

Using Student Behavior Data to Better Understand Class Performance

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Educational Reform is Change

The University of Arkansas physics department has undertaken a variety of reforms. Some have worked. Some haven't. **How do you identify classes that aren't working?**

Student Behavior Measurement

We seek to build a complete model of the actions students take to address the class.

Directly Observed

- Test Score
- Homework Score
- Lecture Attendance
- Lab Attendance

Survey

- Exam Study Time
- Reading Time/Quality
- Homework Time
- Study Actions

Student Behavior Data

- **Non-topical** – Does not depend on instructor coverage choices or test writing decisions.
- **Quantitative** – The accuracy of the measurement can be improved.
- **Non-emotional** – Does not depend on how students are feel or how they like the instructor.

University Physics II

- Introductory Calculus – Based Electricity and Magnetism course at University of Arkansas.
- Observations made for three semesters including 300 students.
- Course presented by same instructor all semesters.
- Concept knowledge evaluated with CSEM.
- Part of the PhysTEC Project.

Directly Observed Data

Action	Average	Missing	Test Correlation	Hake Correlation
Homework	77.17	2.68	0.46	0.29
Lab Quiz	74.62	2.06	0.53	0.46
Lecture Quiz	83.68	2.02	0.49	0.36
Test	79.61	0.02	1.00	0.64
Hake Gain	42.67		0.64	0.99
Total Missing	9.19		-0.27	-0.09

Indirectly Observed Data

	Average	Test Average Corr. (prob.)	Hake Gain Corr. (prob.)
Total Weekly Time	6.12 hr.	-0.08352 (0.1525)	-0.10319 (0.1022)
Exam Study Time	5.88 hr.	-0.20049 (0.0003)	-0.24110 (<.0001)
Total Weekly Reading Time	2.01 hr.	-0.03498 (0.5628)	0.03906 (0.5504)
Homework Time per Week	2.75 hr.	-0.00831 (0.8825)	-0.06127 (0.3158)

UPII is Functioning

- Students are attending class, turning in assignments, and doing well on tests.
- Student time use is consistent with the two hours out of class for each credit hour rule.
- There is no one thing that guarantees success.

Understanding our Students

The data can also provide greater understanding of our students.

	Average	Test Corr. (prob.)	Hake Gain Corr. (prob.)
Percent of exam time focused on 1 activity	51.59%	0.22517 (0.0001)	0.18265 (0.0043)
Reading Quality	-----	0.02677 (0.6448)	0.11661 (0.0635)
Percent of total class time spent for tests	27.35%	-0.24534 (<.0001)	-0.25256 (<.0001)
Reading Balance	31.52%	-0.12182 (0.0443)	0.04069 (0.5339)
Percent of exam time focused on reading	15.62%	0.05566 (0.3543)	0.22104 (0.0006)

Regression

What does the data actually look like?

