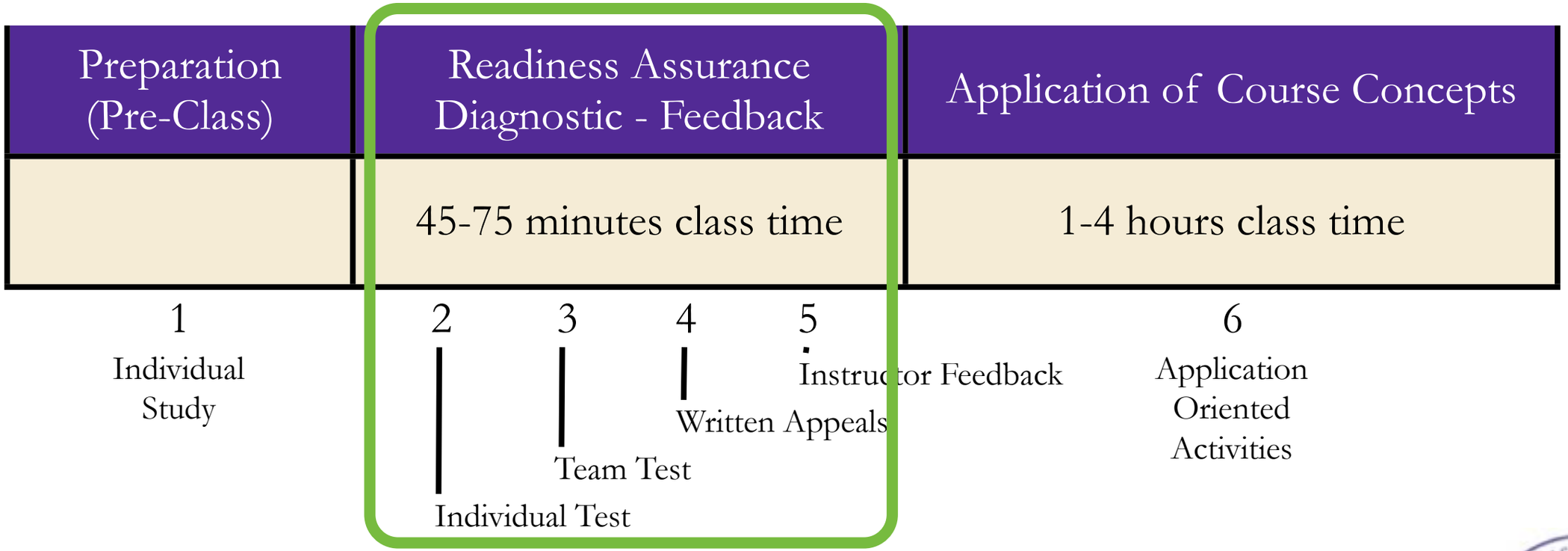
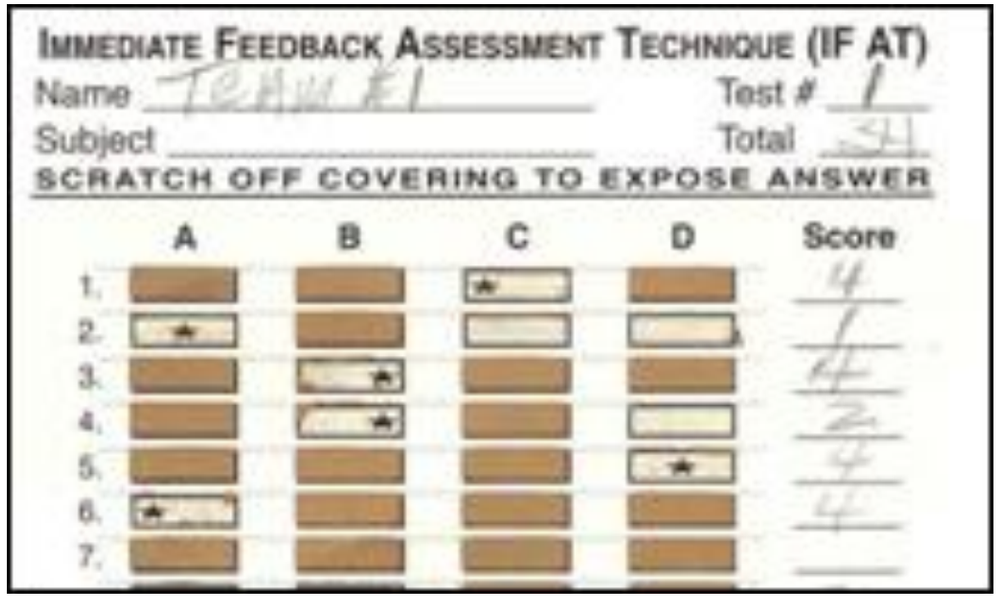


Readiness Assurance Process

In a multiprocessor system, multiple caches may store values for the same program variable. If the value changes in one cache, it should be updated in all the others. What is this phenomenon called?

(a) cache management
(b) race condition
(c) cache coherency
(d) tertiary storage


IMMEDIATE FEEDBACK ASSESSMENT TECHNIQUE (IF AT)
Name Team #1 Test # 1
Subject Total 34
SCRATCH OFF COVERING TO EXPOSE ANSWER

	A	B	C	D	Score
1.			★		4
2.	★				1
3.		★			4
4.		★			2
5.				★	4
6.	★				4
7.					

File information, such as the owner and associated permissions, are stored in what?

(a) directory
(b) superblock
(c) file-organization block
(d) inode

When critical system configuration files are given read-only permissions, thus preventing a normal user from modifying them, this security goal is achieved.

(a) integrity
(b) availability
(c) authentication
(d) confidentiality

RSQC^2 and metacognition

Metacognition

- Flavell: "thinking about thinking"
- Winn & Snyder: "*monitoring your progress* as you learn, and *making changes and adapting* your strategies if you perceive you are not doing so well"

Dr. Saundra McGuire
Louisiana State University

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, 34, 906 - 911.

Winn, W. & Snyder D. (1996). Cognitive perspectives in psychology. In D.H. Jonassen, ed. *Handbook of research for educational communications and technology*, 112-142.

