

Investigating the connection between course grades and student participation in research-based assessments



Dylan Bloodworth  
Manher Jariwala

INTRODUCTION:

Low-stakes research-based assessments (RBAs) are voluntary opportunities for instructors to understand and integrate course transformation built on pedagogical research.

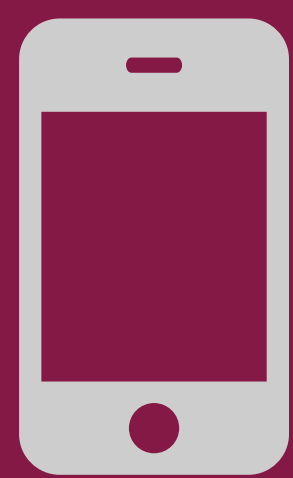
RESEARCH QUESTION:

A prior study by Nissen *et al.*<sup>1</sup> investigating participation rates as well as performance outcomes in low-stakes RBAs found a possible connection between student participation rates and final course grades. We explore this connection further at a different large research university using statistical methods from the previous paper.

METHODS

1. We retrieved physics students’ RBA test scores (*FMCE*<sup>2</sup> and *EMCS*<sup>3</sup>) and class letter grades from previous academic years.
2. We used R Studio to:
  - Investigate the class grade distribution over the course of 10 years.
  - Calculate non-participation rates of students categorized by their final grade.
  - Look at the odds ratio of participation rates in the groups earning A/B vs C/D grades. For example, 93% of A/B students took the pre-test (7% don’t), so the odds A/B students take the pre-test is  $93\%/7\% = 13.3$ . We can do the same for C/D students, then divide the odds for A/B by odds for C/D to get 3.3 times more.

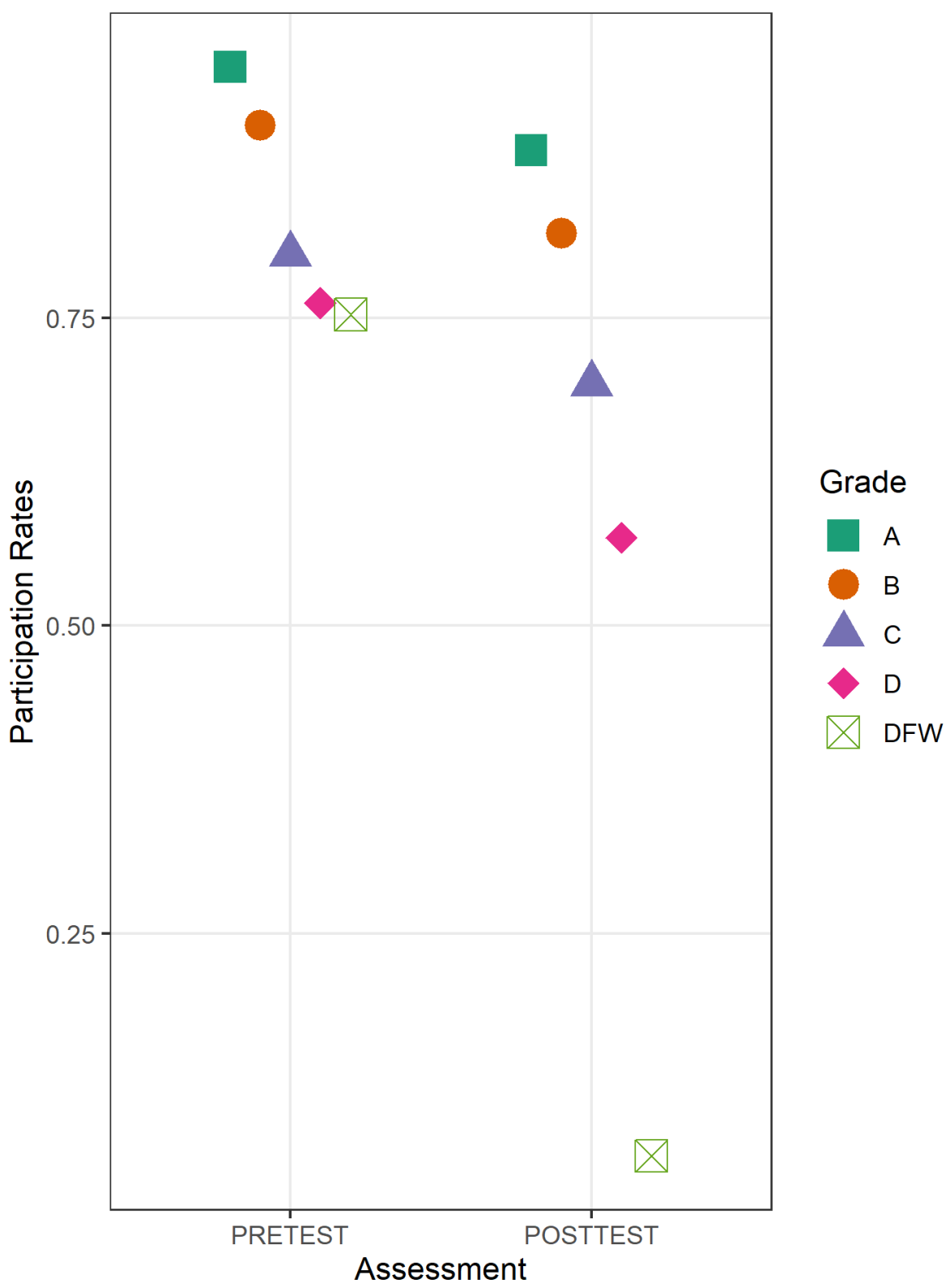
Students who earn A’s and B’s are *3.3 times* more likely to *participate in pre-tests* than those who earn C’s and D’s.