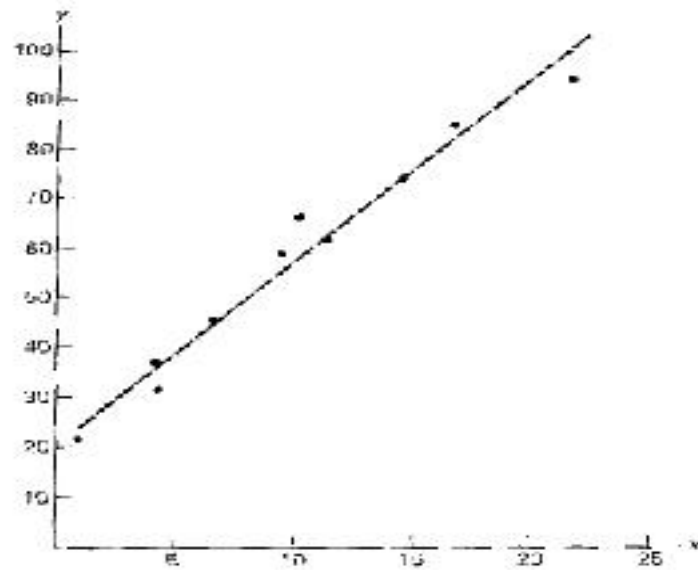
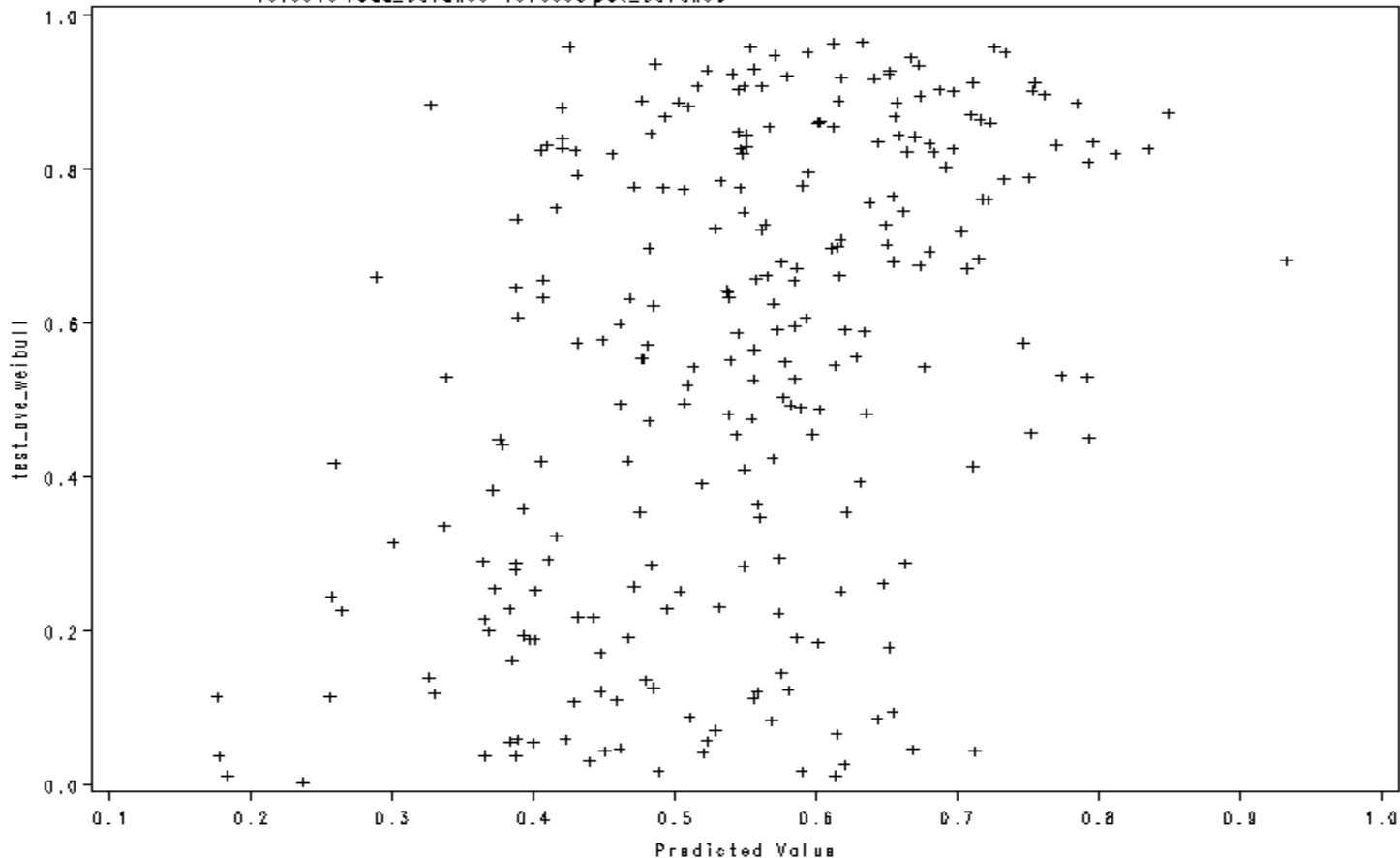


Figure 14.2 Data on test scores and number of hours studied

But What Does It Really Look Like?

Kitchen Sink Regression on Test Average

```
test_ave_weibull = 0.7394 -0.3005 total_missing_weibull -0.0076 total_time_weibull -0.0031 study_time  
+8.2131 total_read_time +0.0004 pct_fraction1 -0.0005 pct_fraction2 -0.0341 hvk_væk_time  
-8.2049 prb_lq25_fall02_5 -2.3317 prb_lq25_fall02_11_PT_a +0.002 balance -0.007 fixed_sln_review  
+0.0009 fixed_read_quality -0.0038 exam_time_fraction -0.0014 total_read_time_balance  
+0.0018 read_balance +0.0008 pct_balance
```



How Much of the Variation in Student Performance is Explained by Behavior and Pre-preparation?