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- Identify the most important or interesting point

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- Explain that concept in your own words

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- Analyze your approach to learning this week's material

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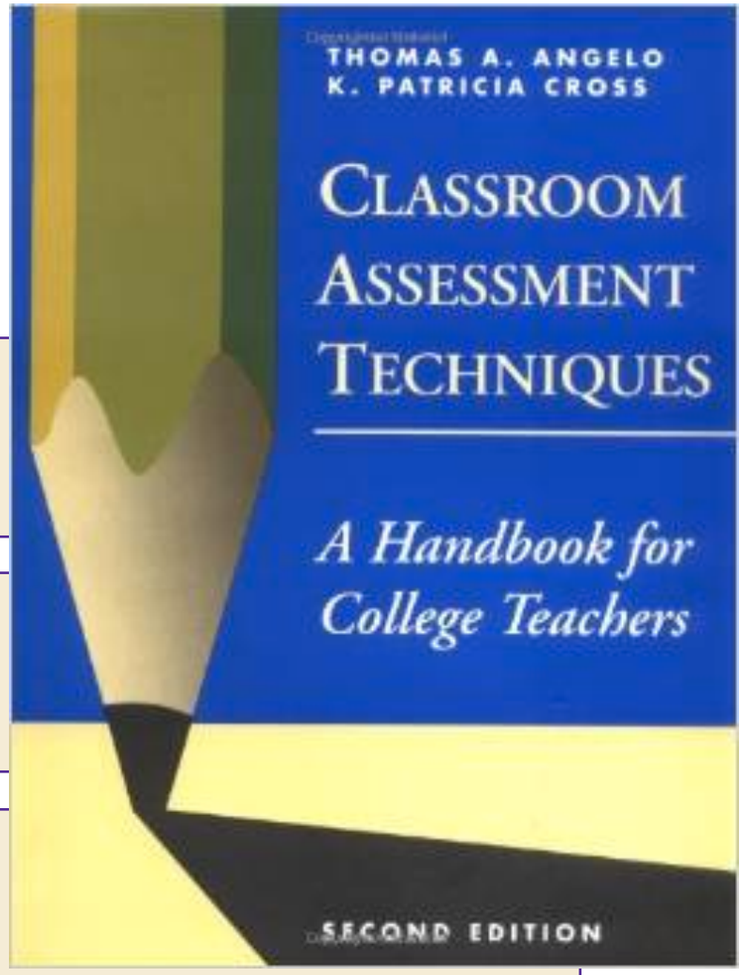

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- What one idea from this week did you find most interesting and why? [recall]

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- What one idea from this week did you find most important and why? [recall]

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- What one idea from this week did you find most important and why? [recall]

- Explain one concept that you understand more now than a week ago. [summarize]

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- Identify one thing from this week that you are confused about. This could be a concept from the lectures and/or book, a requirement of the current project, the relevance of this material, course policies, etc. Try to *explain what you don't understand or why it is confusing*. [question, connect, metacognition]

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- What can *you* do to overcome the confusion you just identified? [metacognition]

Weekly course structure

Complete readings, take iRAT online

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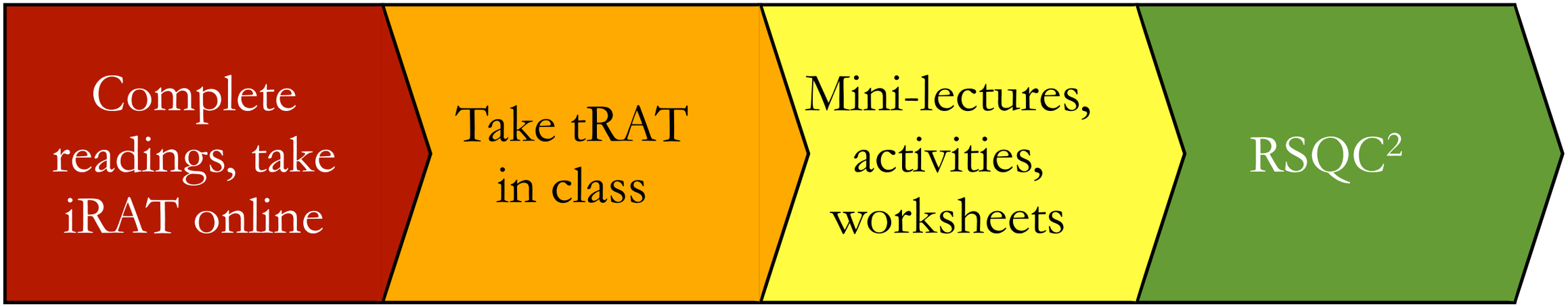

