



ASA Datafest 2024

R-Cubed

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What influences Student Engagement with Statistics?

Sample of School-Based and Out-of-School Factors Impacting Student Learning					
SCHOOL-BASED FACTORS		OUT-OF-SCHOOL FACTORS			
Teacher Quality	Academic Setting	Students	Home/Family	Community	
Professional Development	Curriculum Implementation	Disability Status	Socioeconomic Status	Crime	
Instructional Practices	Instructional Resources	First Language	Parent-Child Relationships	Community Infrastructure	
Teacher Expectations	School Climate	Physical and Mental Health	Parents' Educational Attainment	Population Demographics	
Cultural Responsiveness	Multi-Tiered Systems of Support (MTSS)	Developmental Differences	Household Status	Inequality	

Source: Multiple⁷

soucre: <https://schools.utah.gov/ulead/uleadfiles/reports/topicoverview/Factors%20Influencing%20Student%20Learning.pdf>

Inside the Classroom: What Makes People Engage with Statistics?

Students

Practical Application

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Intrinsic Interest

Teachers

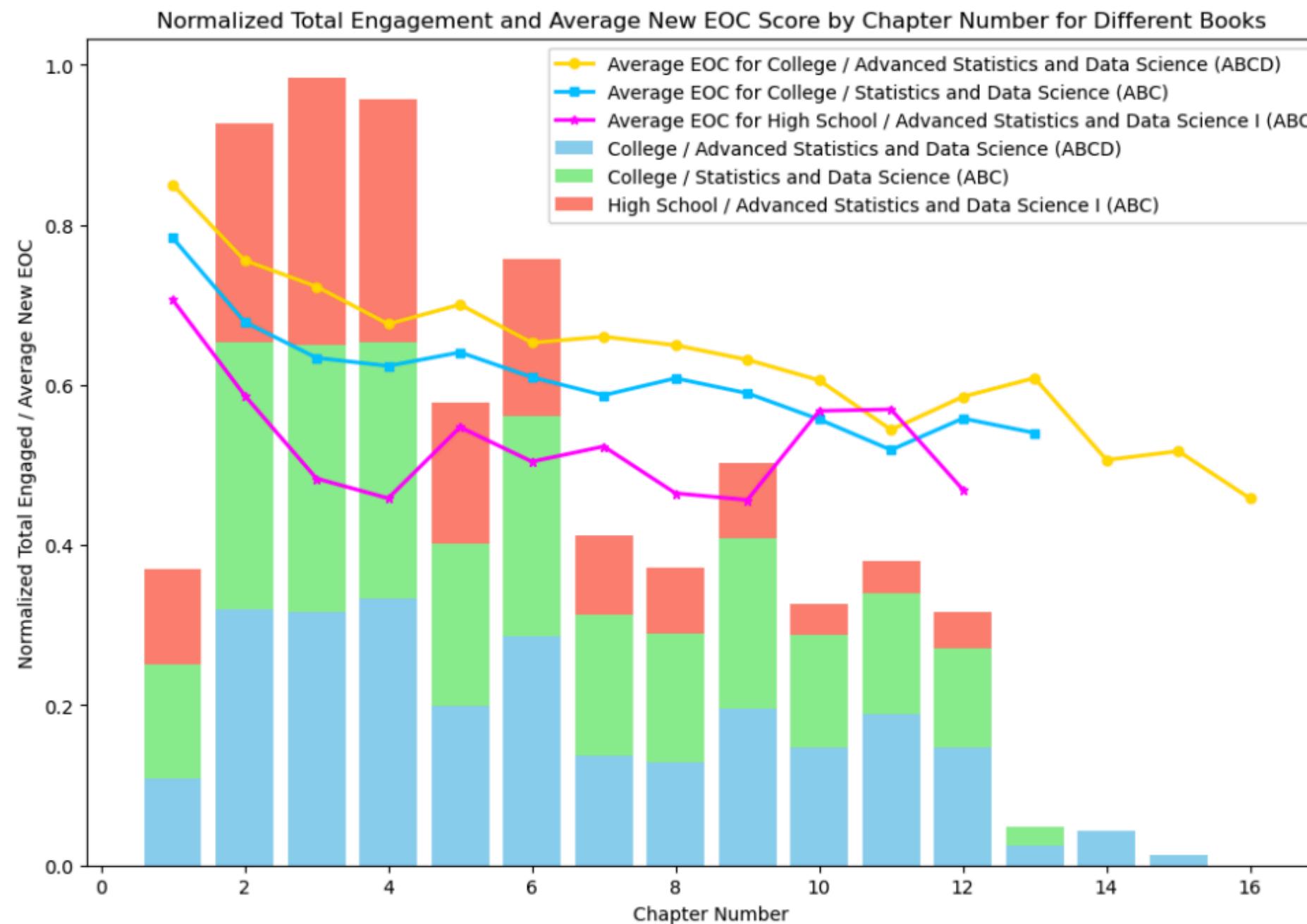
Asking the Right Questions

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Gauging Student Interest

W

Problem Statement: Improving Student Experience with Statistics in CourseKata Textbooks



We define higher EOC scores being indicative of students having a better experience in learning statistics.

Call:

```
lm(formula = avg_score ~ total_engagement + `Intrinsic Value` +  
`Utility Value`, data = lreg3_df)
```

Residuals:

Min	1Q	Median	3Q	Max
-0.54612	-0.09977	0.01022	0.10858	0.44306

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.414598	0.017975	23.066	< 2e-16 ***
total_engagement	0.077755	0.009224	8.430	< 2e-16 ***
`Intrinsic Value`	-0.109673	0.045870	-2.391	0.017 *
`Utility Value`	0.330116	0.047284	6.981	4.83e-12 ***

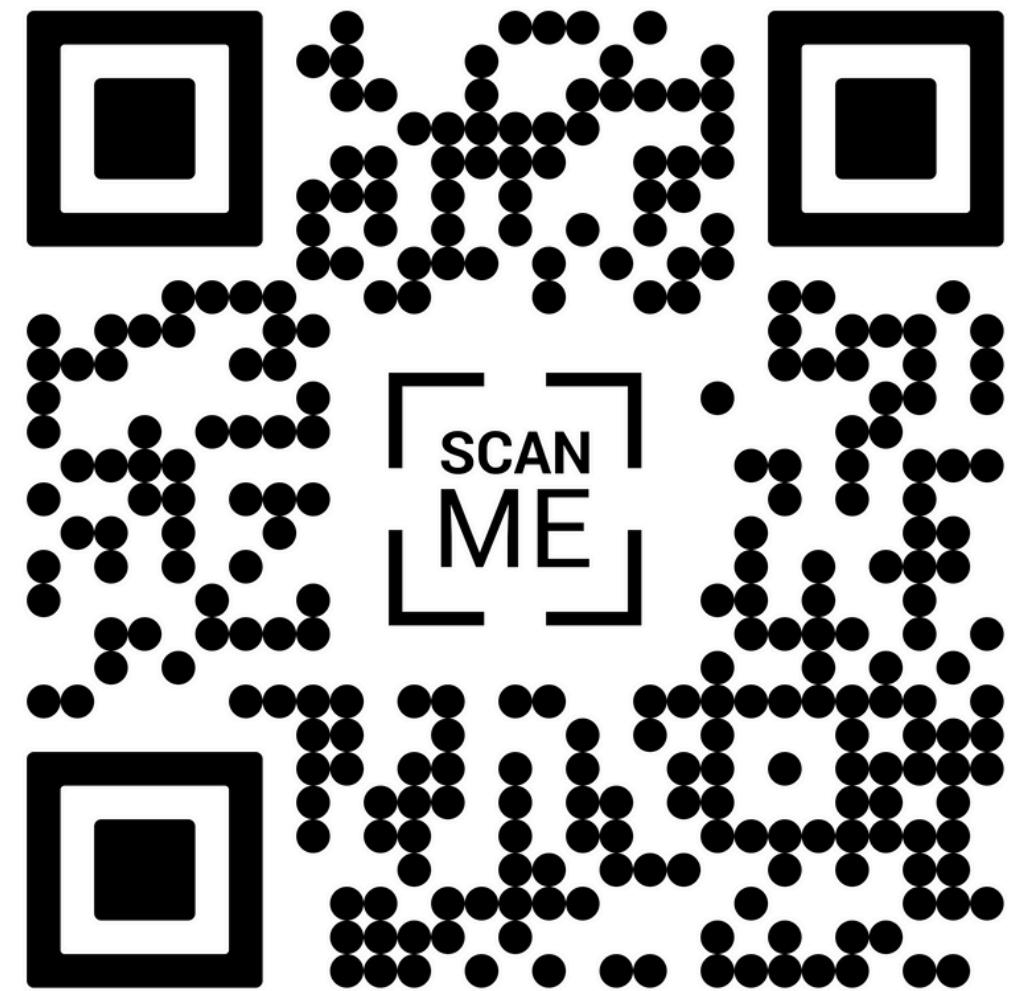
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

