Use of Pre-Instruction Tests to Predict Student Course Performance

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How Predictive of Course Performance are Conceptual Pre-test Scores?

- Halloun and Hestenes (1985): Administered "Mechanics Diagnostic Test" (early version of FCI) and mathematics diagnostic test in general physics courses at Arizona State University

- Course performance determined by scores on class exams

- Examined both algebra- and calculus-based courses that used traditional instruction

Halloun and Hestenes (1985):
Findings

- Scores on physics concept pretest and on math skills pretest were highly correlated with course performance, but nearly uncorrelated with each other (i.e., they were *independent* factors)

- Students with *combined* physics + math pretest scores < 43% had only 5% probabiliity of earning course grade over C

Halloun and Hestenes (1985): *Findings*

- Mean physics pretest scores for students earning various letter grades (calculus-based physics, N = 192, 16% earn A's):

A: 63%

B: 55%

C: 47%

D/F: 42%

Comparison: Large State University (2003)

- Mean FCI pretest scores for students earning various letter grades (calculus-based physics, N = 412, 24% earn A's):

A: 70%

B: 54%

C: 45%

D/F: 37%

Comparison: Arizona State University (2012-13)

- Mean FCI pretest scores for students earning various letter grades

(calculus-based physics, 3 semesters combined; IE instruction; N = 107, grades determined from exams, quizzes, and homework; 32% earn A's):

A: 57%

B: 41%

C: 41%

D/F: 32%

Confounding Factors

- When grades depend heavily on homework and multiple quizzes, "motivation" (and/or consistency) is a key determining factor

- Some students with very high pretest scores fail to attend or submit homework on regular basis, lowering their final grades

What Grade is Predicted by FCI Pretest Score?

- Henderson (2002), U. of Minnesota

(N_{total} = 2020; 21% earn A's; pre ≈ 45%, post ≈ 68%; <g> ≈ 0.42)

Pretest score:	**0-30%**	**63-100%**
	A: 10%	*A*: 47%
	B: 30%	*B*: 40%
	C: 46%	*C*: 9%
	(N = 663)	(N = 349)

What Grade is Predicted by FCI Pretest Score?

- [This work] (2012/13), Arizona State Univ.

  (N_{total} = 107; 32% earn A's; pre = 45%, post = 71%; <g> = 0.47)

Pretest score: **0-30%** **63-100%**

	0-30%	63-100%
	A: 12%	**A**: 65%
	B: 44%	**B**: 22%
	C: 26%	**C**: 13%
	(N = 34)	(N = 23)

Correlations Between Course Grade and Diagnostic Pretest Scores

- Math skills: +0.51 (ASU, 1985; calc-based, $N = 478$)

- Lawson test: +0.50 (Small university, alg-based, $N = 238$)

- Physics concepts:

  +0.55 (ASU, 1985, calc-based, MDT, $N = 478$)

  +0.34 (U. Minnesota, 1997-99, calc-based, FCI, $N = 1645$)

  +0.48 (Small university, 2006-13, alg-based, FCI, $N = 238$)

Does Interactive-Engagement Instruction Lower the Correlation Between Grade and Pretest Score?

- We don't know—insufficient data.

- Regardless, a strong correlation clearly persists in the presence of IE instruction

- Key question remains: What are primary factors underlying "most successful" student cases of low pre/high post/high grade?

Summary

- There is a strong correlation between final course grade and scores on various pre-instruction diagnostic tests

- Pre-instruction tests may be able to give "early warnings" where special intervention might be helpful

- It is important to investigate factors associated with "high gainers" (very low pretest scores with high course performance)