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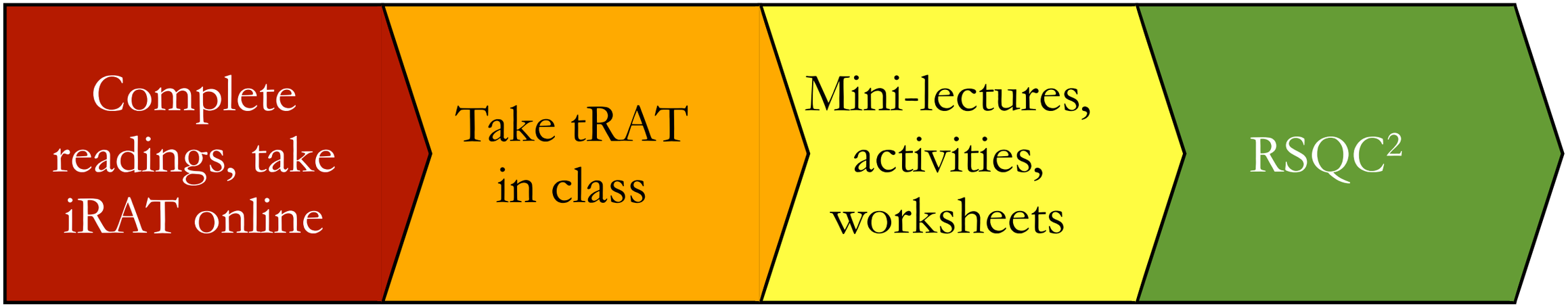
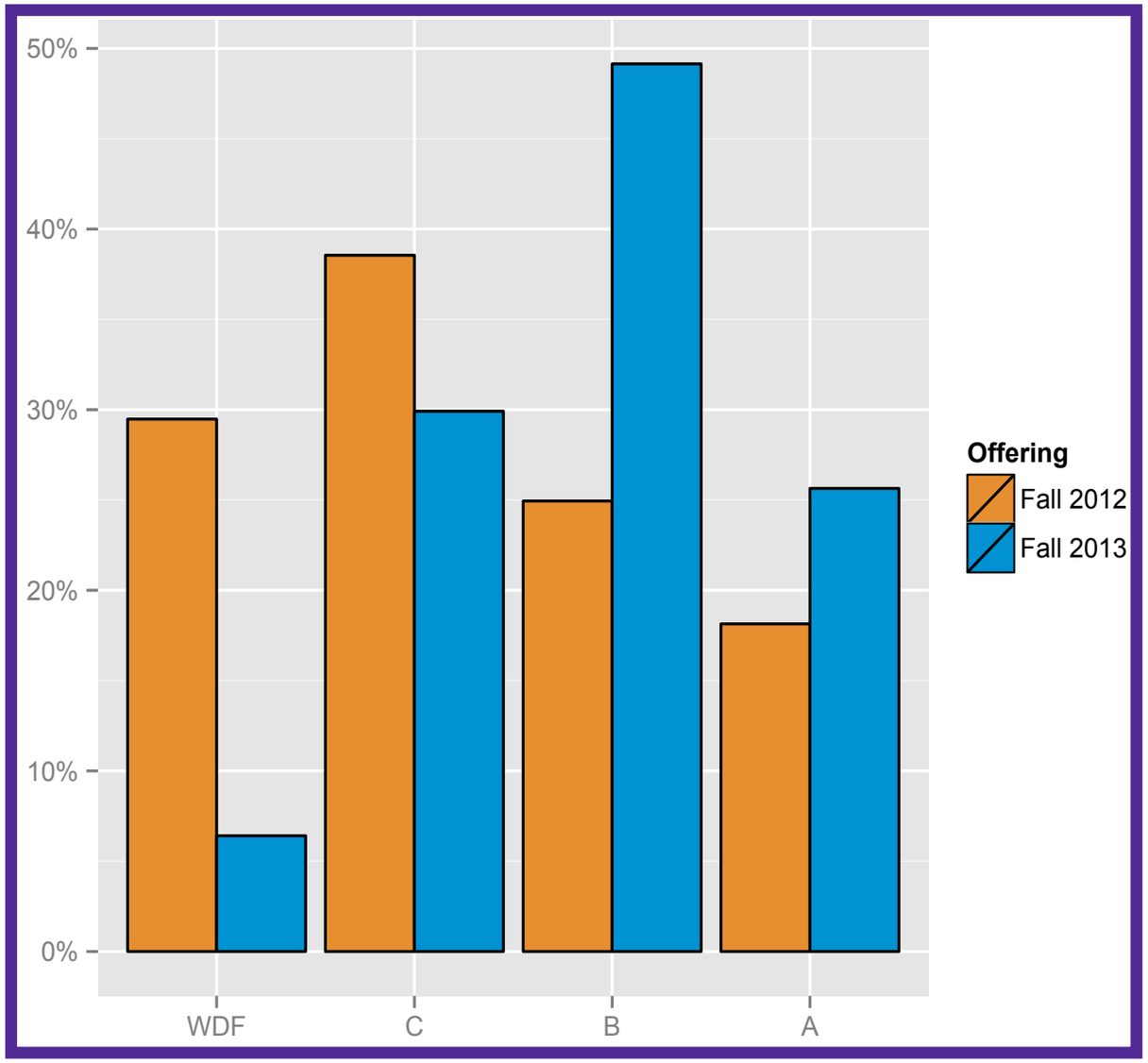


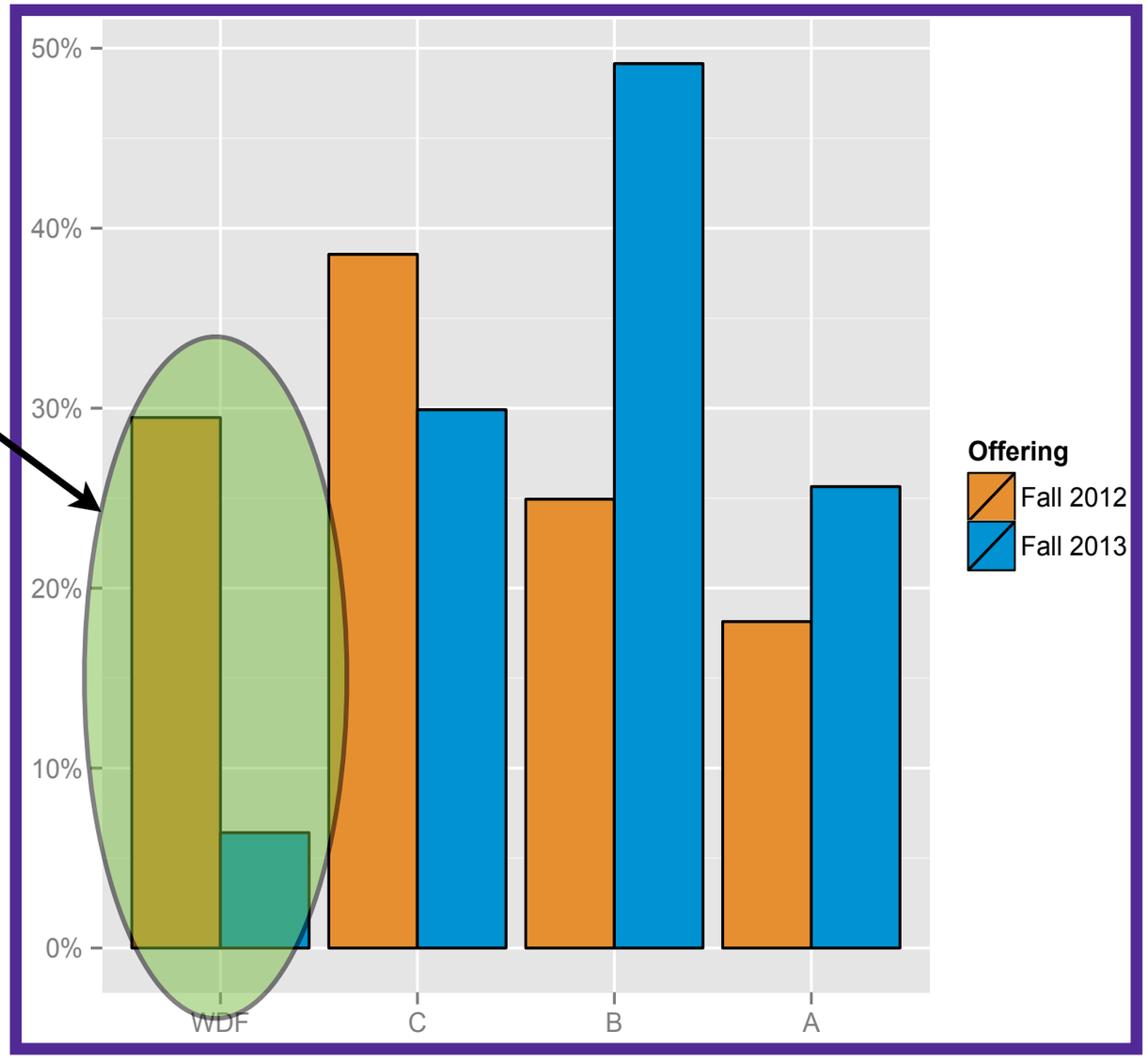
	Sat./Sun.	Mon.	Tue.	Wed.	Thu.	Fri.
In class:		tRAT, muddiest points		interactive lecture		interactive lecture
Out of class:	readings, iRAT					RSQC^2