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Student Engagement Across Textbooks

This tool allows a closer view of each textbook and how they compare to one another. We found:

- ABCD had the most drop in engagement and EOC scores.
- ABC (College) had less drop in engagement and EOC scores.
- ABC (Highschool) had substantial drop in engagement, but EOC scores had little drop.



Suggestion

Using Student Engagement Across Textbooks in the Classroom

- Teachers can use this app to track trends in interest as students engage with textbooks over time and use it to revise their lesson plans.

Engagement and EOC Analysis

How does student engagement and EOC scores look over time?

Explored:

- Engagement vs EOC
- Chapters vs EOC

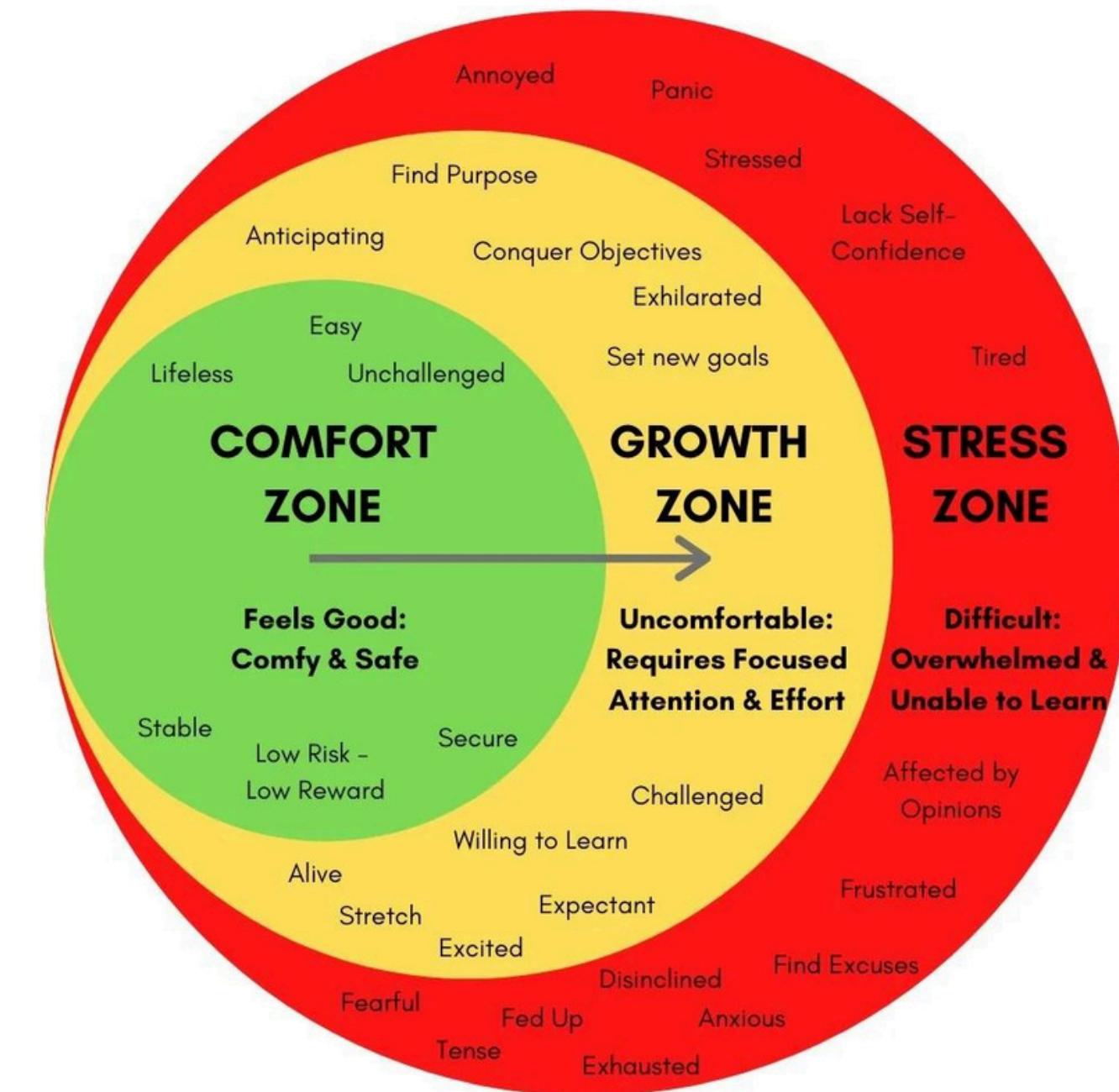


Suggestion

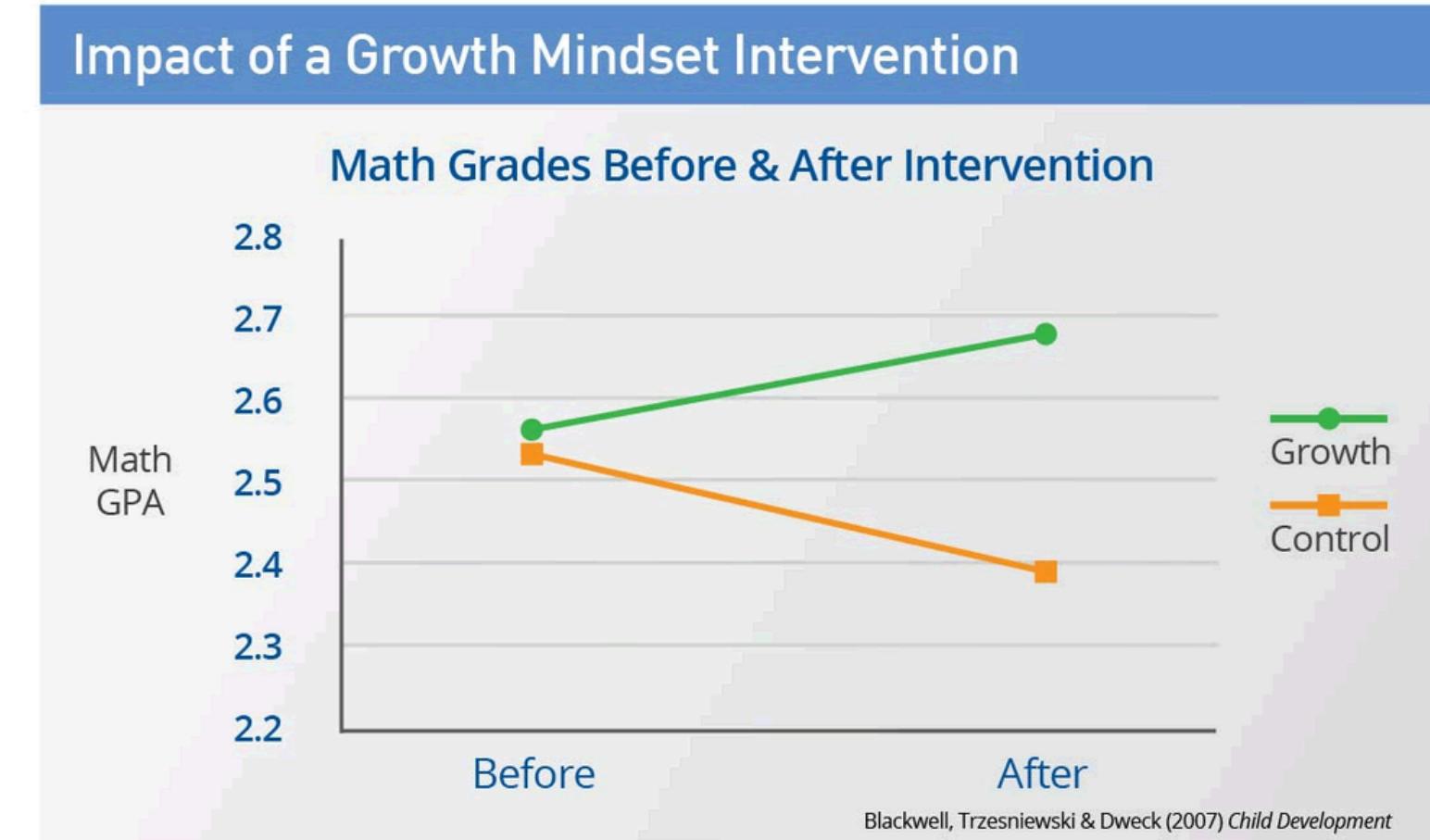
Introduce a diagnostic test to assess student understanding at the outset.