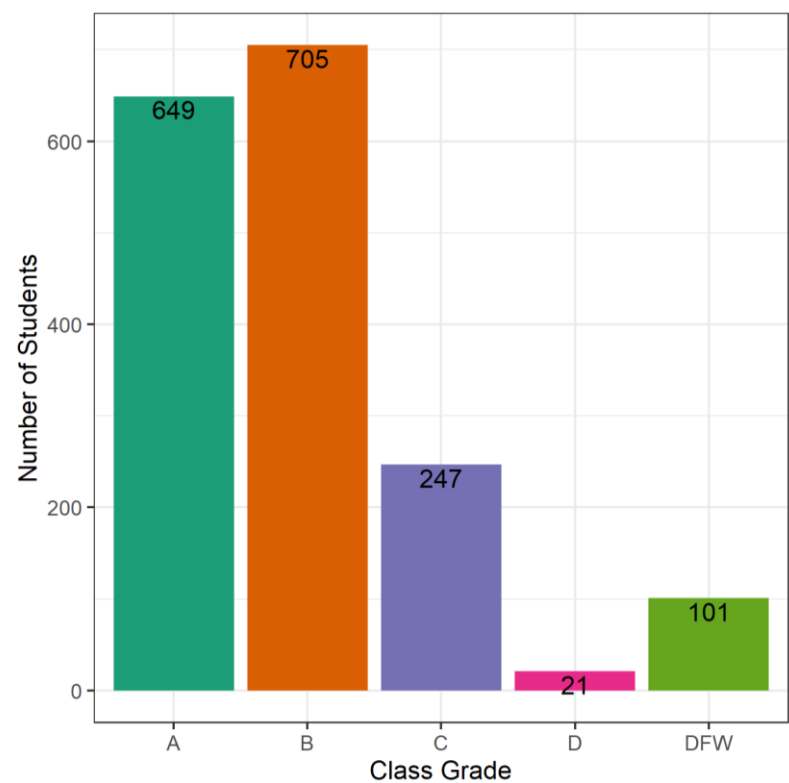
<http://tinyurl.com/BostonU-PER>

FIGURES AND TABLES

Cumulative student participation rates for pre- and post-tests, categorized by their final letter grades in the course, are shown on the right.



Detailed grade distribution and descriptive statistics are given below.



Exam Type	Semester	N	Participation		Student Distribution				
			PRE %	POST %	A	B	C	D	DFW
FMCE	F11	179	92.7	81.6	39	71	43	7	19
	F12	183	93.4	77.6	62	74	27	3	17
	F13	189	93.1	77.8	64	81	33	1	10
	F14	169	93.5	76.9	63	78	22	2	4
	F15	164	89	86.6	66	70	19	0	9
	F16	182	88.5	68.1	82	74	15	1	10
	F17	171	91.2	82.5	67	74	21	1	8
EMCS	F18	175	87.4	82.3	73	68	22	3	9
	F19	165	86.1	72.1	68	59	26	3	9
	F20	146	81.5	74	65	56	19	0	6

TABLE 1. Statistical analysis of student participation rates for ten full semesters. Includes overall course's final class grade distribution and which RBA was given.

RESULTS

We have analyzed the relationship between course grades and participation rates in pre- and post-tests. Students who earn A’s consistently show the highest participation rates, followed consecutively in order by students who earn final grades of B, C, D, or Drop/Fail/Withdraw. This is consistent for both the pre-tests and the post-tests, as well as for two different research-based assessments.

In general, pre- and post-test data are less likely to include students who are underperforming in a class. This limited focus on higher-performing students could potentially lead to incorrect conclusions about newly integrated course transformation.

<sup>1</sup> J.M. Nissen, M. Jariwala, E.W. Close, and B. van Dusen, Participation and performance on paper- and computer-based low-stakes assessments. Intl. J. STEM Ed 5, 21 (2018).  
<sup>2</sup> R. Thornton and D. Sokoloff, Assessing student learning of Newton's laws: The Force and Motion Conceptual Evaluation and the Evaluation of Active Learning Laboratory and Lecture Curricula, Am. J. Phys. 66 (4), 338 (1998).  
<sup>3</sup> C. Singh and D. Rosengrant, Multiple-choice test of energy and momentum concepts, Am. J. Phys. 71 (6), 607 (2003).



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