WDF rate



WDF rate

From 13 to 3



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- Fall 2012: 23/44 A/B
- Fall 2013: 29/43 A/B
  - χ^2 yielded $p = 0.221$

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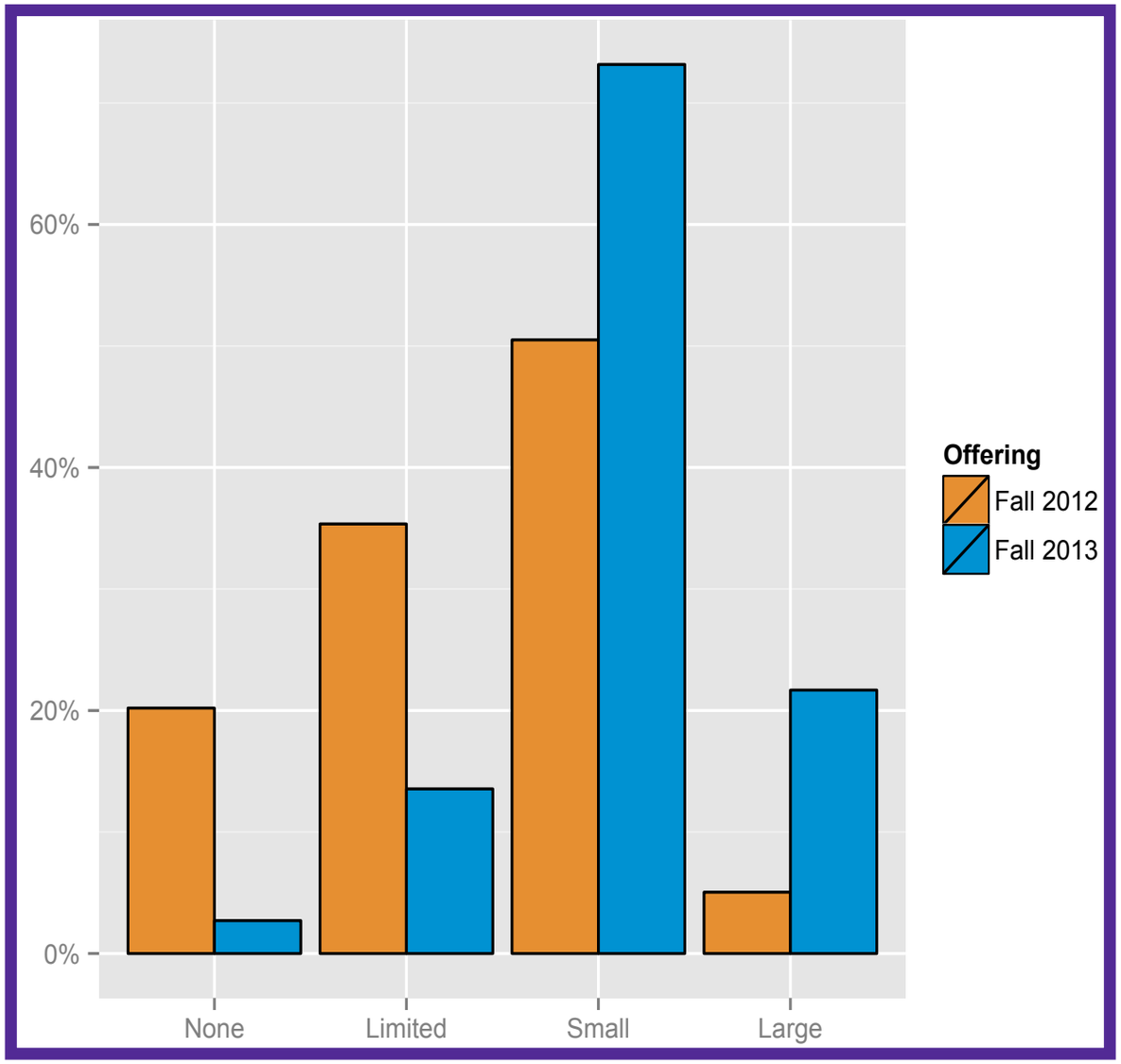