- Proof of Concept: UW Self-Guided Placements for Chemistry, Mathematics, Programming, and Foreign Languages.

Teacher Side: Asking the Right Questions



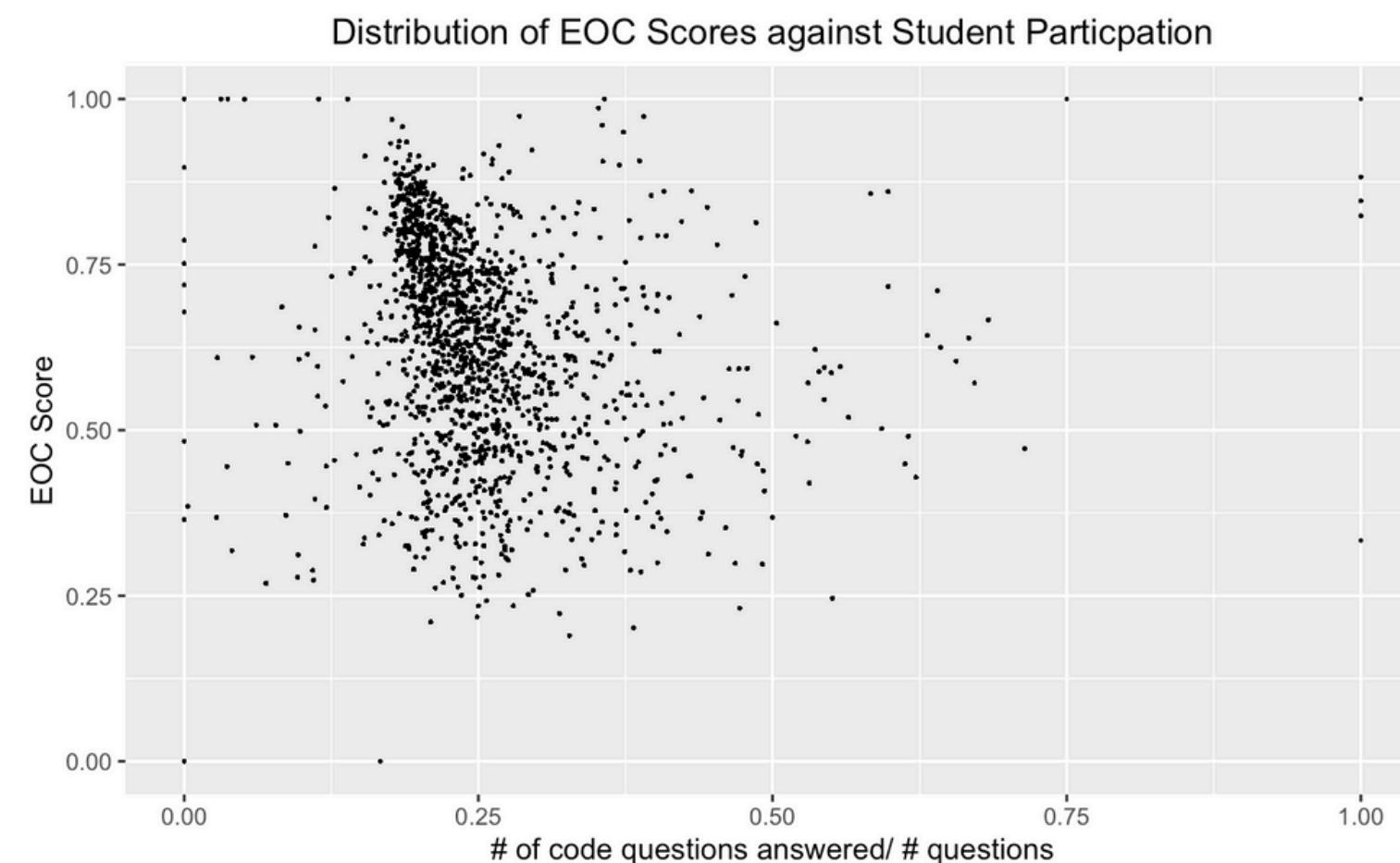
Teacher Side: Encouraging a Growth Mindset