	R^2	R_{adj}^2
Test Average Regression with Pretest and Behavior	0.2654	0.2345
Test Average Regression with Behavior	0.1967	0.1651
Hake Gain Regression with Pretest and Behavior	0.2065	0.1701
Hake Gain Regression with Behavior	0.1845	0.1507

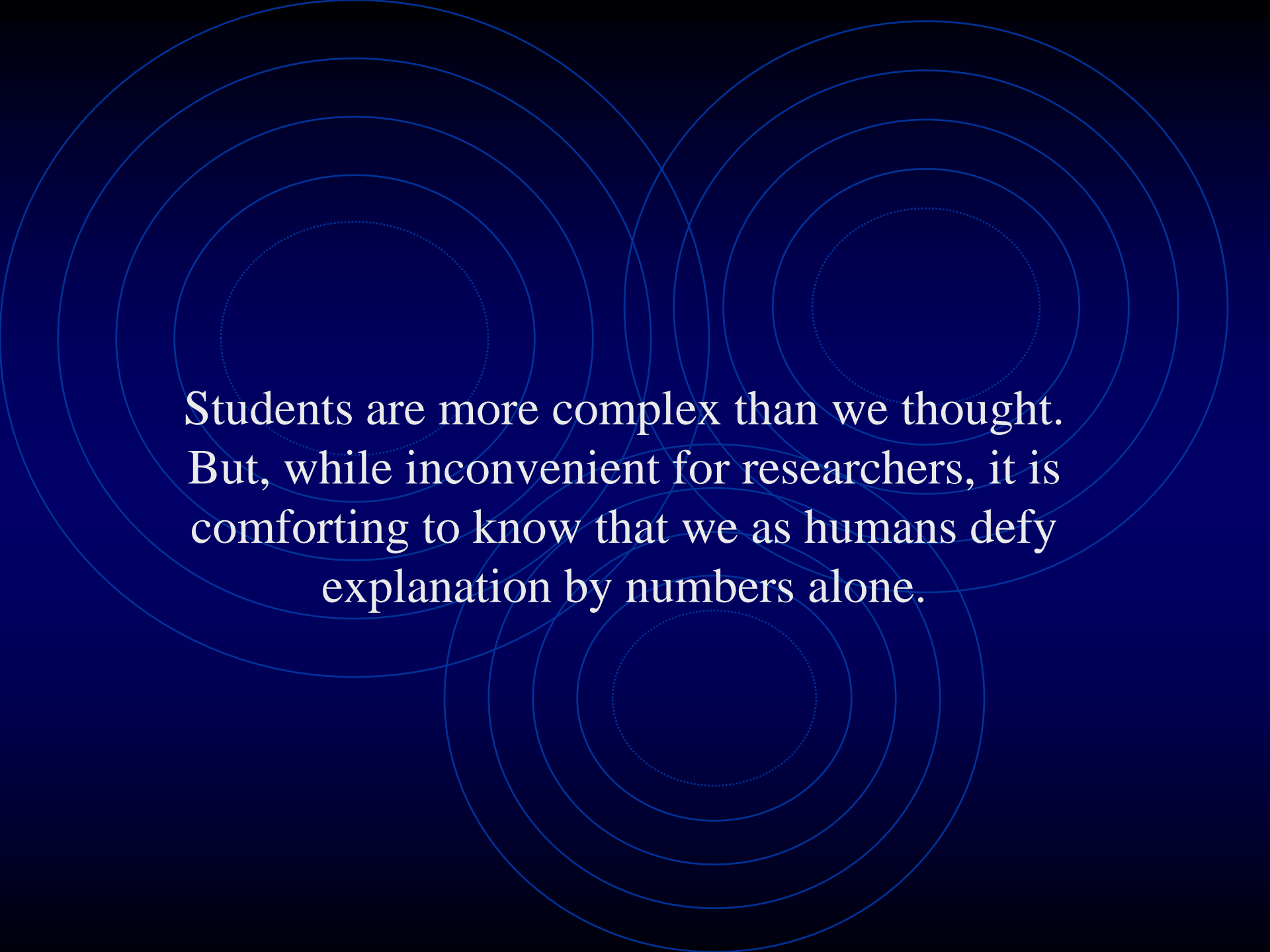
Role of Reading

A many points in this data reading has been more correlated with Conceptual Gain than Test Score. Reading appears to have an important role in building conceptual knowledge

Response	Every Word	Some	None
Count	70	213	23
Test Average	80.59	79	82.50
Hake Gain	49.03	40	42.10

Conclusion

- Student behavior and action data is a valuable additional tool for managing class function.
- Only 27% of student test performance and 21% of concept inventory performance can be explained by behavior and pre-preparation.

The background is a dark blue gradient. It features several sets of concentric circles in a lighter blue color. One set is on the left, one is on the right, and one is at the bottom center. A Venn diagram consisting of two overlapping circles is also present, centered behind the text.

Students are more complex than we thought.
But, while inconvenient for researchers, it is
comforting to know that we as humans defy
explanation by numbers alone.