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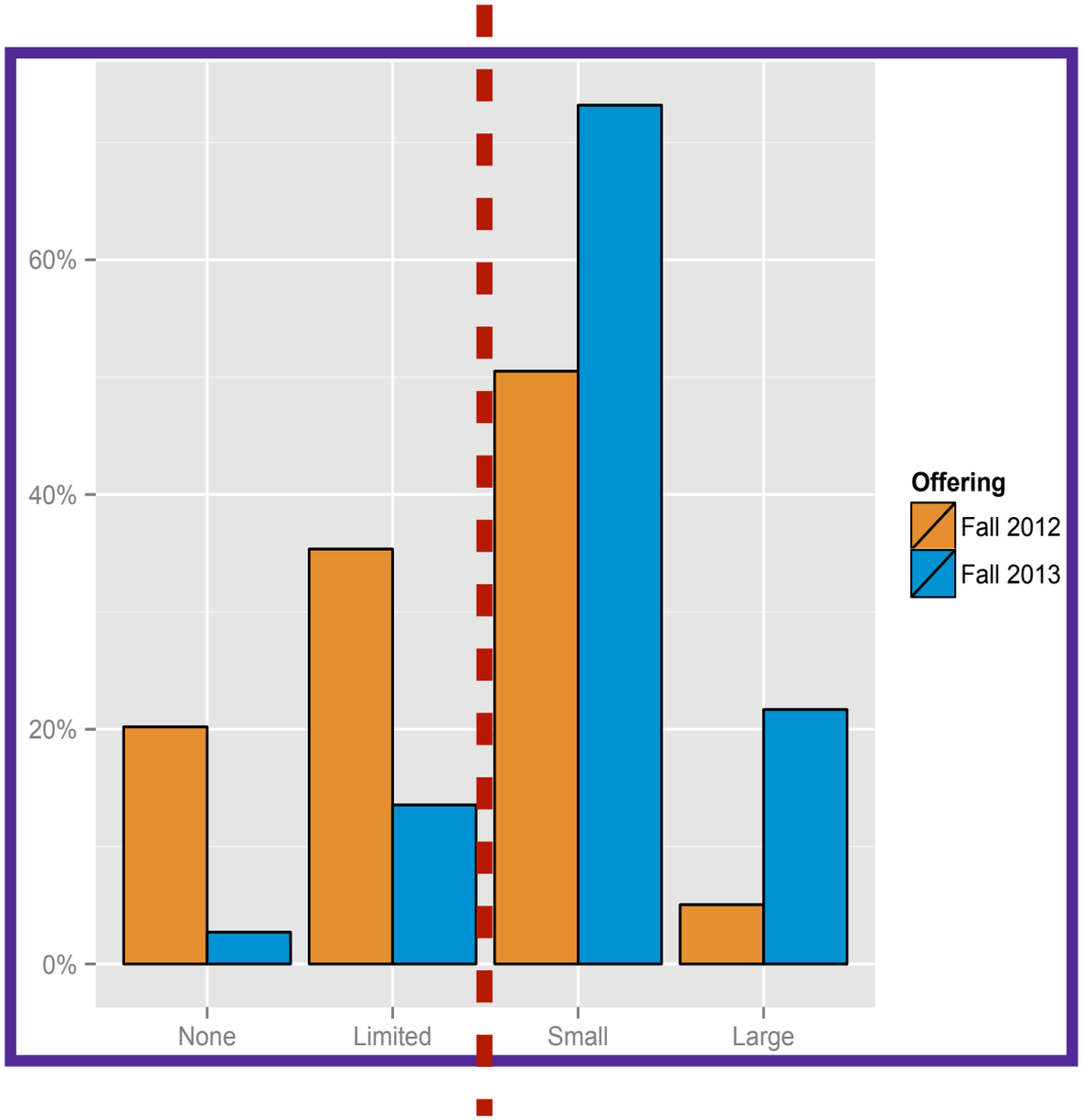

$p = 0.0551$

Impact on final exam grades

Factor	Estimate	Pr(>|t|)
(Intercept)	37.530	$1.6 * 10^{-12}$
C programming	8.562	0.000961
Prerequisite grade	7.658	$2.9 * 10^{-7}$
Intervention	24.228	0.001015
Prerequisite grade:Intervention	-4.301	0.076666

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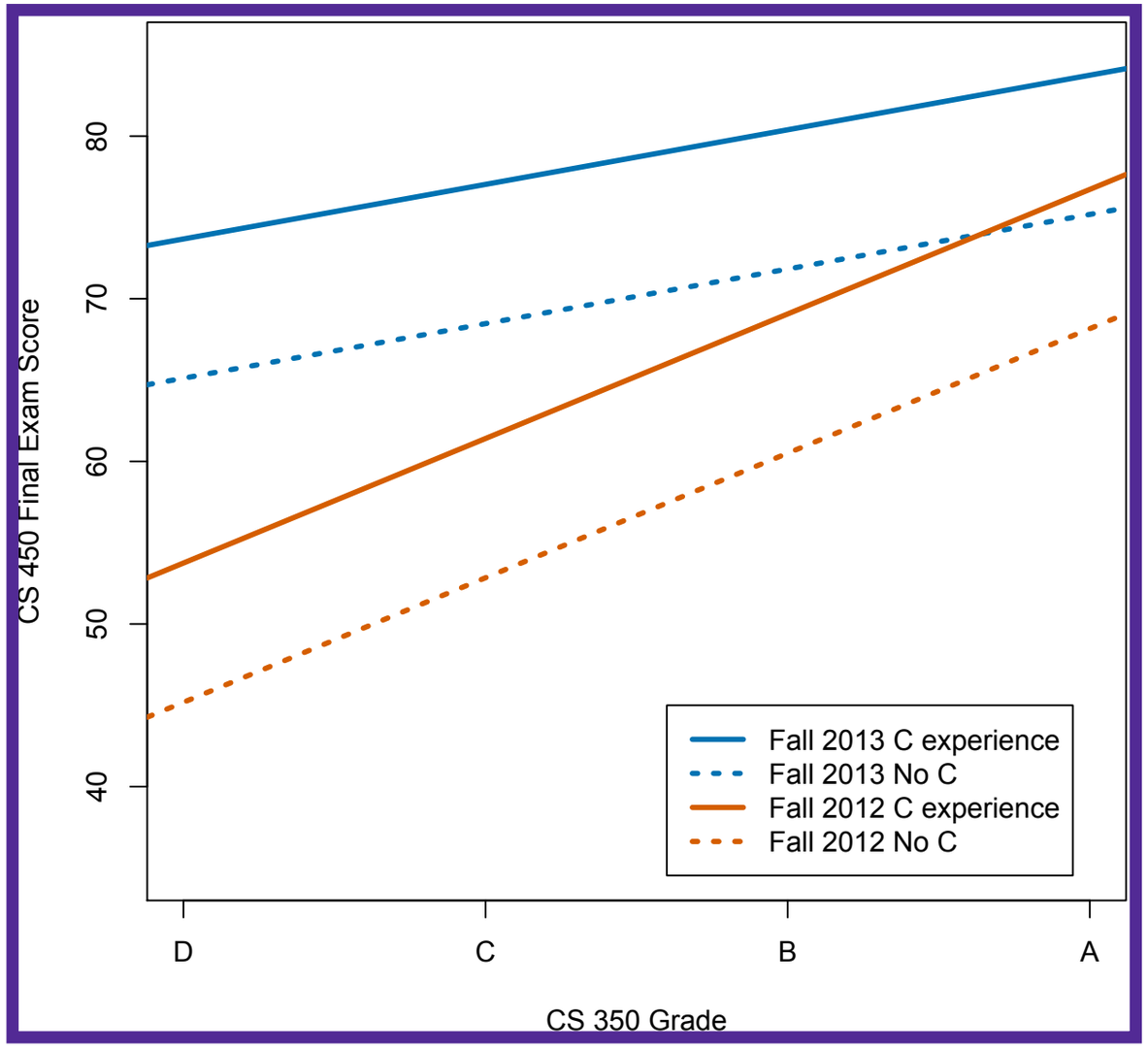