Suggestions

- **Promote a growth-based approach to mathematics**
 - Include optional “excursion” topics to encourage students to pursue curiosity.

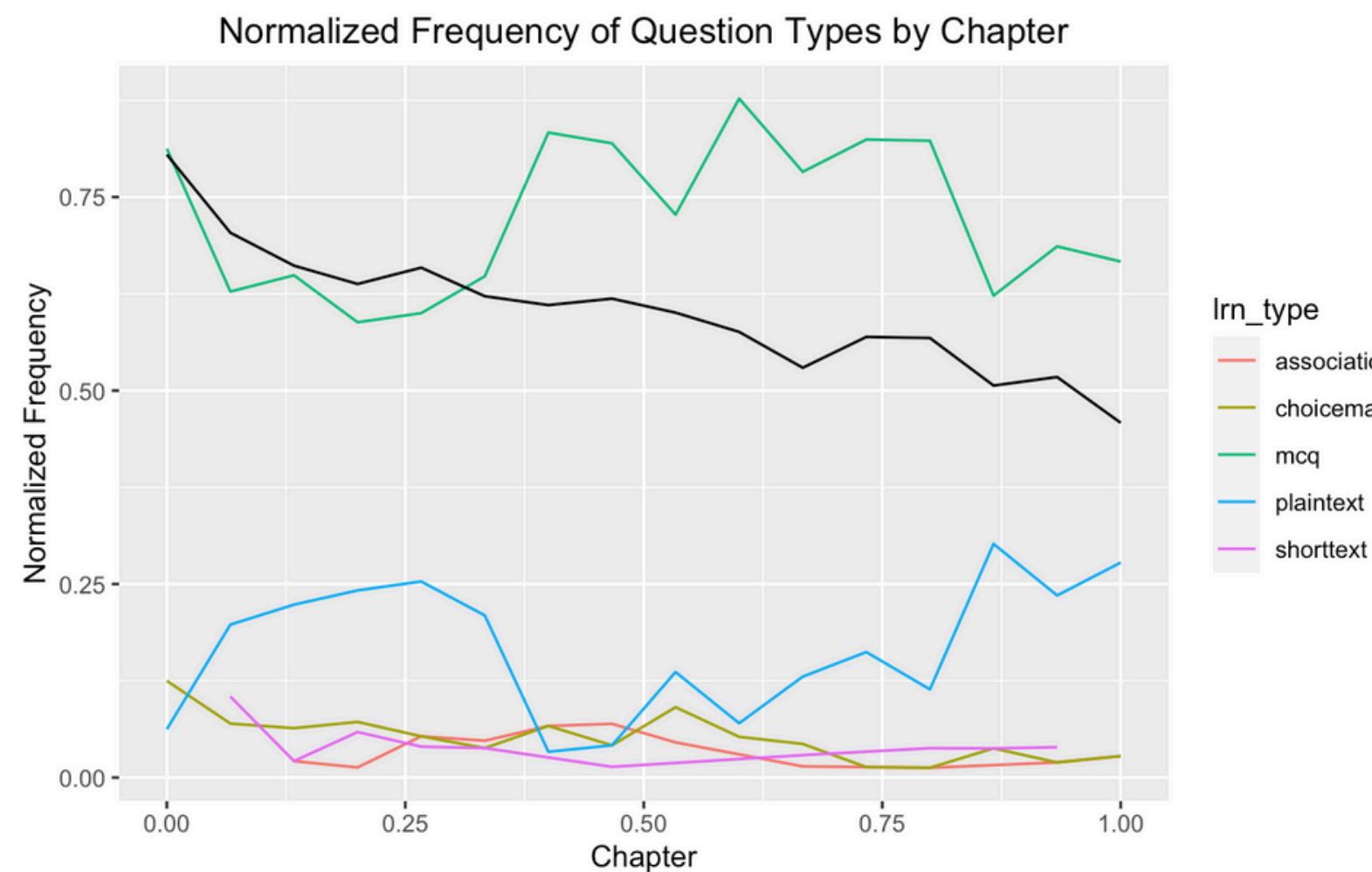
Student Participation Influence on EOC Scores



```
Call:  
lm(formula = avg_EOC ~ chapter_number + lrn_type, data = lreg11)  
  
Residuals:  
    Min      1Q  Median      3Q     Max  
-0.035232 -0.019823 -0.003485  0.014836  0.085143  
  
Coefficients:  
            Estimate Std. Error t value Pr(>|t|)  
(Intercept) 0.711375  0.010523 67.600 <2e-16 ***  
chapter_number -0.234125  0.011433 -20.478 <2e-16 ***  
lrn_typechoicematrix 0.008385  0.011270   0.744  0.460  
lrn_typemcq 0.008385  0.011270   0.744  0.460  
lrn_typeplaintext 0.008385  0.011270   0.744  0.460  
lrn_typeshorttext 0.001821  0.012581   0.145  0.885  
---  
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1  
  
Residual standard error: 0.02877 on 63 degrees of freedom  
Multiple R-squared:  0.8699, Adjusted R-squared:  0.8596  
F-statistic: 84.27 on 5 and 63 DF, p-value: < 2.2e-16
```

- Over 70% of questions students answer are multiple-choice questions
- Summary of linear model implies that asking a mcq question is no different than asking another type in improve student's experience of learning statistics
- Suggestion:

Question Type Influence on EOC Scores



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Suggestion

- **Evaluate and remove questions that may not contribute effectively to learning.**
 - Keep 50% of the current questions
 - Increase the number of implementation-based questions (ex: code, plaintext) compared to understanding-based questions (ex: mcq, association)

Suggestion

- **Implement a discussion board at the end of each section that allows students to post.**
 - Students would be anonymous to each other, but not instructors
 - Students can answer or talk about cool concepts and applications
 - Would promote intrinsic value and utility
 - Instructors and TAs can answer questions and offer resources to look further into concepts
 - Proof of Concept: Ed Discussion, Stack Exchange

An aerial photograph of a university campus during the day. The campus features several large, historic buildings with red brick facades and blue-tiled roofs. A prominent building in the center-left has a tall, light-colored tower topped with a green dome. The grounds are filled with mature green trees and manicured lawns. In the background, a city skyline with modern buildings is visible under a clear blue sky.

Thank You