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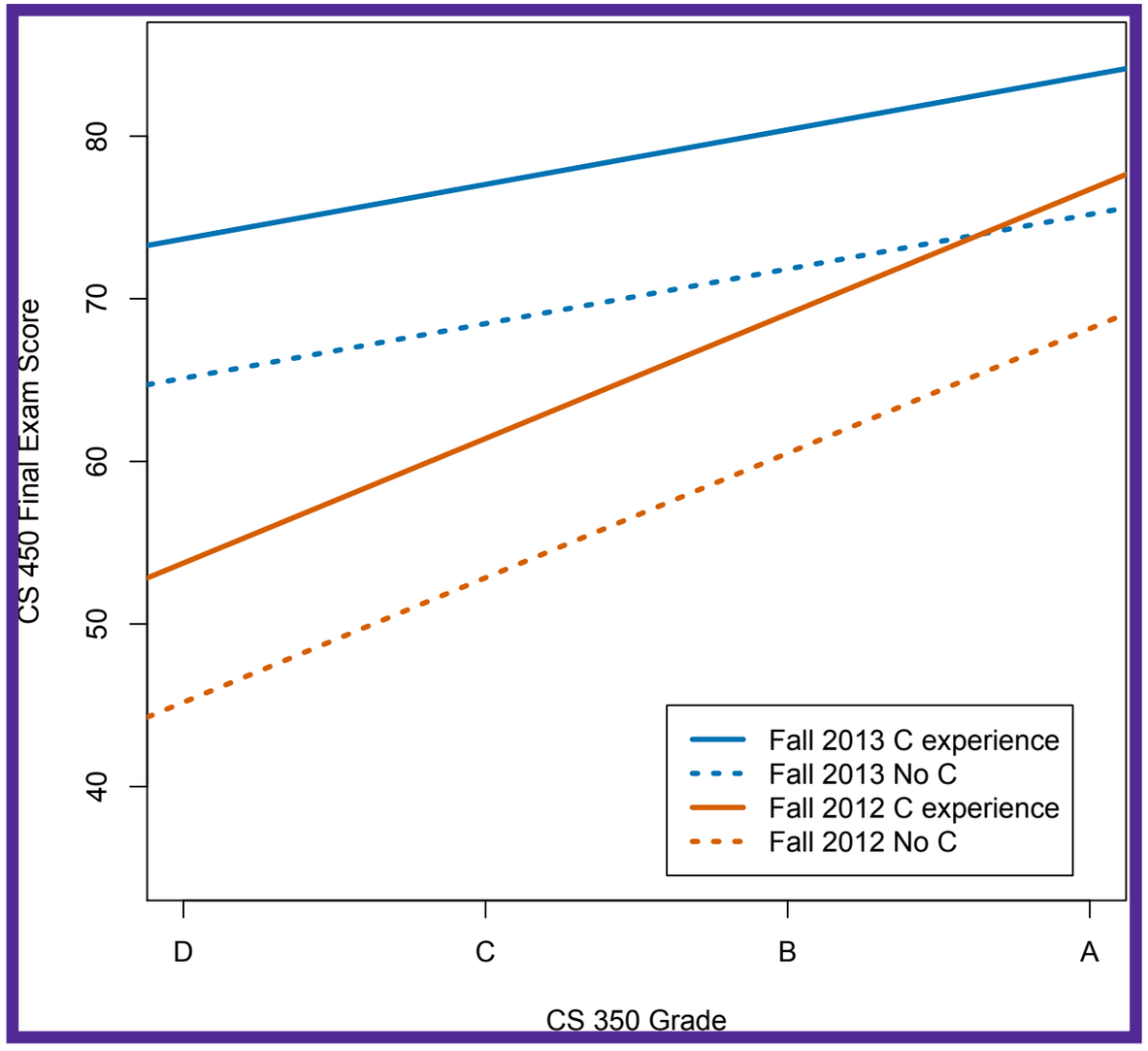

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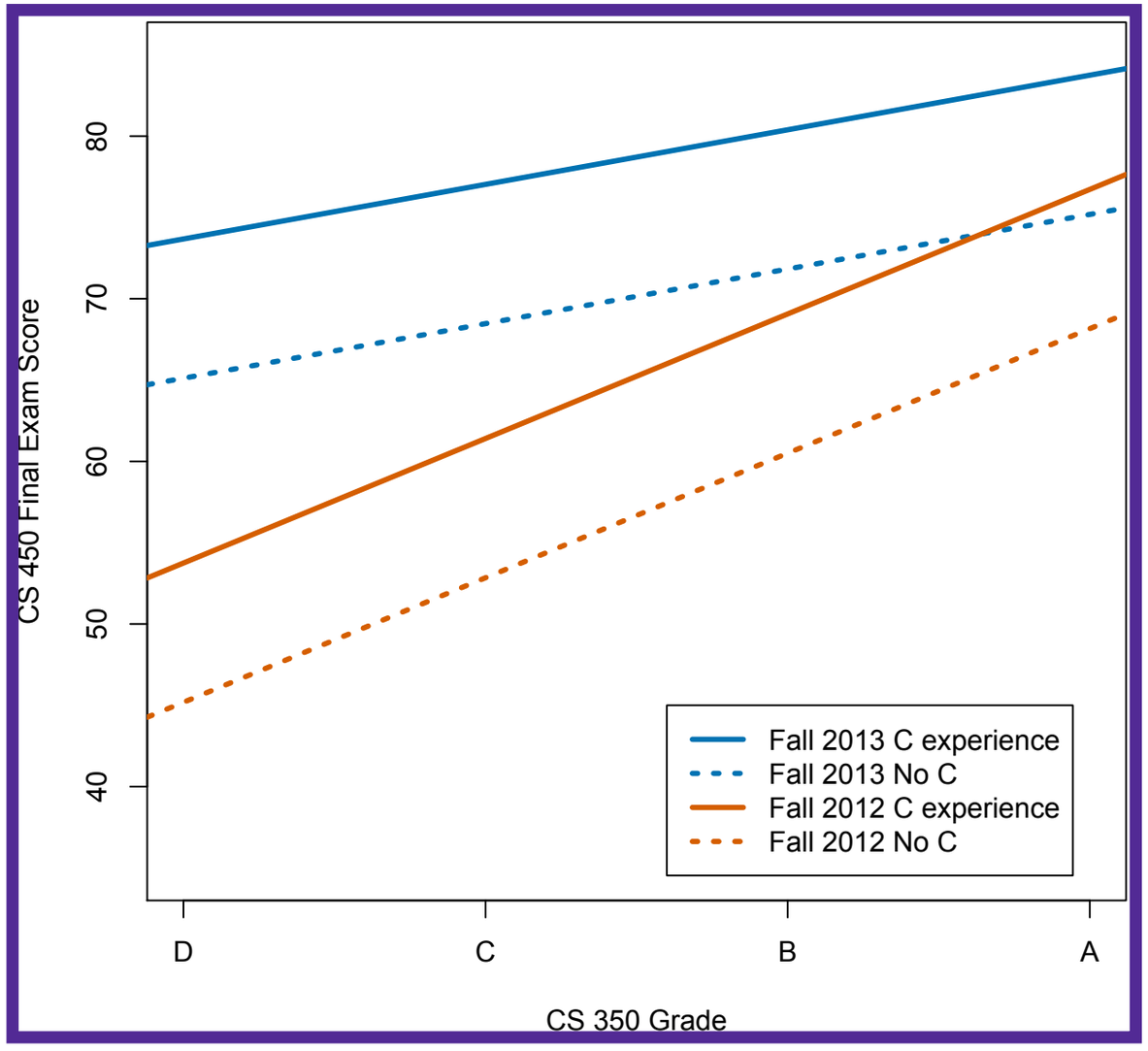

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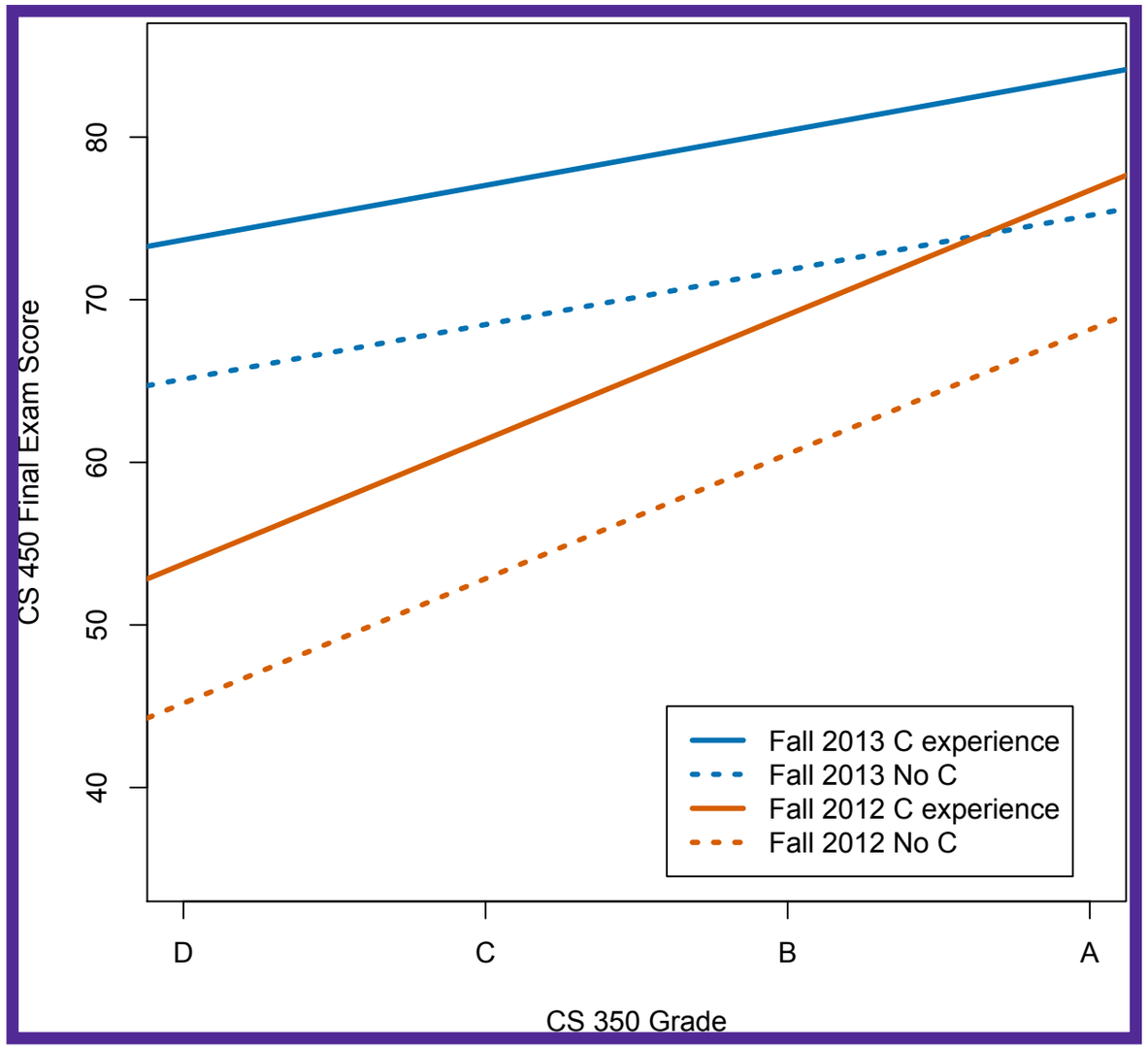

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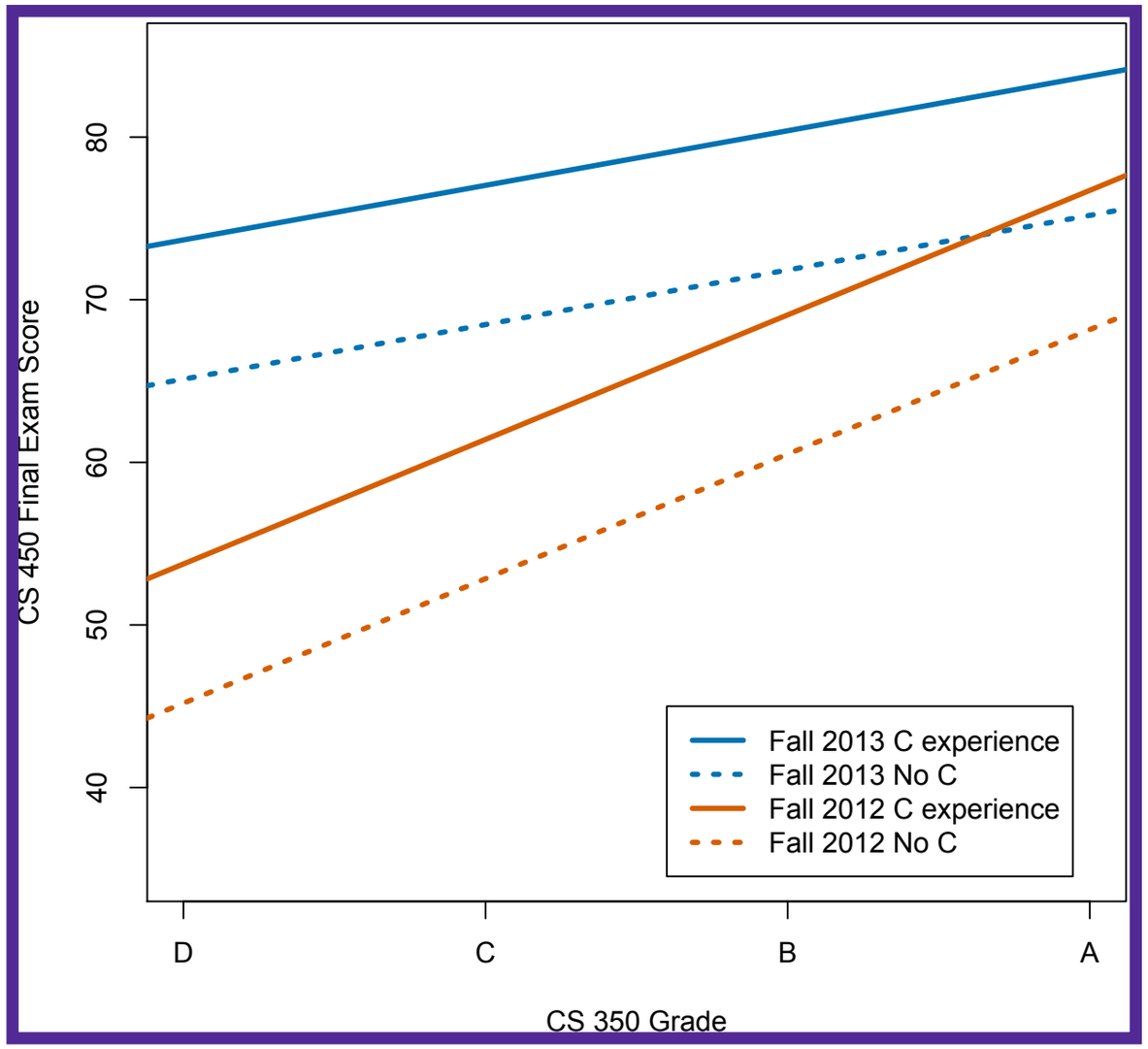

Linear regression model

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  - ANOVA $p = 0.4958$
- Significance of C programming
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- Grade/intervention interaction
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- Overall acceptable model
  - $p = 1.153 * 10^{-12}$
  - $R^2 = 0.5114$

Impact on projects

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  - $p = 0.09181$, $R^2 = 0.1535$
  - Intervention only significant factor ($p = 0.0678$)

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- Weak linear model based on team qualifications
  - $p = 0.09181$, $R^2 = 0.1535$
  - Intervention only significant factor ($p = 0.0678$)
- **Interesting**: C experience is **<u>not</u>** significant predictor for projects
  - Teams with less experience were able to catch up

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- Aggregate, rephrase, and ask on discussion forum

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- Establishing foundational knowledge or uncovering misconceptions

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Project alignment

- iRAT/tRAT questions about connections to project

Take-away messages

RAP and RSQC^2 as entry points to active learning

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  - Use LMS and IF-AT to automate grading

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- Potentially high reward
  - Overall improvements, especially for low-end students
- Effect of individual vs. team C experience as prerequisite
  - Individual = letter grade difference
  - Team = no difference in project completion
- Positive student feedback
  - Less complaining about project

Why I was tired...

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Questions?